CLASS-XI

Study Notes

Computer System Overview

Period-1

Introduction:

Learning Outcomes

- an in-depth understanding of why computers are essential components in business, education and society
- Introduce the fundamentals of computing devices and reinforce computer vocabulary, particularly with respect to personal use of computer hardware and software, the Internet, networking and mobile computing.
- Provide foundational or "computer literacy" curriculum that prepares students for life-long learning of computer concepts and skills. Completion of course fulfils pre-requisite to enroll in other computer science courses required for a certificate, A.A. degree, transfer to the university or to qualify for high demand employment.

Introduction

Computers are the machines that have revolutionized the world around us. The way we used to live around 25-30 years ago is very different from how we live today. A modern age student cannot even imagine life, without email, Internet, print outs, playing music on computers or smart phones, photos just a click away in the form of smart phones and so on. In short, in every aspect of life around us, we see computers play a role directly or indirectly. Computers deliver so much, diligently and efficiently, all thanks to the wonderful combination of their hardware and software.

¢) Hardware. The physical electronic components of a computer are called hardware, e.g., keyboard, CPU, monitor, printer etc.

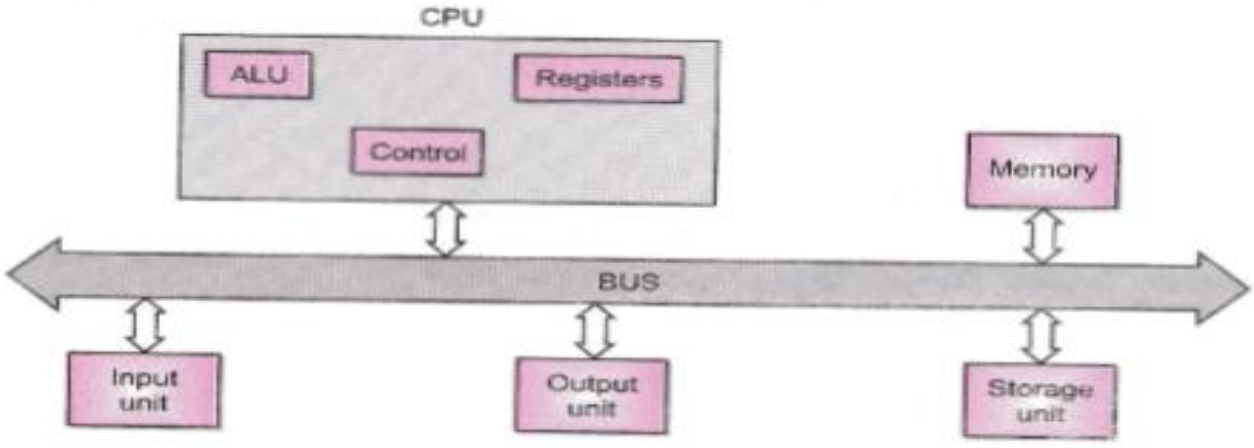
¢) Software. These are the recorded instructions and programs that govern the working of a computer. Recall that a program is a set of instructions to carry out a specific task or achieve special work goal.

Basic Computer Organization:

Computer organization refers to logical structure of a computer describing how its components are connected to one another; how they affect one another's functioning, and contribute to overall performance of the computer.

Computers, as you must be knowing, follow the 'IPO' principle i.e., Input+ -> Process- e- Output (a certain input is processed to generate specific output). So, the computer organization is also like this - these are component(s) dedicated to obtain input in different forms, component(s) dedicated to perform processing part and component(s) to produce output in different forms.

Thus basic computer organization is as shown in the next slide. To see the interconnections and basic working of computer (Computer Organization),



Basic Computer Organization.

Input Unit

The input unit is formed by the input devices attached to the computer. Examples of input devices and media are: keyboard, mouse, magnetic ink character reader (MICR), optical mark reader for taking input and converting it into computer understandable form (the binary code). Since a computer operates on electricity, it can understand only the language of electricity i.e., either ON or OFF or high voltage or low voltage. That means a computer can understand two stages ON/OFF or High/Low voltage or the binary language that uses just two symbols: 1 for ON and O for OFF.

All the inputs consisted of data (on which the action was to be performed) as well as the instruction (the action to be taken).

On the same lines, the computer input also consists of data and instructions. For example, if the given input to the computer is Add 2 and 3 then data consists of 2 and 3 and instruction is Add. Similarly, if the given input is Print "Hello World" then data consists of "Hello World" and instruction is Print.

The input unit is comprised of different input devices that take the input in different forms and pass them in digital form to CPU for processing.

Some common input devices are:

(i) Keyboard. Keyboard is a typewriter like device which is used to type in the letters, digits and commands.

(ii) Mouse. Mouse is a pointing device with either a roller on its base or some laser mechanism. Mouse controls movement of pointer (also called mouse pointer) on screen.

(iii) Microphone (Mic). We can send sound input to computer through a special input device called microphone or mic in short. A mic converts the sound received into computer's format, which is called digitized sound or digital audio.

A mic can work if your computer has a special hardware known as sound card.

Output Unit

The output unit is formed by the output devices attached to the computer. The output coming from the CPU is in the form of electronic binary signals which needs conversion in some form which can be easily understood by human beings i.e., characters, graphical or audio visual form. This function of conversion is performed by output units.

Some popular output devices are:

Output Unit converts the output in binary form to human readable form.

(i) Monitors. Monitor (or "screen") is the most common form of output from a computer.

It displays information in a similar way to that shown on a television screen. The picture on a monitor is made up of thousands of tiny coloured dots called pixels.

(ii) Printers. Printers are the devices that deliver information by means of printed characters on paper.

(iii) Speakers. Speakers receive the sound in form of electric current from the sound card and then convert it to sound format audible to user.

The CPU (Central Processing Unit

The CPU or the Central Processing Unit is the main control centre and processing unit. It is also called brain of the computer as it guides, directs, controls and governs the performance of a computer. The CPU has some sub-components that help in carrying out the processing of a task.

These are:

Arithmetic Logic Unit (ALU): -

The ALU performs all the four arithmetic (+, -, *, /) and some logical (<, >, =, < =, >=, ! =) operations. When two numbers are required to be added, these numbers are sent from memory to ALU where addition takes place and the result is put back in the memory. In the same way, other arithmetic operations are performed (through ALU only).For logical operations also, the numbers to be compared are sent from memory to ALU where the comparison takes place and the result is returned to the memory.

The result of a logical operation is either TRUE or FALSE. These operations provide the capability of decision-making to the computer.

(ii) Control Unit (CU):

The CU controls and guides the interpretation, flow and manipulation of all data and information. The CU sends control signals until the required operations are done properly by ALU and memory. Another important function of CU is the program execution i.e., carrying out all the instructions stored in the program. The CU gets program instructions from memory and executes them one after the other. After getting the instructions from memory in CU, the instruction is decoded and interpreted i.e., which operation is to be performed. Then the asked operation is carried out. After the work of this instruction is completed, control unit sends signal to memory to send the next instruction in sequence to CU.

The control unit even controls the flow of data from input devices to memory and from memory to output devices.

(iii) Registers:

Registers or processor registers are small units of data holding places. The CPU uses registers to temporarily hold some important processing-information during the time the processing is taking place. CPU may store some part data or some memory address or some instruction in its processor registers.

