International Journal of Computer Science Trends and Technology (IJCST) – Volume 8 Issue 5, Sep-Oct 2020

RESEARCH ARTICLE OPEN ACCESS

Theoretical Concepts of a Computer Machine and Its Importances: A Survey

Dr. Mamillapally Raghavender Sharma

Assistant Professor, Department of Statistics, University College of Science,

Osmania University, Hyderabad, Telangana - India

ABSTRACT

The industry and society requirements and technologies have been steadily and rapidly increasing. The technological advancement witnessed in the computer industry is the result of a long chain of immense and successful efforts made by two major forces are: academia, and the industry. Organizational domains are increasingly opting for open source systems. Due to that reason computers are used as control systems for a wide variety of industrial and consumer services. Computer systems have conventionally been defined through their interfaces at a number of layered abstraction levels, each providing functional support to its predecessor. Tremendous computer history was started with the invention of a machine called abacus by Chinese in around before 3000 years in Babylonia. After that time period, conceptual changes were not made until 16th century. In the period, 19th century Jacquard invented an automatic loom operated by a mechanism which was operated using punched cards technique. At the same time, a device which was provision to modern computer developed by Charles Babbage a mathematician and computer pioneer in same century. This provides a base for modern computer. More sophisticated electrical machines did specialized analog calculations in the early 20th century. In this paper, we discuss main important rudimentary foundations of a traditional and modern computer.

Keywords—Computer, Processor, Abacus, Jacquard Loom, Input, Process, Output, BIOS, Compiling, Optimization, algorithm, Sophisticated, Flowchart

I. INTRODUCTION

The first known use of the word "computer" was in 1643 in a book called "The Young Mans Gleanings". Abacus also called a counting frame is used for to do systematic calculations. After many inventions in 19th century Charles Babbage developed his differential and analytical engine. This device had provisions for inputting the data, performing arithmetic operations, printing output results, and storing the data. It resembles the exact architecture of recent computer. That's why he is called father of modern computer. We are all familiar with calculations in our day-to-day life. We apply mathematical operations like addition, subtraction, multiplication, and division etc. and many other formulae for calculations. Simple calculations take less time to complete. But complex calculations take much longer time. Similarly another factor is accuracy in calculations. So, man explored with the idea to develop a machine, which can perform all arithmetic calculation faster with full accuracy and perform special tasks at a very high speed of operation. This gave birth to a machine called 'computer'. The term Computer is derived from '**compute**' which means '**to calculate**'.

You have already experienced the impact of computers in our day to-day life. Now-a-days computers are used in every field. Reservation of tickets in air lines and railways, payment of telephone and electricity bills, deposits and withdrawals of money from banks, business data processing, medical diagnosis, Weather forecasting, etc. are some of the areas where computer has become extremely useful. A different definition of computer architecture is built on four basic viewpoints. These are the structure, the organization, the implementation, and the performance. In this definition, the structure defines the interconnection of various hardware components, the organization defines the dynamic interplay and management of the various components, the implementation defines the detailed design of hardware components, and the performance specifies the behavior of the computer system.

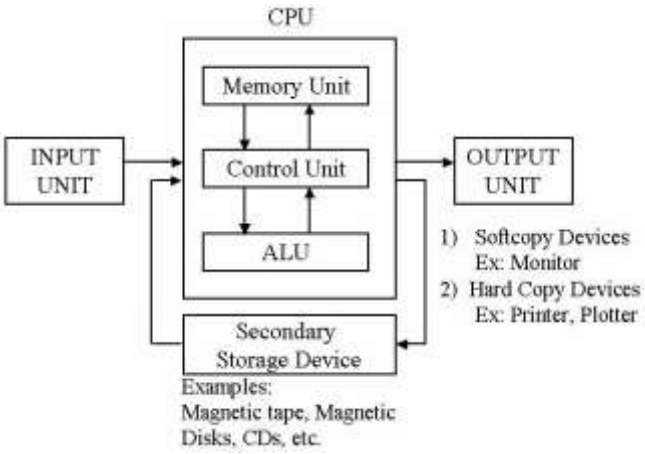

Fig. 1. Functional diagram of a generalized computer

A computer can be compared with a magic box, which serves different purpose to different people. During the processing the computer has to perform various functions such as receives data (**input**), processes data (**processing**), and produces desired result (**output**) and stores results (**storage**) in the memory to retrieve in the future [1], [2]. The computer gives impression that it is a calculating machine but really computer can do several jobs other than calculations. Though a computer can do several jobs, but it can't do on its own decision. A computer user should instruct the computer in order to achieve some specific goal. Moreover, a computer is a combination of hardware and software, which are used for processing and storing the data. Data, the plural form of

datum refers to raw material, observations, figures, and statistics that are often without meaning.

- Inputting
- Processing
- Outputting

It gets the data through an input device, processes the data using processor, and gives the desired output using output device. A computer can be defined as "A computer is a versatile electronic device which takes the data from external world using input devices, processing that data into useful information with the help of a processor, and produce the results as our requirement."

In a computer terminology some technical terms are:

Table. 1. Technical terms

TERM	MEANING
Data	Set of basic raw facts
Information	Processed, meaningful data
Instruction	A command given to computer in order to perform specific task
Inputting	Enter the data into computer
Processing	Manipulation of information
Outputting	Getting final results in the form of our desire after processing
Bus	Group of Wires, used for transfer data between registers. It can be divided into three types: Data bus, Control Bus, Address Bus
Data Bus	Used to move the Data in a computer
Address Bus	To move Address or Memory location
Control Bus	To send Control Signals between various parts of a computer

Every computer consists of basic elements such as Hardware, Software, Firmware, and Human ware. Physical components of a system are called as hardware. The hardware wound not work without set of programs. Hardware is little different to any other complex piece of electronic machinery. The set of programs which control the activities of computer system or which may be processed on computer to do some useful work is called as software.

The software directs and guides the each part of computer system including CPU. In other words, software means collection of programs whose objective is to enhance the capabilities of hardware. Software can be classified as: system software, and application software. System software controls and monitors the various activities and resources of a computer and makes it easier and more efficient to use the computer. In other hand, application software is designed to perform people-related tasks such as payroll, inventory, and sales analysis. A programs by which perform the predefined instruction in machine memory called firmware. Examples of firmware are ROM, PROM, EPROM etc. And human beings who are used the computer are called human ware.

A. Advantagesand Disadvantages of computers

Computer plays a vital role in processing of data in an organization or a field. Computers help in processing volume of data efficiently and accurately within short period of time [3].

The characteristics which make a computer indispensable are:

1. Speed

The computer is able to process the data and gives the output in fractions of seconds, such that required information is given to the user on time enabling the user to take right decisions on right time. A powerful computer is capable of executing about 3 million calculations per second.

2. Accuracy

The accuracy of computer defines as which avoids errors in calculations and gives exact results. If in an output we get errors, these errors are due to errors in instructions given by the programmer, i.e. a computer follows garbage-in-garbage-out principle.

3. Reliable

The output generated by the computer is very reliable, but it is reliable only when the data, which is passing as input to the computer and the program, which gives instructions are correct.

4. Storage Capacity

The computer has a provision to store large volumes of data in the small storage devices, which have capacity to store huge amounts of data and help the retrieval of data in an easy task.

5. Versatility

Computers are very versatile machines. Computers are capable of performing almost many tasks at a time, provided the task can be reduced to a series of logical steps.

6. Atomicity

Once the instructions fed into computer it works automatically without any human intervention until the completion of execution of program or meets logical instructions to terminate the job.

7. Diligent

A computer is free from tiredness, lack of concentration, fatigue, etc. It can work for hours without creating any error. If millions of calculations are to be performed, a computer will perform every calculation with the same accuracy. Due to this capability it overpowers human being in routine type of work.

8. **Communication**

A computer communicates with other systems even in remote places.

Disadvantages

Computers can success in every field of modern era. But computers have some limitations.

Dependency: Computers cannot think on its own decision. Human beings should instruct them in order to make work them.

No I.Q: Computers cannot have an I.Q i.e. they cannot learn from past experience on its own.

Environment: The operating environment of the computer should be dust free and suitable.

No Feeling: Computers have any feelings or emotions. And it cannot make judgment on feeling, taste, experience, and knowledge unlike humans.

B. Classifications of computers

The classification of computers is based on the following four criteria [2], [4].

1) According to purpose: according to purpose, computers divided into following two groups.

General purpose: These computers are theoretically used for any type of applications i.e. not only for specific goal but also for all purposes. These computers can be used in solving a business problem and also used to solve mathematical equation with same accuracy and consistency. Most of the computers used now-a-days are general purpose digital computers. Personal computers, including desktops, notebooks, smart phones and tablets, are all examples of general-purpose computers. Computers that follow instructions for general requirements such as sales analysis, financial accounting, inventory and management information etc. in modern era, almost all computers which are used in fields such as commercial, educational, and the applications are general-purpose are treated as general purpose computers.

Special purpose: Computers which are used for to do special tasks such as scientific, research applications, weather forecasting, medical diagnostics etc. are comes under special purpose computers. Examples for special purpose computers are: home appliances, toys and games, cash machines, and vehicle computers.

2) According to technology used: according to technology (operational function) used computers are grouped into three categories.

Analog computers: Analog computers are special purpose computers which are programmed for measuring physical quantities that represent and store the data in continuously varying physical quantities such as electricity, voltage, or frequency. These computers are mainly used in engineering, and scientific applications. Example: thermometer, and speedometer. Means a analog computer that performs arithmetical operation by measurable quantities, such as mechanical movement, the rotation of gears rather than by number. The word analog is derived from the Greek ana-logon, meaning "according to a ratio"**.** These are almost extinct. An analog computer can perform several mathematical operations simultaneously also. Everything we see and hear is change continuously. In *Analog computers*, data is transmitted for its operation in the form of continuous signals. Examples of analog computer are Speedometer, resistance of capacitor, frequency of signal and voltage etc. Analog computers are used in situation where data not to be transferred into bits.

Digital computers: Today most of all computers are come under this category. These types of computers mainly programmed for represent and store the data in discrete values. Computers use binary system to store the data and information. Although, human being enters the data in decimal form computer can convert that data into binary form. They use digital circuits and are designed to operate on two states, namely bits 1 and 0. They are analogous to states ON and OFF. Data in this type of computers is represented as a series of 0s and 1s. Digital computers are suitable for complex computations and have higher processing speeds. Digital computers are either general purpose computers or special purpose ones. If there are discrete values in input values then digital computers are used which means data is transmitted for its operation in the form discrete signals (or discontinuous signal). Examples of digital computers include the Mac Book, IBM PC, the Apple Macintosh as well as modern smart phones.