Period-2

Introduction :

The Memory [Main Memory / Primary Memory]

The memory of a computer is more like a predefined working place, where it temporarily keeps information and data to facilitate its performance. Each memory location has a unique memory address. When the task is performed, it clears its memory and memory space is then available for the next task to be performed. When the power is switched off, everything stored in the memory gets erased and cannot be recalled.

The memory of a computer can be thought of as 'cells'. Each of these cells is further broken down into smaller parts known as bits. A bit means a binary digit i.e., either O or l. A number of bits together are used to store data instructions by their combination.

A bit is an elementary unit of the memory. Eight bits together form a byte.

One byte is the smallest unit which can represent a data item or a character.

Other units of memory are KB, MB, GB, TB.

The order of the unit are bit, byte, kilobyte, mega byte, giga byte and peta bytes etc.

1 byte=8bit / 1kb=1024 byte/ 1 mb=1024 kb/1 gb=1024mb etc.

Since computer's main memory (primary memory) is temporary, secondary memory space is needed to store data and information permanently for later use. Some most common secondary storage media are the hard disk, CD-RWs, pen drive etc. The secondary memory devices are also known as storage devices.

Parts of Main Memory / Primary Memory

In the random-access memory (RAM), the memory cells can be accessed for information transfer from any desired random location. That is, the process of locating a word in memory is the same and requires an equal amount of memory, thus the name "random access".

The main drawback of RAM memory is that it is a volatile memory. That is, when the power goes off, the contents of RAM gets erased.

The RAM chips in a computer can be of two basic types:

(i) Dynamic RAM (DRAM).

These are made up of transistors and capacitors. The amount of time taken to produce data required from memory, from the start of access until the availability of data is called memory access time. Today's DRAM chips have access times ranging from below 20 to 70 nanoseconds.

(ii) Static RAM.

These are made up of flip-flops 1 and offer faster access times (about 10 nanoseconds) than DRAMs.

Static RAMs are thus used in specialized applications while dynamic RAMs are used in the primary storage sections of most computers.

Read Only Memory (ROM) :

As the name implies, a read-only memory (ROM) is a memory unit that performs the read operation only; it does not have a write capability. This implies that the binary information stored in a ROM is made permanent during the hardware production of the unit and cannot be altered by writing different words into it (hence non-volatile). Whereas a RAM is a general purpose device whose contents can be altered during the computational process, a ROM is restricted to reading words that are permanently stored within the unit. ROMs are used for applications in which it is known that the information never needs to be altered, for example, a monitor program controlling a machine. These, however, are slower than RAM.

There are various types of ROM which are given below:

(i) **PROM** (programmable ROM). Also called OTP (One Time Programmable). PROM is a user-programmable memory in which information is burnt using special equipment called a ROM burner.

(ii) **EPROM** (erasable programmable ROM). In EPROM, one can program the memory chip (through various mechanisms e.g., UV radiation) and erase it many times as needed. The UV-EPROM can take up to 20 minutes for erasing EPROM contents.

(iii) **EEPROM** (electrically erasable programmable ROM). In EEPROM, the EPROM is erased electrically which is faster. Also, with EEPROM, selective bytes can be erased unlike UV-EPROM which erases fully.

(iv) **Flash EEPROM**. It is like EEPROM but is very fast comparatively (the erasure of the entire contents takes less than a second). Also, it erases fully and not selectively.

(v) **Mask ROM**. Mask ROM refers to a kind of ROM in which the contents are programmed by the IC manufacturer. It is not a user-programmable ROM.

The Storage Unit

Computers need to store and retrieve data for processing. Since primary memory has a limited storage capacity and is not permanent, secondary storage devices are used to store large amount of data permanently. There are various types of secondary devices available these days.

To specify the storage capacity of storage devices, same units of memory are used, which are used for measuring primary memory. That is, we can represent the storage capacity of storage devices in terms of kilo bytes (KBs), mega bytes (MBs), gigabytes (GBs) and tera bytes (TBs) as we do for main memory.

Let us now talk about some most common storage devices :

1. **Hard Disks:**

The hard disk memories store information on one or more circular platters (or disks) which are continually spinning. These rotating disks are coated with a magnetic material and stacked with space between them. Information is recorded on the surface of rotating disks by magnetic heads as tiny magnetic spots.

The hard disks of today have storage capacity measured in giga bytes upto tera bytes.

2. **Compact Disks (CDs)**

The compact disks or CDs are optical media. The CDs are relatively cheap and have a storage capacity of upto 700 Mb. There are three main types of CDs :

(i) CD-ROM (Compact Disk-Read Only Memory). This is used only to store information and cannot be used to store data. It is mainly used for CD distribution e.g., encyclopedias, software, games, e-books etc.

(ii) CD-R (Compact Disk-Recordable). It is mainly used for CD-R and can be written on only once and disk can't be erased.

(iii) CD-RW (Compact Disk-Rewritable). CD-RW is an erasable disk you can write on multiple times.

3. Flash Memory

A flash drive is a small, ultra-portable storage device with a 'solid state' memory i.e., it has no moving parts unlike magnetic storage devices, nor does it make use of lasers - unlike optical drives. Instead, it works in a similar way to RAM. The key difference is that data is retained in Flash memory even when the power is switched off. They are now fairly inexpensive, costing from ₹250/- upwards. Typical sizes range from 256 Mbytes up to 128 GB and beyond.

4. Blu Ray Disk

Blu-ray Disc (also known as Blu-ray or BD) is an optical disc storage media format. Its main uses are high-definition video and data storage. The disc has the same dimensions as a standard DVD or CD. While current optical disc technologies such as DVD, DVD± R, DVD± RW, and DVD-RAM rely on a red laser to read and write data, the new format uses a blue-violet laser instead, hence the name Blu-ray. The benefit of using a blue-violet laser (405 nm) is that it has a shorter wavelength than a red laser (650 nm), which makes it possible to focus the laser spot with even greater precision. This allows data to be packed more tightly and stored in less space, so it's possible to fit more data on the disc even though it's the same size as a CD/DVD. Blu Ray disks of today are capable of storing up to 128 GB of data.

5. The System Bus

The system bus (or the bus) is an electronic pathway composed of connecting cables and that connects the major components of a computer system. Through system bus, data and instructions are passed among the computer system components.

- ¢) The data carrying part of system bus is called data bus.
- ¢) The control instruction carrying part of system bus is called control bus.
- ¢) The memory address carrying part of system bus is called Address bus.
- ¢) A separate type of bus called I/O Bus connects the Input, Output and other external devices to the system.