Hybrid computers: These computers are mainly used in AI (Artificial Intelligence), robotics, and other computer aided manufacturing such as process control. This category of computers corporate into technology of both analog and digital computers functions and operations. This category computers store and process analog signals using analog-digital converters and digital signals using digital-analog converters. These computers are a combination of both digital and analog computers. In this type of computers, the digital segments perform process control by conversion of analog signals to digital ones. Example for a hybrid computer system is a cement plant where all calculations are made by digital systems (digital computers) and accordingly action such as increase of certain material in the furnace and increase/decrease of fuel for temperature is performed by the help of analog system.

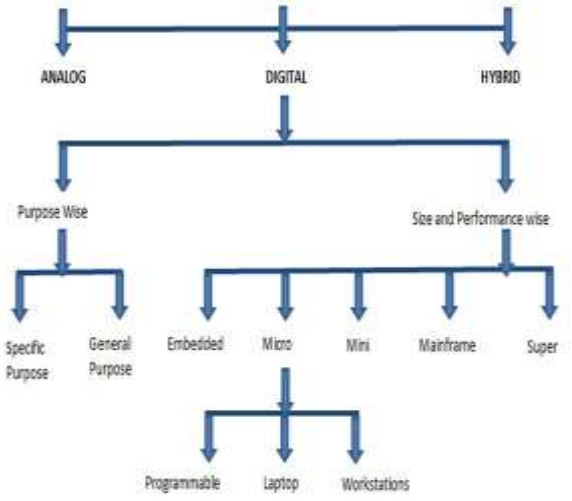

Fig. 2. Computer types according to technology

3) According to memory and size: according to this category, computers are divided into five types.

Micro computers: Microcomputers are the smallest category of computers consisting of a microprocessor and associated storage and I/O elements. These are designed to be

used by single user oriented operating system i.e. one user per a session. A computer with a microprocessor and its central processing unit is known as a microcomputer. Inside the microcomputer, the arithmetic and control unit is combined on a single chip called a microprocessor. They do not occupy much space. Microcomputers are considered to be two types; PC and work stations. PC varieties are desktop, tower, portable computers that can run easy-to-use programs such as word processing or spreadsheets. A monitor, a keyboard and other similar input-output devices, computer memory in the form of RAM and a power supply unit come packaged in a microcomputer. These computers can fit on desks or tables and prove to be the best choice for single-user tasks.

Mini computers: Mini computers provide the facility of more storage capacity and communication link between users. When compare with micro computers minicomputers fast in operation. These are designed for use multiple user oriented operating system. In terms of size and processing capacity, minicomputers lie in between mainframes and microcomputers. Minicomputers are also called mid-range systems or workstations. The term began to be popularly used in the 1960s to refer to relatively smaller third generation computers. They took up the space that would be needed for a refrigerator or two and used transistor and core memory technologies. The 12-bit PDP-8 minicomputer of the Digital Equipment Corporation was the first successful minicomputer.

Wearable Computers: A record-setting step in the evolution of computers was the creation of wearable computers. These computers can be worn on the body and are often used in the study of behavior modeling and human health. Military and health professionals have incorporated wearable computers into their daily routine, as a part of such studies. When the users' hands and sensory organs are engaged in other activities, wearable computers are of great help in tracking human actions. Wearable computers do not have to be turned on and off and remain in operation without user intervention.

Medium computers:

Desktops: A desktop is intended to be used on a single location. The spare parts of a desktop computer are readily available at relatively lower costs. Power consumption is not as critical as that in laptops. Desktops are widely popular for daily use in the workplace and households.

Laptops: Similar in operation to desktops, laptop computers are miniaturized and optimized for mobile (portable) use. Laptops run on a single battery or an external adapter that charges the computer batteries. They are enabled with an inbuilt keyboard, touch pad acting as a mouse and a liquid crystal display. Their portability and capacity to operate on battery power have proven to be of great help to mobile users.

Notebooks: They fall in the category of laptops, but are inexpensive and relatively smaller in size. They had a smaller feature set and lesser capacities in comparison to regular laptops, at the time they came into the market. But with passing time, notebooks too began featuring almost everything that laptops had. By the end of 2008, notebooks had begun to overtake laptop in terms of market share and sales.

Personal Digital Assistants (PDAs): It is a handheld computer and popularly known as a palmtop. It has a touch screen and a memory card for storage of data. PDAs can also be used as portable audio players, web browsers and smart phones. Most of them can access the Internet by means of Bluetooth or Wi-Fi communication.

Tablet Computers: Tablets are mobile computers that are very handy to use. They use the touch screen technology. Tablets come with an onscreen keyboard or use a stylus or a digital pen. Apple's iPad redefined the class of tablet computers.