Period-3

Introduction :

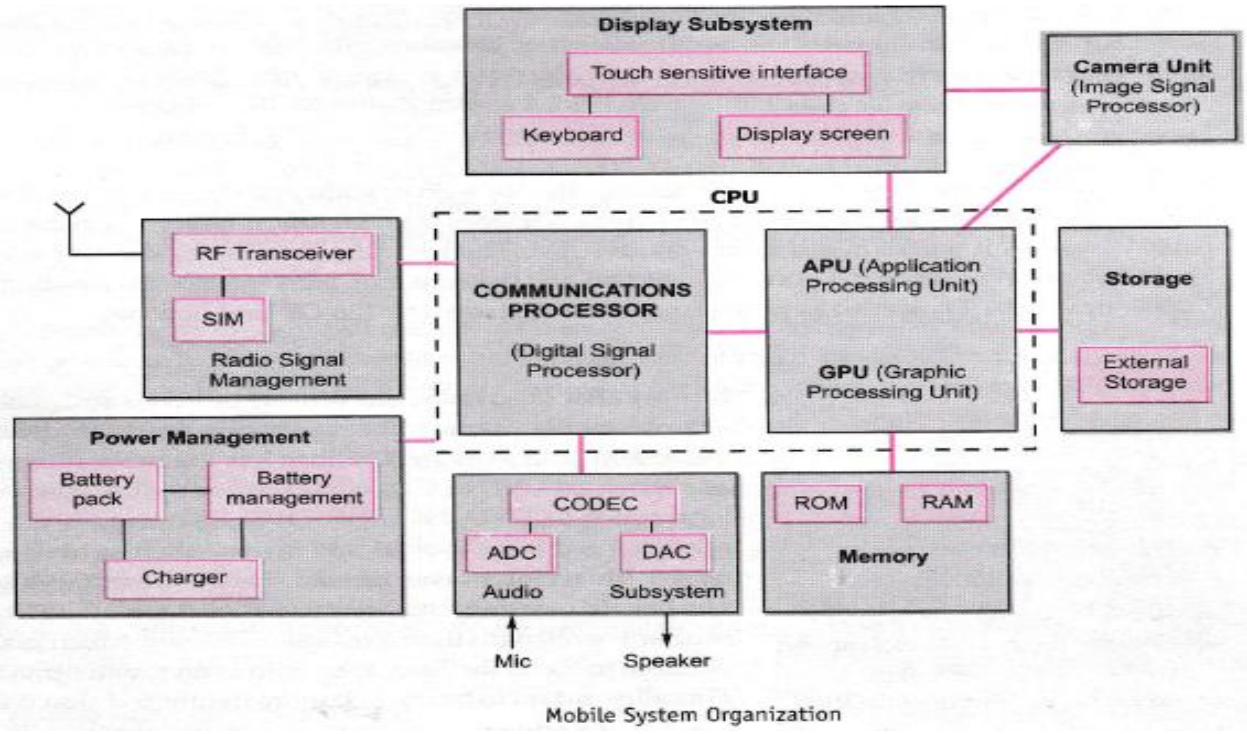
Mobile System Organization

Modern mobile system are tiny computers in your hand. Although they have less computing power compared to their bigger versions, they handle

diverse type of applications such as making calls through radio signals, offering camera utilities, handling touch sensitive screen, display audio/video/graphical content but having little battery based power etc.

Thus, the system organization of a mobile system has components to handle all these. Let us talk about these functional components of a mobile system one by one.

A mobile system's CPU handles diverse types of applications but has a little power compared to computers as mobile systems run on battery power.



Mobile System Organization

Mobile Processor (Mobile CPU)

This is the brain of a smart phone. The CPU receives commands, makes instant calculations, plays audio/video, stores information and sends signals throughout the device.

The CPU of a mobile system has majorly two sub-processor types :

(i) Communications Processing Unit (ii) Applications Processing Unit (APU)

i. Communications Processing Unit. [Mobile System I/0 Unit]

This subsystem is responsible for making and receiving phone calls on a mobile handset. It has a digital signal processor that helps it work with RF. Transceiver and the Audio subsystem.

= > Radio Signal Management Unit is responsible for connecting SIM (which provides a type of modem) to the base stations through radio signals. (3G/LTE/4G based cellular networks).

(iii) **Applications Processing Unit (APU).** This subsystem is responsible for governing, controlling all types of operations taking place on a mobile system by running various types of mobile applications (apps).

2. Display Sub system:

This subsystem is responsible for providing display facilities, touch. sensitive interface and touch sensitive keyboards.

3. Camera Sub system:

This sub unit is designed to deliver a tightly bound image processing package and enable an improved overall picture and video experience. It has an integrated Image Signal Processor ensures things like instant image capture, high-resolution support, image stabilization, and other image enhancements.

4. Mobile System Memory

Like its other counterparts, a mobile system also needs memory to work. A mobile system's memory is comprised of following two types of memories :

(i) RAM (Random Access Memory). It is the work memory of your mobile system. The installed mobile apps, when run, are first loaded in the RAM and then executed. These apps remain in the RAM after you are no longer using them and then they are shifted to background.

The more RAM you have on a smart phone, the better the performance and faster the phone will generally be. RAM does not store information once the device is turned off.

(ii) ROM (Read Only memory). The ROM or Read Only Memory is a part of mobile system's internal storage and it is not accessible for users to write on and is thus referred to

as Read Only Memory. The ROM is basically Flash memory or technically EEPROM (electrically erasable and programmable read only memory).

This ROM part of a mobile system internal storage is where operating system resides. It also has some preinstalled apps in this memory sections which cannot be deleted on users' end either. This is the reason why you don't get full internal memory as advertised on the Box, because a part of it has been used to house operating system and other pre-installed apps.

5. Storage:

The external storage of a mobile system is also called expandable storage. It comes in the form of SD cards, or micro SD cards etc. It is the storage which can be removed easily by you and can be used for storing pictures, music, videos and the likes. To an extent, even the cloud storage can also be categorized as external storage.

6. Power Management Subsystem (Battery)

This subsystem is responsible for providing power to a mobile system. The mobile systems work on limited power provided through an attached battery unit. This subsystem has a battery management system that works with a battery charger and a battery unit, and provides power to the mobile system in required form.

Period-4

Introduction :

Software Concepts

TYPES OF SOFTWARE

A computer system consists of hardware and software for its proper functioning.

Hardware represents the physical and tangible components of the computer i.e., the components that can be seen and touched. Input devices, output devices, CPU, hard disk, printer etc. are examples of computer hardware.

Software represents the set of programs that govern the operation of a computer system and make the hardware run. Software can be classified broadly into two categories.

1. System Software 2. Application Software

System Software:

A computer is mere a machine that knows nothing of itself. Rather it requires instructions for each and everything it performs. These instructions are provided to it through software. The software that controls internal computer operations (viz. reading data from input devices, transmitting processed information to the output devices, checking system components, converting data/instructions to computer understandable form etc.) is known as system software.

The system software can further be classified into two categories:

1. Operating System 2. Language Processor

Operating System:

The primary goal of an operating system is thus to make the computer system convenient to use and secondary goal is to use computer hardware in an efficient manner. An operating system is an important component of a computer system which controls all other components of the Computer system.

Major components of a computer system are:

1. The Hardware
2. The Operating System

3. The Application program routines (compiler, linkers, database management systems, utility programs)

4. The Human ware (users)

TYPES OF SOFTWARE

where hardware provides the basic computing resources, the application program routines define the ways in which these resources are used to solve the computing problems of the users and the Operating System controls and coordinates the use of the hardware among the various application programs for the various users.

An operating system's major role is to execute a program.

There are different types of operating systems available today to cater to varied type of requirements. These are : Single user OS, Multiuser OS, Time sharing OS, Real time OS, Multiprocessing OS, Distributed OS etc

Language Processors

A language processor is a special type of a computer software that can translate the source code into an object code or machine code. Here you should know the meaning of the terms source code or object code.

¢) A source code refers to the program-code written by a programmer in a high level programming language (HLL) such as in C, Java, C++ etc.

¢) An object code refers to a code usually in machine language or binary code, a language that computer can understand easily and run on hardware.

So, you can safely say that language processors are software that converts source codes into object codes.

There are three types of language processors: assembler, compiler and interpreter.

(i) Assembler. This language processor converts the program written in assembly language into machine language.

(ii) Interpreter. An interpreter is a type of system software that translates and executes instructions written in a computer program line-by-line, unit by unit etc.

(iii) Compiler. A Compiler is another type of system software that translates and executes instructions written in a computer program in one go.

Application Software

This type of software pertains to one specific application. For instance, a software that can perform railway reservation functions cannot prepare result for a school.

These are the programs written by programmers to enable computer to perform a specific task such as processing words, inventory control, handling calculations and figures, medical accounting, financial accounting, result preparation, railway reservation, billing etc.

Application software can further be subdivided into four categories:

1. Packages
2. Utilities
3. Customized Software
4. Developer Tools

Period-5

Introduction :

Package and Utilities

Packages:

Only system software does not suffice for efficient use of computers because the system software exists mostly for the benefit of the computer. Other programs i.e., the application software are required to make the computer useful for people. Application software has been written to do almost every task imaginable, from word processing to selecting a college to attend.

As applications may be numerous (from thousands to millions of them), it is not feasible to design software for each one of them. Rather some general software are designed that may be used by individual users in the manner it suits their needs and requirements. Such general-application software are known as packages.

Some major and most common categories of general application software (packages) are:

1. Word Processing Software
2. Spreadsheets
3. Database Management Systems
4. Desktop Publishing Software
5. Graphics, multimedia, and presentation applications

Utilities:

Utilities are those helpful programs that ensure the smooth functioning of the computer. Utility programs or simply Utilities are meant to assist your computer. Some utilities help you backup data, some help remove outdated files or recover data that has been accidentally erased. Some make it easier to find and arrange the information you need. And some help you avoid virus attacks or clean viruses, if any. In other words, the utility programs perform house-keeping functions.

It is an established truth that everything comes with certain pros and cons. Software also is not an exception to it. Utilities bridge the gaps by helping to solve the problems and maximize your computers potential.

Some important utilities are:

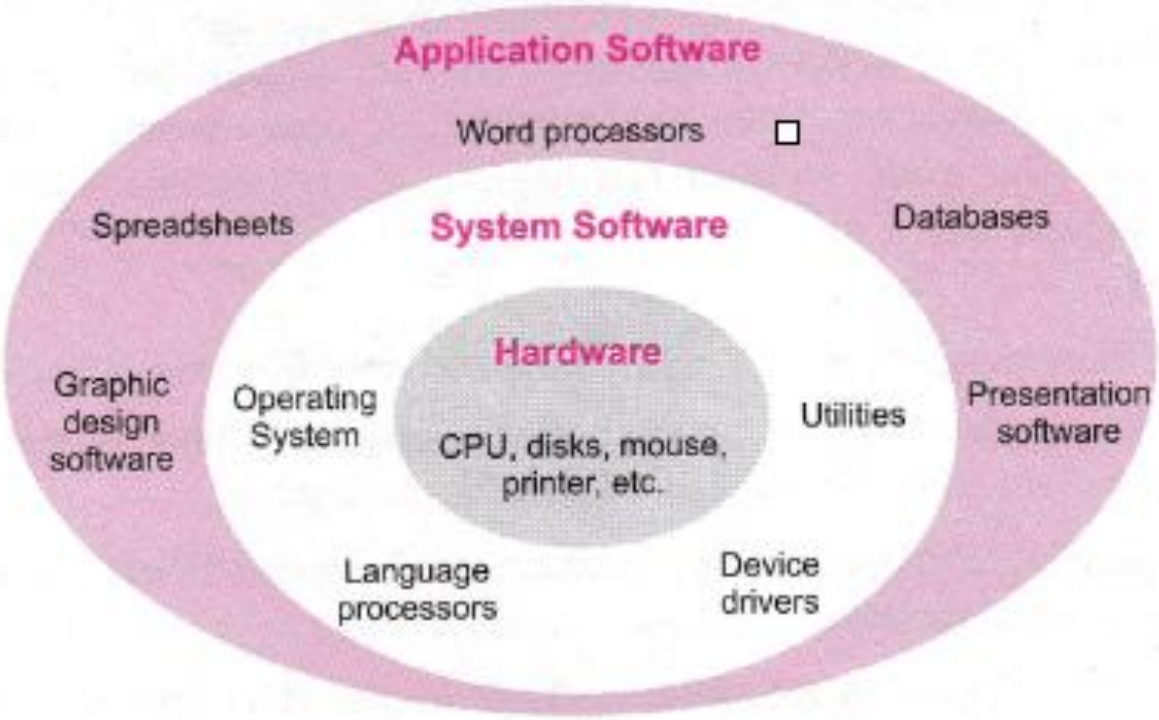
1. Text Editor. This utility program is used for creating, editing text files.
2. Backup Utility. This utility program facilitates the backing-up of disk. Back-up me is duplicating the disk information so that in case of any damage or data-loss, this backed up data may be used.
3. **Compression Utility.**
   This utility program facilitates compression of files. Large files can be compressed so that they take less storage area.
4. **Disk Defragmenter:**

A file is fragmented when it becomes too large for your computer to store in a single location on a disk. When this happens, your computer splits the file up and stores it in pieces. You can use fragmented files, but it takes your computer longer to access them. Disk Defragmentor utility program speeds up disk access by rearranging the files and free space on your computer, so that files are stored in contiguous units and free space is consolidated in one contiguous block.

5. Antivirus Software.

This utility program ensures virus-free work environment. A computer virus is a malicious computer program that disrupts normal functioning of a computer. An antivirus software scans your disk for viruses and removes them, if any virus is found. Moreover,

some antivirus software remains present in memory, all the time so that they can detect the viruses (as soon as they occur) and counterattack them.



Working hierarchy in a computer.

Period-6

Introduction:

Business Software, Compiler vs. Interpreter

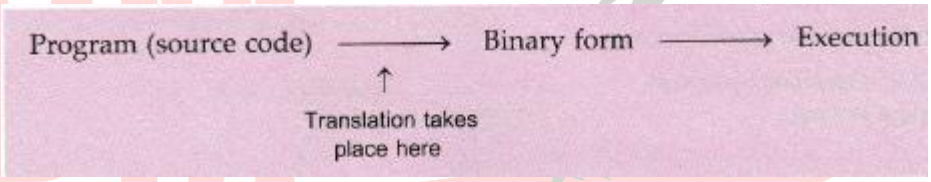
This type of software is specifically created software according to business requirements. This type of software is developed to meet the general requirements of a business. For instance, a company wants to computerize its'Accounts' department and gets software that can serve its needs. Such software is business software. There is much readymade business software. These can cater to a variety of business needs. Examples of

these software are Inventory Management System (for managing inventory details of a company), Payroll system (for handling payroll of a company's employees), Financial Accounting, Hotel Management and Reservation System etc. Although there are standard business software available in market, yet some companies prefer getting customized (tailor-made) software as per their specific requirements

However, such software's cannot be directly installed at any other user's workplace as the requirements of the second user may differ from the first and the software may not fit in the requirements of the new user.