Large computers: These types of computers are having high storage capability and high operation capability to support many powerful peripheral devices. Example: mainframe computers. Large organizations use mainframes for highly critical applications such as bulk data processing and ERP. Most of the mainframe computers have capacities to host multiple operating systems and operate as a number of virtual machines. They can substitute for several small servers. Mainframes are very large computers with a very high capacity of main store. Because they can process large amounts of data are very quickly; big companies, banks, government departments as their main computer use them. They can be linked into a network with smaller departmental computers. Microcomputers or with each-other. They act as hosts of larger national and international communication networks, handling hundreds of users at same time. Some examples of mainframes are IBM 4381, ICL (International Computers Limited) 39 series and CDC (Control Data Corporation) cyber series.

Servers: They are computers designed to provide services to client machines in a computer network. They have larger storage capacities and powerful processors. Running on them are programs that serve client requests and allocate resources like memory and time to client machines. Usually they are very large in size, as they have large processors and many hard drives. They are designed to be fail-safe and resistant to crash.

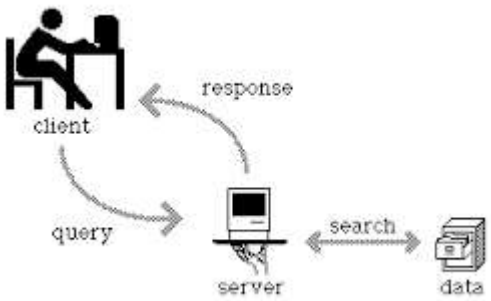

Fig. 3. A computer server based sales processing system

Extra large computers: In this category, computers are categorized by their very large and very processing speed. These are generally used for complex scientific applications.

Supercomputers: The highly calculation-intensive tasks can be effectively performed by means of supercomputers. Quantum physics, mechanics, weather forecasting, molecular theory are best studied by means of supercomputers. Their ability of parallel processing and their well-designed memory

hierarchy give the supercomputers, large transaction processing powers. Examples of supercomputers are CARY XMP-24 and NEC-500, and PARAM developed in India.

4) Harvard architecture computer

The Harvard architecture is computer with separate storage and signal pathways for instructions and data. It contrasts with the **von Neumann architecture**, where program instructions and data share the same **memory** and pathways.

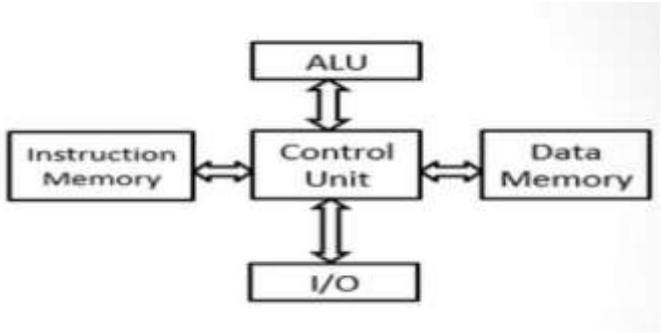

Fig. 4. Specimen Harward architecture

Relatively pure Harvard architecture machines are used mostly in applications where trade-offs, like the cost and power savings from omitting caches, outweigh the programming penalties from featuring distinct code and data address spaces. The principal advantage of the pure Harvard architecture—simultaneous access to more than one memory system—has been reduced by modified Harvard processors using modern CPU cache systems.

5) Von Neumann architecture

The Von Neumann architecture is a theoretical computer design based on the concept of stored-program where programs and data are stored in the same memory. The concept was designed by a mathematician John Von Neumann in 1945 and currently serves as the foundation of almost all modern computers. Neumann machine consists of a central processor with an arithmetic/logic unit and a control unit, a memory, mass storage and input and output. The **von Neumann architecture**, where program instructions and data share the same **memory** and pathways.

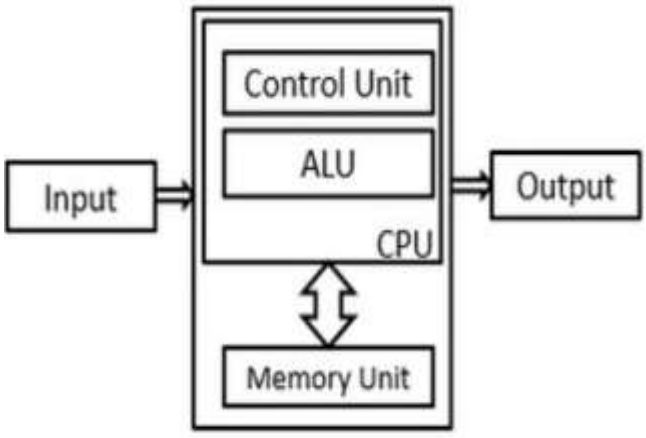

Fig. 5. Neumann architecture computer

6) CISC (Complex Instruction Set Computer)

A complex instruction set computer is a **computer** in which single instructions can execute several low-level operations (such as a load from memory, an arithmetic operation, and a memory store) or are capable of multi-step operations or addressing modes within single instructions. **CISC** is most often **used** in automation devices whereas RISC is **used** in video and image processing applications. When microprocessors and microcontroller were first being introduced, they were mostly **CISC**. This was largely because of the lack of software support present for RISC development. Some examples of CISC microprocessor instruction set architectures (ISAs) include the Motorola 68000 (68K), the DEC VAX, PDP-11, several generations of the Intel x86, and 8051.