Compiler and Interpreter

So broadly you can say that the programmer creates a program (the source code), which needs to be converted into binary (by some special type of software) so that computer can execute it, i.e., the basic flow of program execution is :



The special software that translate a source code into machine understandable form as translator software or simply the translators.

There are broadly two types of translators:

1. Compiler
2. Interpreter.

The job of both these translators is to convert source code into machine understandable code at the computer can execute. In the following section, we shall learn what goes in important translation process.

UNDERSTANDING TRANSLATION PROCESS:

There are mainly two types of translators: compiler and interpreter that convert source code into machine code, but in different ways. The working pattern of a compiler is very different from interpreter. Let us learn about what happens during compilation and what happened during interpretation.

The Compilation Process:

A compiler takes the source code and then follows certain micro steps to produce a low level code. The major steps in compilation process are listed below. Please remember that there is not any set number of steps followed by compiler. Idea is to understand what a compiler a compiler does.

The compilation mainly undergoes the following steps:

1. Preprocessing
2. Compilation
   - Analysis [Front end phase]
   - Synthesis [Back end phase]
3. Assembly
4. Linking

1. Preprocessing Phase:

This phase removes comments from the source code. For some languages like C/C++ that have preprocessor directives, this phase carries out all preprocessor directives such as macro substitution, inclusion of header files etc. Modules imported in a program using import command, are also added to the code during this phase.

At the end of this phase, the source code is converted to just the complete code that has nothing extra (as comments removed) and nothing yet to be added/expanded , preprocessor directives resolved and modules imported).

2. Compilation Phase:

The compilation phase can be further subdivided into two sub-phases:

(i) Analysis (Front-end phase)

(ii) Synthesis (back-end phase)

(i) **Analysis Phase**. As we know that in a program, the smallest individual unit is called a token e.g., keywords, identifiers, literals, operators etc. In the analysis phase, the compiler identifies all the tokens of the source code and their requirements. Using

this information, the compiler creates a special type of table, called the symbol table that contains the details of all the tokens in the source code.

This sub-phase is also called front-end phase of compilation.

(ii) **Synthesis Phase** (the back end phase). The back end phase of the compiler parses the code and generates syntax tree, analyzing the syntax of the source code. A syntax tree (or abstract syntax tree (AST) is a tree representation of syntactic structure of source code.

For example, the expression 4 * 5 + 9 will be represented as a syntax tree as shown below. You need not go in further details of syntax trees. During both the phases of compilation, if the syntax and semantic rules of the programming language are found violated in source code, the compiler generates an error, with the line number of the source code.

At the end of compilation, all the errors found in the source code are listed with line numbers. Programmer can correct the errors and recompile the corrected code, i.e., first two phases of compilation process are repeated. The compilation process will move to next phase only if the source code is found to be error-free (free from all compile-time errors).

Once the code is error-free, the compiler converts into intermediate code that is in the form of assembly level instructions.

3. Assembly Phase:

This phase receives the assembly level instructions and then converts it into object code, which is a form of machine code. This phase does the same work that an assembler does i.e., converts assembly code to binary code.

4. Linking:

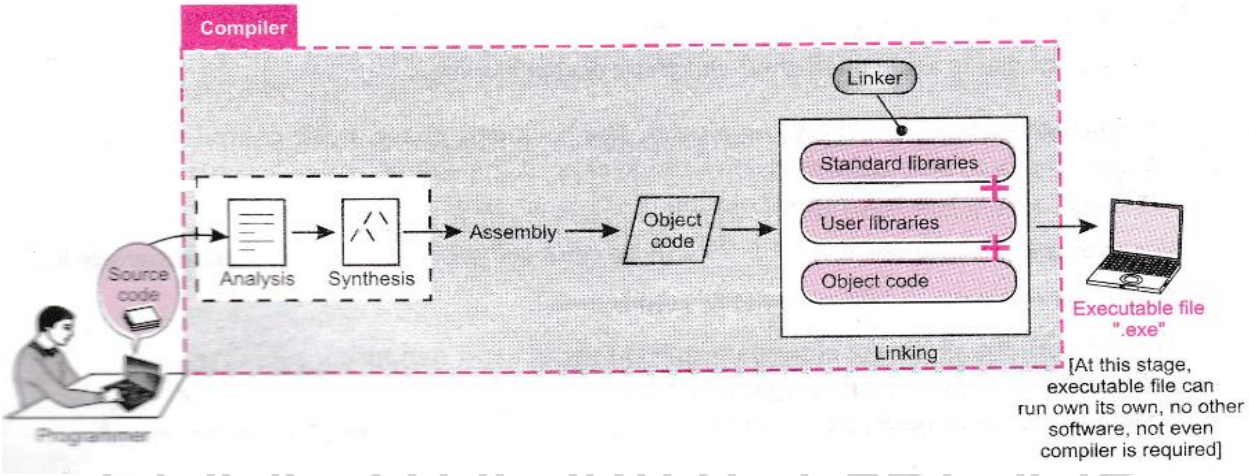
The object code received by this phase is very much binary code, but still computer cannot execute it because linking of important libraries is yet to be done. This phase does this. In this phase, all the required libraries are linked with the object code.

The part of the compiler which performs the linking of libraries is called Linker.

In this phase, with the help of OS, all memory references are resolved and code is converted to a form which requires nothing else to run: it has everything in it to execute itself. That is, the code has become executable (.exe file) now.

5. Loader

The loader is a part of compiler that loads the computer executable module into memory for execution. Now the computer can run the executable file without requiring any other software. Here the role of compiler is also over and hence compiler is also not needed to run the e executable file.



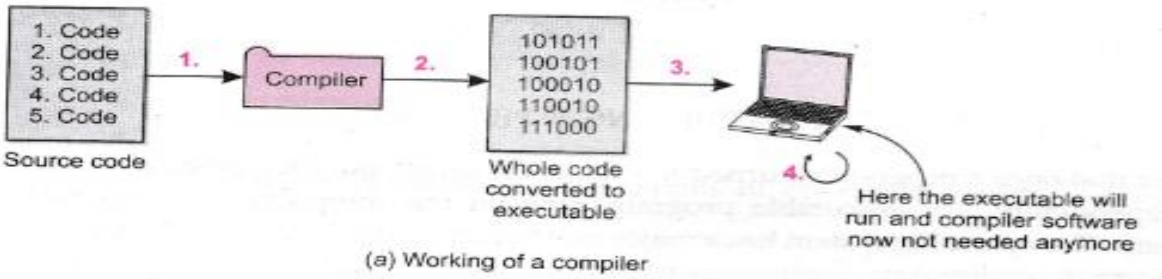
Please note that the compiler works on whole program i.e., it converts all the lines of the code into object code and then to executable code. If there is error, even only at the last line of code, the compiler won't proceed to the next sub-phase until the whole code is error-free. Similarly, it converts the whole code to object code and then to executable code.

There are many compiled languages such that C, C++, C#, Scala etc. There are many interpreted languages such as Python, Perl, PHP etc. Let us understand how the interpretation process takes place and how it is different from compilation.