7) RISC (Reduced Instruction Set Computer)

RISC-based machines execute one instruction per clock cycle. The RISC architecture will need more working (RAM) memory than CISC to hold values as it loads each instruction, acts upon it, then loads the next one. The RISC instruction set requires one to write more efficient software (e.g., compilers or code) with fewer instructions. Examples of processors with the RISC architecture include MIPS, PowerPC, Atmel's AVR, the Microchip PIC processors, Arm processors, RISC-V, and all modern microprocessors have at least some elements of RISC.

C. Operating System Concepts

In order to operate a computer an OS is must. An operating system is a collection of programs that control the operation of all hardware and other resources in the computer system. A program is collection statements to achieve desired result. It co-ordinates, and manages all resources of a computer. User programs interact with operating system using set of extended instructions. These instructions are called "system calls". These system calls are used to create, delete and use various software objects that are manages by the Operating systems. The following are common in any Operating system. Various types of operating system components are: Process, Files, System Calls, and the shell. Booting Process means Load the OS into the Computer [5], [6].

Types of Operating systems

Operating systems are basically capable to do all functions but the way of processing or approach of the systems may vary from one Operating System to another. The following basic types of operating systems are

1. Batch Processing Systems
2. Interactive Operating systems
3. Multi-Programming Operating Systems
4. Multi-Processing Operating Systems
5. Multitasking systems
6. Multi-user Operating systems
7. Virtual storage systems
8. Multi processor OS
9. Network OS

10. Distributed OS

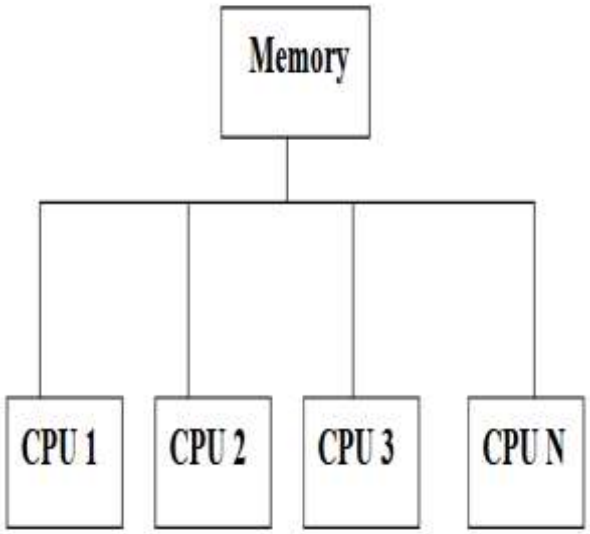

Fig. 6. Multiprocessing OS architectur in a computer

Based on the features of the operating systems and the interface provided, they can be classified as:

a. User Friendly Operating System: These Operating systems provide a pleasant and easy to work environment, they are usually graphical based, where the various options are represented as icons, menus etc. examples are Windows 95, Windows 98, Windows-NT are some of the user friendly Operating systems.

b. Programming friendly Operating Systems: The programmer is anyone who has fair knowledge about programming concepts and he is expected to know the computer in a detailed manner. The programmer much concerned about various utilities, functionalities, flexibility and powerful environment. UNIX, XENIX, LINUX etc. are some of the character based interfaces which are very powerful and programming friendly operating systems.

Character User Interfaces (CUI)

This user interface is character based; one gets prompts in characters and a user has to type the characters. These were the interfaces which enabled the programmers to do work easy, but they it is difficult to work in as we have to type every instruction and commands. MS-DOS, UNIX, LINUX etc. are some of the most popular character based operating systems.

Graphical User Interface (GUI)

This interface is graphical i.e. there are pictures, graphical objects, images, menus etc. which have specific functionalities. This interface provides very pleasant environment to work on it. Here almost every action is automated, at click of a button can get desired action done. Windows XP, Windows7, Windows-NT are some of very popular GUI based Operating systems.

Functions of Operating System

There are Many Functions those are performed by the Operating System but the main goal of Operating System is to provide the interface between the user and the hardware. The various Functions those are performed by the Operating System are as explained below:

Resource Management: Means Operating System will Manages all the Resources those are attached to the System means all the Resource like Memory and Processor and all the Input output Devices those are attached to the System are known as the Resources of the Computer System and the operating system will Manage all the Resources of the System. The Operating System will identify at which Time the CPU will perform which Operation and in which Time the Memory is used by which Programs. And which Input Device will respond to which Request of the user means When the Input and Output Devices are used by the which Programs. So this will manage all the Resources those are attached to the Computer System.

Storage Management: Operating System also Controls the all the Storage Operations means how the data or files will be Stored into the computers and how the Files will be Accessed by the users etc. All the Operations those are responsible for storing and accessing the files is determined by the operating system. An Operating System also allows us creation of files, creation of directories and Reading and Writing the data of files and directories and also copies the contents of the files and the directories from one Place to another place.

Process Management: The operating system also treats the process management means all the Processes those are given by the user and the process those are system‘s own processes are Handled by the OS. The Operating System will create the Priorities for the user and also start or Stops the Execution of the Process and Also Makes the Child Process after dividing the Large Processes into the Small Processes.

File Management: A File is a collection of related information defined by its creator commonly fill represent program 9both source and object forms) and data. The O.S. is responsible for the following activates in connection with file management.

(I)Creating and deleting files.

(ii)Creating and deleting directories.

(iii)Supporting primitives for manipulating file, and directories.

(iv)Mapping files onto secondary storage. (v)Backing up files on stable (Nonvolatile) storage media.

Memory Management: Operating System also manages the Memory of the Computer System means provide the memory to the Process and also reallocates the memory from the process. And also defines that if a process gets completed then this will reallocate the memory from the processes. Main memory is quickly accessible data shared by the CPU and I/O devices. The OS is responsible for following activities in connection with memory management.

1) keeping track of which parts of memory are currently being used and by whom.

2) deciding which processes are to be loaded into memory when memory when memory space becomes available.

3) Allocating and Deallocating memory memory space is needed.

Security Management: Operating System also provides us Sharing of Files between Multiple Users, and also Provides Security among users by using user names and passwords for login: Check Programs, Monitor Program, Basic input/output System (BIOS) Program, Utility Programs, and File Maintenance Programs.

I/O Management: One of the purposes of an operating system is to hide the peculiarities of specific h/w devices from the user. For Example: in UNIX. The peculiarities of I/O devices are hidden from the bulk of the O.S.

Examples of OS include: Windows versions, UNIX, LINUX, MS-DOS (Disk Operating System).

Windows Introduction

Windows is software tools which help to do our work easily. It is easy to learn. Windows is a link between Dos and us, which provides us the faculty to do all the work of DOS without exercising in DOS. Windows is also known as graphical user interface (GUI). Windows is made by Microsoft Company. That is why it is called Ms- win-down windows control ass the work of computer simply and effectively. To do any work in previously popular operating system Dos, the commands of Dos had be written, they had to be kept in mind but windows has make it easier, whatever work is performed. Windows is an operating system for PC's. Windows 95 is one of the most popular versions of it. Which is manufactured by Microsoft Company of America in 1985? It is a single user multitasking operating system. It can do business and personal job both in very efficient way. Windows 98 is another version of windows. In this section we will discuss about windows-XP. Actually windows are the result of research work on GUL (Graphical User Interface). Xerox Corporation did this research work after 1980. The first computer, which was developed by this corporation, is Xerox Star, but GUI was popular when Apple computers made Macintosh computer [11].

The developments of Windows in different years are as follows.

Table. 2. Traditional Microsoft Windows OSs

S. No.	Name of Version	Year	Main Features
1.	Windows 1.0	1985	GUI based Windows
2.	Windows 1.	1987	Overlapping Windows
3.	Windows 2.10	1987	Virtual Machine
4.	Windows 3.0	1990	Program manager/file Manager
5.	Windows 3.1	1992	Multimedia and Networking
6.	Windows 3.11	1993	32 Bit Networking
7.	Windows 95	1995	32 Bit Operating System
8.	Windows 98	1998	Internet Facility
9.	Windows Millennium	2000	Multimedia and Networking
10.	Windows XP	2001	Multimedia and Networking

Following are features of Windows-XP

1) Developed Interface.

2) Long File Name.

3) Windows Explorer.

4) Games and Multimedia facility.

5) Similarity with the previous program.

6) Easy Postal Service.

7) 32-bit Multitasking.

8) Plug and hardware similarity.

9) Network Facility.

Basics of windows

1) Icon: Icons are small graphical images that can represent you computer's Programs, files, folders and amongst other things. Folder and shortcut is type of ICON. The Folder is a work as directory and shortcut work to execute the program. To activate an icon you double click (two click in quick work succession) on it with the left mouse button, this will activate the icon and either start a program or open a file/folder. The icons on your desktop can be renamed by right clicking on them and selecting rename, similarly they can be deleted by right clicking on and selecting delete. You can easily create your own icons for your favorite programs, folders, etc

2) Desktop: The vertical screen of windows XP is called Desktop. When we switch on CPU power, then booting process of computer is started. After completing of booting process the loading of windows is started. At the end screen will be appear, called Desktop. There are many objects on the Desktop. Only useful objects are appearing on the Desktop. There are many objects are: My Computer Recycle Bin, My network places, task Bare Start Menu, Files and Folders, shortcuts. These objects are shows on the Desktop with the help of small pictures. The name of that objects is given below the picture it is called icon of object. If necessary, then other objects can be put on the Desktop.

Some Permanent Icons of the Desktop

1. My Computer

2. My Document

3. Internet Explorer

4. My Network Places

5. Recycle Bin

3) Taskbar: The bottom strip of Desktop is called Taskbar. "Start" menu and other buttons are available, on the Taskbar such as show Desktop, Launch Internet Explorer Browser, Launch Outlook Explorer, Anti Virus, Sound Effect, Volume, Clock etc. when we Start any Program or open any Windows, a button related to that Windows will be appear on the Taskbar. We can reach immediately on all started programs with the help of Taskbar.

The Task Bar has following option are: (i)Start Button: This button is used to open start menu. (ii)Quick Launch Bar: You can add icons to this area and it provides quick access to programs or documents even when the desktop is not visible.

(iii)Windows Tabs: These are used to switch between any open programs. Documents, etc. In our example we have two windows open (word and excel). To change form one windows to another simply click on the corresponding windows tab clicking a second time on the same tab will minimize the window. (iv)System Tray: The system tray displays icons for programs that are loaded into memory. (For Example – The volume control, Date and Time icon).