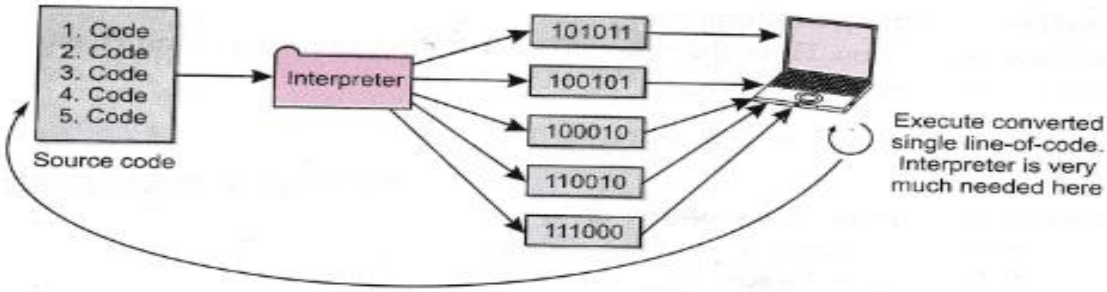
The Interpretation Process

Since an interpreter is also translator software like compiler, its role is to convert the source code into machine-intelligible code. Though its purpose is the same as compiler, its working is very different from a compiler.

Unlike compiler (which works with whole program at all steps), the interpreter focuses on one line of code or one unit of code at a time. The interpreter analyses one line of code, converts into object code, adds in required libraries, if any and runs it. The first line of code is executed, even before the second line code is converted to object code. This way, the interpreter proceeds with each line of code.



(a) Working of a compiler



(b) Working of an interpreter

Only once the interpreter finishes running one line of code or a section of code successfully will it actually move onto the next line.

Compiler Vs. Interpreter:

	Compiler	Interpreter
Input	A compiler takes an entire program as its input.	An interpreter takes a single line of code or single instruction (such as loop) as its input.
Output	It generates intermediate object code from the whole program.	It does not generate any intermediate object code.
Memory	Requires more memory during compilation.	Requires less memory during interpretation as interprets single instruction/ unit-of-code at a time.
Errors	Display lists of errors of entire program with line numbers and the error(s) in that line.	Interpreter displays the error of single instruction it is interpreting. Thus errors also appear one line at a time.
Always required	No. Once the role of compiler is over, a compiler is no longer required to run the executable file.	Always required. Interpreter translates and runs one instruction every time, so it is always required in memory to run the code.
Workload	Compilation once done, stays always. Recompilation not required if the code (without any change) needs to run again. The same executable can be rerun without the compiler.	Interpretation is required each time you have to run the code. The interpreter does not create an executable and hence it is required every time, the code is to run.

Period-7

Introduction :

Operating System, need of OS, Functions of OS

You have learnt that once a program is turned to executable form (.exe file), they can be run by computer independently. An executable program runs on the computer with the help of operating system. The operating system has a major role to play in the execution of the program in executable form. In· earlier days, computers used to run one program at a time. But modern day computers are capable of running multiple programs (multi-programming) and catering to programs of multiple users (multi-user). Thus, the role of OS in running a program is much more complex and important today.

Role of Operating System

A program when not running is simply lying on the disk. To execute it, it must be loaded into memory first and CPU be assigned to it so that its instructions can be run. The moment a program is loaded for running/executing, it is called a Process.

Multiple programs are run interlaced with each other so as to improve overall efficiency of the computer. Multiprogramming improves the overall efficiency of the computer systems by getting more work done in less time as the CPU may be shared among a number of active programs which are present in the memory at the same time. While CPU is executing a job, it has to wait if the job requires certain I/0 operation. In this case (when I/0 is needed), the CPU waits for the I/0 operation to get over; this wait time is CPU's idle time. So what an OS does is that in place of making the CPU sit idle, it loads another job for CPU i.e., another job takes over the use of CPU, increasing efficiency thereby and reducing CPU idle time.

The measure of system's efficiency is throughput, which refers to number of job carried out in a given unit of time. So, this way i.e., by loading another job(s) to minimize the CPU's idle time, increases the throughput of the computer system. For example, if CPU is working on a job that requires 10 milliseconds to compute and after 7 milliseconds the job requires an I/0 operation, which takes about 8 milliseconds. Thus, after

7 milliseconds, the CPU had to sit idle for milliseconds and then compute the job for rest 3 milliseconds. So CPU completed 1 job in total 1 milliseconds.

Now see another scenario. As soon as the CPU has to wait, the OS loads another process that requires about 7 milliseconds to compute. So CPU, in place of sitting idle, works on second job and then gets back with first job. In this case, CPU was able to complete 2 jobs in 18 milliseconds.

$$\text{Throughput} = \frac{\text{no. of job completed}}{\text{time taken}}$$

In first case throughput is 1 job / 18 millisecond

In second case throughput is 2 jobs / 18 millisecond INCREASED PERFORMANCE

Thus, we can say that by loading multiple processes, the operating system improves the overall performance of the computer system. When multiple processes are running simultaneously, it is important to manage them. For this purpose, OS provides following functions :

i. Process Management
ii. Process Scheduling
iii. Memory Management
iv. I/0 Management

1. Process Management:

When a program needs to be executed, it approaches OS. The process scheduler of the OS loads it into memory and it becomes a process, which is executed as per its instructions, as soon the processor or CPU is assigned to it.

A process is given some memory with these sections for its proper execution :

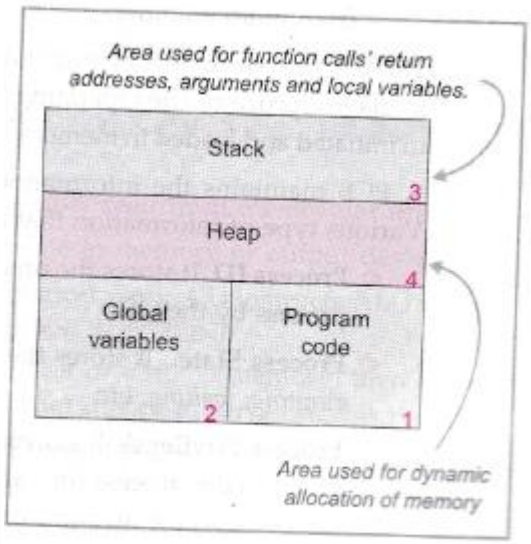
¢) One region in the memory holds the compiled code of the program. Every instruction and every function of the program starts at a particular address.

¢) The next region is the memory area where the global variables of the program are stored. Global variables remain in the memory as long as program continues.

¢) The third region known as Stack, is used for great many things while your program executes. The stack is used for holding the return addresses at function calls, arguments passed to the functions, and local variables for functions. The local variables remain in memory as long as the function

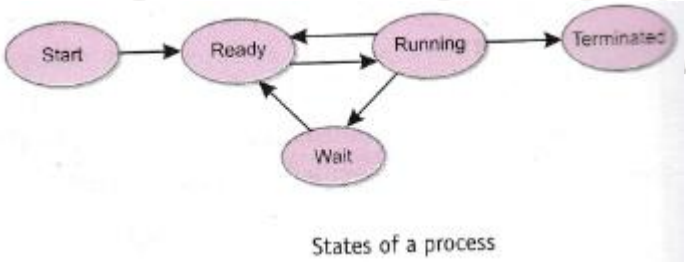
continues and after that they are erased from the memory. The stack also stores the current state of the CPU.

¢) The Heap memory area is a region of free memory from which chunks of memory are allocated via dynamic memory allocation functions.



Conceptual memory map of a process.

When a program is ready to be executed, it is loaded in memory (start) and it becomes an active process. An active process passes through different states. These are:



States of a process

¢) Start state. This is the initial state when a process_ is first started/created by loading the program in memory.

¢) Ready state. When a program is loaded in memory (becomes a process) and is ready to be executed, has to wait for the CPU. That is, the CPU might be executing other processes/jobs to it has to wait for its turn on CPU. This is the ready state of a process.

¢) Running state. Once the process gets CPU time, the CPU starts executing the instruction

¢) Waiting state. If during execution, the process has to wait for some resource, such as waiting for user input, or waiting for a file to become available, then the CPU takes up the next process (in ready state) waiting for CPU and the current process state become waiting state. Once it gets its required resource (input or file etc.), its state will again be changed to ready state so that CPU can pick it up again and continue with its execution.

¢) Terminated or Exit. Once a process all the instructions-are successfully executed and it has completed its execution, or it is terminated by the operating system; in either case, its state is changed to the terminated state. A process that has terminated state is removed from main memory.

The OS process manager maintains a data structure called PCB (Process Control Block) to manage a process. The Operating System maintains a PCB for every process. As soon a process is initiated and loaded in memory, it is given an ID called Process Id (PID) and its PCB is created.

A PCB maintains the information needed to keep track of a process. Various type of information that a PCB contains is as listed below:

¢) Process ID: It stores the unique identification number given to the process by the OS.

¢) Process State: It stores the current state of the process i.e., ready, running, waiting, etc.

¢) Process Privileges: It stores the information about access privileges given to the process for various system resources e.g., if a process can use specific memory or which I/0 devices it can access etc.

¢) Pointer. A process can create sub-processes. In such cases, a pointer store about the parent process of current process/sub-process.

¢) Program Counter. Program Counter register stores the address of the next instruction to be executed for this process.

¢) CPU Registers. It stores information about various CPU registers which the process can use for execution.

¢) Other Scheduling and Accounting Information. It stores other details related to process such as its links to memory allocated, its priority details, how much CPU time this process has used so far, and so on.

How CPU Executes the Instructions of a Ready Process ?

Let us now see how a CPU runs the instructions of a loaded process. Please note that the CPU runs the process, instruction by instruction. CPU executes the instructions of a process by fetching it, decoding it and then executing it. Let us see how it happens broadly

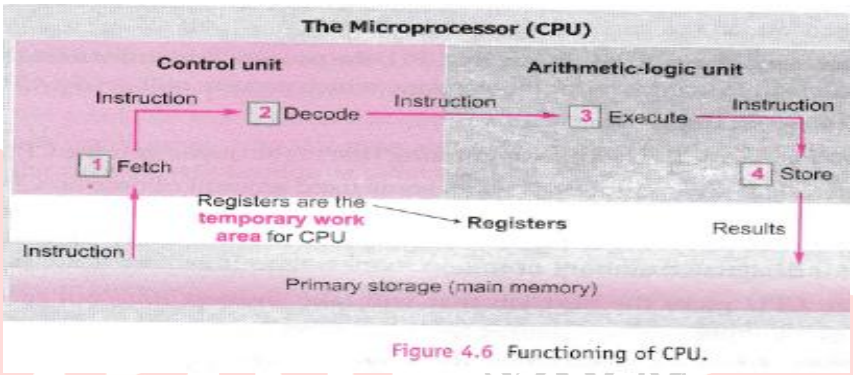


Figure 4.6 Functioning of CPU.

Let us understand this,

1. Program is loaded in main memory.
2. Control Unit (CU) brings first-(or next) instruction of the program (FETCH THE INSTRUCTION).
3. CU now determines what type of instruction is this (DECODE THE INSTRUCTION) that is, whether it requires
   - any mathematical work,
   - or simply read from memory or input-device,
   - or any logical work,
   - or write to memory or output device, etc.
4. If the instruction involves mathematical or logical work, CU instructs ALU to carry out or execute the instruction (EXECUTE THE INSTRUCTION).

   (Or if the instruction involves simple read from or write to memory, then CU directly instructs the memory or input device or output device to carry out this.)
5. ALU produces some results, which are then stored in the main memory. (STORE THE RESULT)
6. For the next instruction in the program, again steps 2 to 4 are carried out

The fetch-decode-execute cycle is also known as instruction cycle.

2. Process Scheduling by OS:

All this is the job of process scheduler of OS. The process scheduling is the activity of the process manager that handles the removal of the running process from the CPU and the selection of another process on the basis of a particular strategy.

Since all the loaded processes have to be shared by CPU, the process scheduler decides upon a strategy (scheduling algorithm) which helps it determine which process will get the CPU time.

Some common scheduling strategies are :

¢) FCFS(First Come First Served). The process entering first in the queue gets the CPU first.

¢) Round Robin Scheduling. Every process is given some fixed amount of time-on CPU (called a time slice), say n milliseconds. If the process is over during that time, process is terminated; otherwise its state is changed to waiting and the next ready process in given the CPU time for designated amount of time.

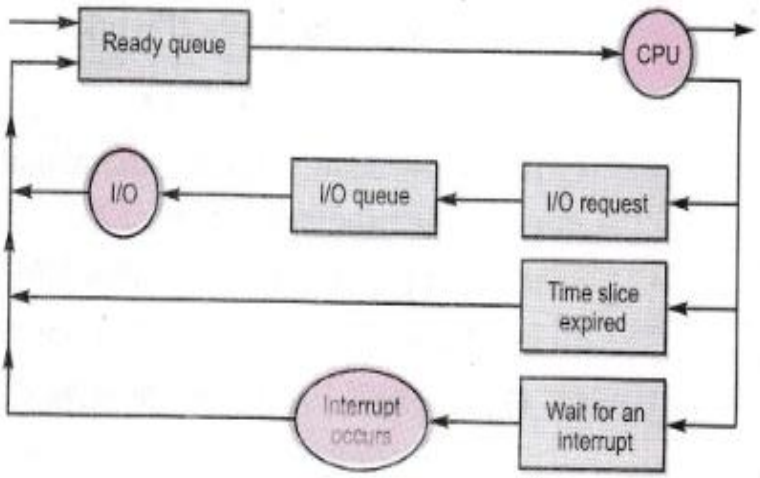
¢) Shortest job next. CPU picks the next job that will take shortest time out of all ready processes and many more.

The process scheduler maintains some Process Scheduling Queues :

¢) Job queue. This queue keeps all the initiated processes in the system.

¢) Ready queue. This queue has all processes with ready state and waiting to execute. A new process is always put in this queue.

¢) Device queues. The processes which are waiting to use an I/0 device are added to device queue.



3. Memory Management:

Memory management part of OS is another very important part as everything which is being processed has to be loaded in memory.

Thus memory manager performs these functions :

¢) keeps track of each and every memory location, regardless of either it is allocated to some process or it is free.

¢) checks how much memory is to be allocated to processes and how it is be allocated.

¢) decides which process will get memory at what time.

¢) keeps track of whenever some memory gets freed or unallocated and correspondingly it updates the available memory, allocated memory etc.

¢) ensures the safety of data in the memory allocated to a process so that other running processes do not get hold of this data.

4. I/O Management:

Whenever a process requires some I/0, the I/0 management part of OS takes over. The role of I/0 manager of OS is to connect the process to actual I/0 device through some strategy.

The I/0 manager sends the I/0 request to the physical device and upon receiving a response from the device, it passes the received response to the process.