D. Computer apllications

The term Application refers to Software which is a set of instructions or code written in a program for executing a task or an operation in a Computer. Applications play a vital role in a Computer as it is an end-user program that enables the users to do many things in a system. The application programs are designed and developed to run in a System Software which is an Operating system. An Operating System is system software that enables al the applications programs to run and execute various tasks in a Computer system. The GUI based applications carries out various tasks in a Computer like creating documents, playing games, browsing and many more [7].

1. Education
2. Communication
3. Entertainment
4. Business application

A computer has high speed of calculation, diligence, accuracy, reliability, or versatility which has made it an integrated part in all business organizations. Computer is used in business organizations for −

- Payroll calculations
- Budgeting
- Sales analysis
- Financial forecasting
- Managing employee database
- Maintenance of stocks, etc.

5. Publishing

6. Banking
Today, banking is almost totally dependent on computers.

Banks provide the following facilities: Online accounting facility, which includes checking current balance, making deposits and overdrafts, checking interest charges, shares, and trustee records. ATM machines which are completely automated are making it even easier for customers to deal with banks.

07. Insurance

8. Healthcare

9. Engineering Design

10. Military

E. Classification of memory system of a computer

Memory means storage capability of a computer. Memory (storage devices) can be measured in computer with the following features [8].

- Speed
- Volatility
- Access method
- Portability
- Cost and capacity

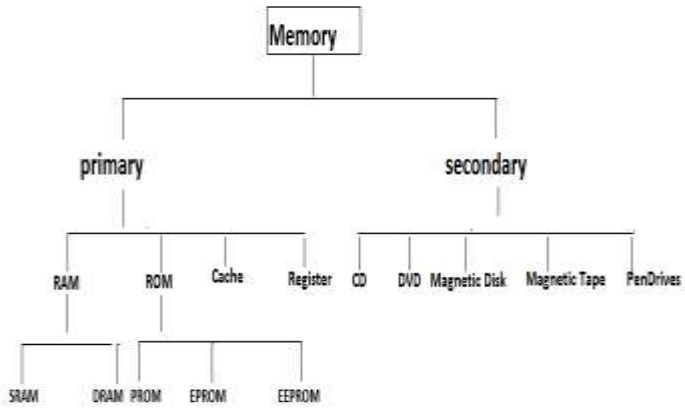

Fig. 7. Memory system categorization in a computer

Primary Memory

Primary Memory is also known as internal memory or main memory. You can store and retrieve data much faster with primary memory compared to secondary memory. Primary memory is more expensive than secondary memory. When the computer is doing any job, the data that have to be processed are stored in the primary memory. This data may come from an input device like keyboard or from a secondary storage device like a floppy disk, memory card or pen drive etc. The primary memory itself is implemented by two types of memory technologies. The first is called Random Access Memory (RAM) and the other is read only memory (ROM). A more appropriate name for RAM is RWM (Read Write Memory), the CPU can write and read information from any primary memory location implemented using RAM. The other part of primary memory is implemented using ROM which stands for Read Only Memory.

Random Access Memory (RAM): The primary storage is referred to as Random Access Memory (RAM) because it is possible to randomly select and use any location of the memory directly to store and retrieve data. As soon as the computer is switched off, the contents of the primary memory is lost because it is volatile in nature. It takes same time to any address of the memory as the first address. It is also called read/write memory. The storage of data and instructions inside the primary storage is temporary. It disappears from RAM as soon as the power to the computer is switched off. The memories, which lose their content on failure of power supply, are known as volatile memories. So now we can say that RAM is volatile memory.

SRAM: Static Random Access Memory (Static RAM or SRAM) is a type of RAM that holds data in a static form, that

is, as long as the memory has power. The term is pronounced "S-RAM", not "sram". MOFSET (metal-oxide-semiconductor field-effect transistors) is a popular SRAM type.

DRAM: DRAM is a type of RAM that stores each bit of data on a separate capacitor. This is an efficient way to store data in memory, because it requires less physical space to store the same amount of data than if it was stored statically. Therefore, a DRAM chip can hold more data than an SRAM (static RAM) chip of the same size can. However, the capacitors in DRAM need to constantly be refreshed to keep their charge, so DRAM requires more power than SRAM. DRAM is the most common type of memory found in personal computer systems. While there are many types of DRAM available, the most common type is synchronous DRAM SDRAM, which is a faster version of standard DRAM. This is the type of memory most computers use for their main system memory.

Read Only Memory (ROM): There is another memory in computer, which is called Read Only Memory (ROM). The storage of program and data in the ROM is permanent. The ROM stores some standard processing programs supplied by the manufacturers to operate the personal computer. The ROM can only be read by the CPU but it cannot be changed. The basic input/output program is stored in the ROM that examines and initializes the various equipments attached to the PC, when the switch is turned ON. The memories, which do not lose their content on failure of power supply, are known as non-volatile memories. ROM is non-volatile memory. Various RAM technologies [7]:

PROM: There is another type of primary memory in computer, which is called Programmable Read Only Memory (PROM). You know that it is not possible to modify or erase programs stored in ROM, but it is possible for you to store your program in PROM chip. Once the programs are written it cannot be changed and remain intact even if power is switched off. Therefore, programs or instructions written in PROM or ROM cannot be erased or changed.