During the time, a process is with I/0 manager, the CPU keeps on working with processes.

Period-8

Introduction :

Cloud Computing, Private & Public Cloud

Cloud computing is an emerging trend in the field of information technology, where computer-based services are delivered over the Internet or the cloud, for the case of their accessibility form any where using any smart device. The services comprise software, hardware (servers), databases, storage, etc. These resources are provided by companies called cloud service providers and usually charge on pay per use basis, like the way we pay for electricity usage. We already use cloud services while storing our pictures and files as backup on Internet, or host a website on the Internet. Through cloud computing, a user can run a bigger application or process a large amount of data without having the required storage or processing power on their personal computer as long as they are connected to the Internet. Besides other numerous features, cloud computing offers cost-effective, on-demand resources. A user can avail need-based resources from the cloud at a very reasonable cost.

Cloud computing refers to storing and accessing data and programs over the Internet instead of your computer's hard drive. The cloud is just a metaphor for the Internet. To store and access program over a cloud, you need access to a cloud. There are broadly two types of clouds one can access :

(i) Public cloud (ii) Private cloud

Public Cloud:

Public cloud refers to a common cloud service made available to multiple subscribers. The cloud resources (like servers and storage) are owned and operated by a third-party cloud service provider and delivered over the Internet. In a public cloud,

you share the same hardware, storage, and network devices with other organizations that use the same cloud, called cloud "tenants."

Public cloud deployments are frequently used to provide web-based email, online office applications, storage, and testing and development environments.

Microsoft Azure, Google drive, Amazon Cloud Drive, I Cloud etc. are examples of public cloud.

Private Cloud:

A private cloud consists of computing resources used exclusively owned by one business or organization. In a private cloud, the services and infrastructure are always maintained on a private network and the hardware and software are dedicated solely to one organization.

Private clouds are often used by government agencies, financial institutions, any other mid- to large-size organizations with business-critical operations seeking enhanced control over their environment. A private cloud, also known as an internal or enterprise cloud, resides company's intranet or hosted data center where all the data is protected behind a firewall.

Period-9

Introduction :

Cloud Services(SaaS, IaaS, PaaS, Block-Chain Technology

Cloud computing refers to storing and accessing data and programs over the Internet instead of your computer's hard drive. The cloud is just a metaphor for the Internet. To store and access program over a cloud, you need access to a cloud. There are broadly two types of clouds one can access :

(i) Public cloud (ii) Private cloud

Cloud services:

- Software as a Service (SaaS)
- Infrastructure as a service (IaaS)
- Platform as a service (PaaS)

Software as a Service (SaaS):

In the software on demand SaaS model, the provider gives customers network-based access to a single copy of an application that the provider created specifically for SaaS distribution. The application's source code is the same for all customers and when new features or functionalities are rolled out, they are rolled out to all customers. Depending upon the service level agreement (SLA), the customer's data for each model may be stored locally, in the cloud or both locally and in the cloud.

Organizations can integrate SaaS applications with other software using application programming interfaces (APIs). For example, a business can write its own software tools and use the SaaS provider's APIs to integrate those tools with the SaaS offering.

Infrastructure as a Service (IaaS):

Infrastructure as a service (IaaS) is a form of cloud computing that provides virtualized computing resources over the internet. IaaS is one of the three main categories of cloud computing services, alongside software as a service (SaaS) and platform as a service (PaaS).

Platform as a service (PaaS)

is a cloud computing model in which a third-party provider delivers hardware and software tools -- usually those needed for application development -- to users over the internet. A PaaS provider hosts the hardware and software on its own infrastructure.

Block-Chain Technology :

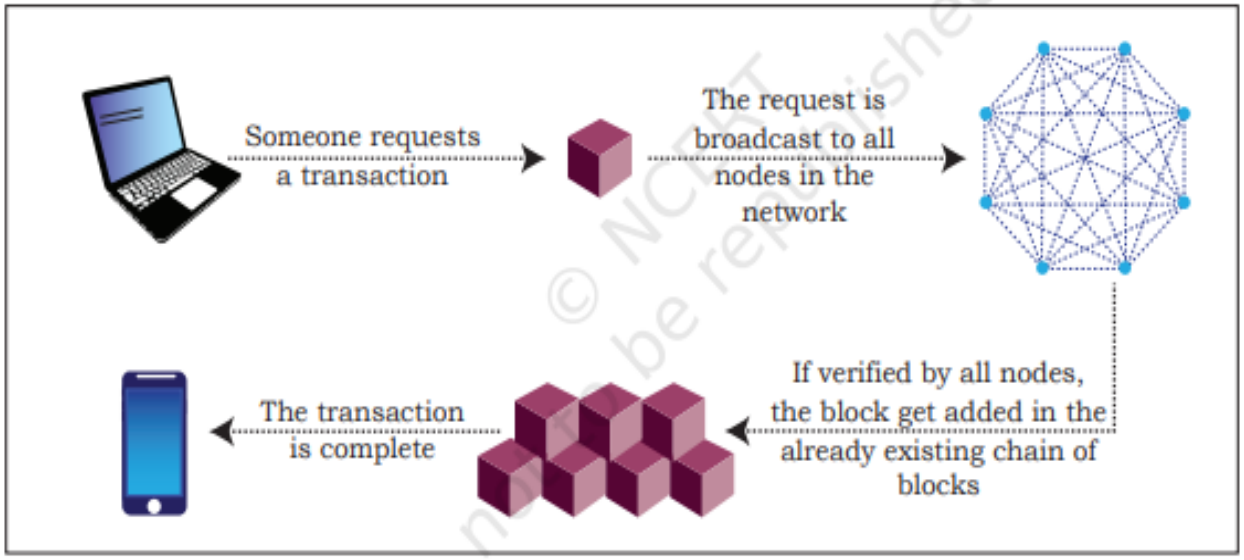
Block chain, sometimes referred to as Distributed Ledger Technology (DLT), makes the history of any digital asset unalterable and transparent through the use of decentralization and cryptographic hashing.

A simple analogy for understanding block chain technology is a Google Doc. When we create a document and share it with a group of people, the document is distributed instead of copied or transferred. This creates a decentralized distribution chain that gives everyone access to the document at the same time. No one is locked out awaiting changes from another party, while all modifications to the doc are being recorded in real-time, making changes completely transparent.

Traditionally, we perform digital transactions by storing data in a centralized database and the transactions performed are updated one by one on the database. That is how the ticket booking websites or banks operate. However, since all the data is stored on a central location, there are chances of data being hacked or lost. The block chain technology works on the concept of decentralized and shared database where each computer has a copy of the database. A block can be thought as a secured chunk of data or valid transaction. Each block has some data called its header, which is visible to every other node, while only the owner has access to the private data of the block. Such blocks form a chain called block chain.

We can define block chain as a system that allows a group of connected computers to maintain a single updated and secure ledger. Each computer or node that participates in the block chain receives a full copy of the database. It maintains an 'append only' open ledger which is updated only after all the nodes within the network authenticate the transaction. Safety and security of the transactions are ensured because all the members in the network keep a copy of the block chain and so it is not possible for a single member of the network to make changes or alter data.

The most popular application of block chains technology is in digital currency. However, due to its decentralized nature with openness and security, block chains are being seen as one of the ways to ensure transparency, accountability and efficiency in business as well as in governance systems.



Block chain technology

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