EPROM: This stands for Erasable Programmable Read Only Memory, which overcome the problem of PROM and ROM. EPROM chip can be programmed time and again by erasing the information stored earlier in it. Information stored in EPROM can be erased by exposing it to ultraviolet light. This memory can be reprogrammed using a special programming facility. When the EPROM is in use, information can only be read.

EAPROM: This stands for Electrically Alterable Programmable Read Only Memory. This concept is same as that of EPROM. The only difference is that the memory can be altered using electrical signals. The whole of the memory need not be erased.

Cache Memory: The speed of CPU is extremely high compared to the access time of main memory. Therefore, the performance of CPU decreases due to the slow speed of main memory. The decreases the mismatch in operating speed, a small memory chip is attached between CPU and Main memory whose access time is very close to the processing speed of CPU. It is called CACHE memory. CACHE memories are accessed much faster than conventional RAM. It is used to store programs or data currently being executed or temporary data frequently used by the CPU. It is also very expensive to have bigger size of cache memory. Its size is therefore, normally kept small.

Registers: The CPU processes data and instruction with high speed. There is also movement of data between various units of the computer. It is necessary to transfer the processed data with high speed. So the computer uses a number of special memory units called registers. They are not part of the main memory but they store data or information temporarily and pass it on as directed by the control unit.

Secondary Storage (Auxiliary Memory): You are now clear that the operating speed of primary memory or main memory should be as fast as possible to cope up with the CPU speed. These high-speed storage devices are very expensive and hence the cost per bit of storage is also very high. Again, the storage capacity of the main memory is also very limited. Often it is necessary to store hundreds of millions of bytes of data for the CPU to process. Therefore, additional memory is required in all the computer systems. This memory is called auxiliary memory or secondary storage. In this type of memory the cost per bit of storage is low. However, the operating speed is slower than that of the primary memory. Huge volume of data are stored here on permanent basis and transferred to the primary storage as and when required. Most widely used secondary storage devices are magnetic tapes, magnetic disks and floppy disks, Compact disks and Pen drives etc.,

CD: The CD-ROM format was developed by Japanese company Denon in 1982.Compact disc (CD) is a digital optical disc data storage format released in 1982 and co-developed by Philips and Sony. The format was originally developed to store and play only sound recordings but was later adapted for storage of data (CD-ROM). Several other formats were further derived from these, including write-once audio and data storage (CD-R), rewritable media (CD-RW), Video Compact Disc (VCD), Super Video Compact Disc (SVCD), Photo CD, Picture CD, CD-i, and Enhanced Music CD. The first commercially available Audio CD player, the Sony CDP-101, was released October 1982 in Japan. Standard CDs have a diameter of 120 millimeters (4.7 in) and can hold up to about 80 minutes of uncompressed audio or about 700 MB of data. The Mini CD has various diameters ranging from 60 to 80 millimeters (2.4 to 3.1 in); they are sometimes used for CD singles, storing up to 24 minutes of audio, or delivering device drivers.

DVD: DVD, short for Digital Versatile Disc, is also an optical medium to store digital data. A standard DVD can hold 4.7 GB of data. So DVD is widely used to store large files like video and movies. The capacity is the biggest difference between CD and DVD.DVDs are similar to CDs and are also an optical disc storage device. These were developed independently by Philips, Sony, Toshiba, and Panasonic in 1995. Prior to this, video and film were being recorded on Video CD (VCD) that was available in the market in 1993. Other formats that came out in the same year included Multimedia Compact Disc (MMCD) and Super Density (SD) disc. The difference in formats caused the companies to come

together and set up standards for maintaining one type of format, which resulted in the formation of DVD. As prices of DVDs went down, it causes VHS tapes to become obsolete by offering better technology.

Magnetic Tape

Magnetic tapes are used for large computers like mainframe computers where large volume of data is stored for a longer time. In PCs also you can use tapes in the form of cassettes. The cost of storing data in tapes is inexpensive. Tapes consist of magnetic materials that store data permanently. It can be 12.5mm to 25 mm wide plastic film-type and 500 meter to 1200 meter long which is coated with magnetic material. The deck is connected to the central processor and information is fed into or read from the tape through the processor. It is similar to cassette tape recorder. This tape is a normal magnetic recording which is designed with a slender magnetizable covering on an extended, plastic film of the thin strip. This is mainly used to back up huge data. Whenever the computer requires accessing a strip, first it will mount to access the data. Once the data is allowed, then it will be unmounted. The access time of memory will be slower within magnetic strip as well as it will take a few minutes for accessing a strip.

Magnetic Disk

You might have seen the gramophone record, which is circular like a disk and coated with magnetic material. Magnetic disks used in computer are made on the same principle. It rotates with very high speed inside the disk drive. Data are stored on both the surface of the disk. Magnetic disks are most popular for direct access storage. Each disk consists of a number of invisible concentric circles called tracks. Collection of such tracks forms a sector. Information is recorded on tracks of a disk surface in the form of tiny magnetic spots. The presence of a magnetic spot represents one bit (1) and its absence represents zero bit (0). The information stored in a disk can be read many times without affecting the stored data. So, the reading operation is non-destructive. But if you want to write a new data, then the existing data is erased from the disk and new data is recorded. The magnetic disks in the computer are circular plates fabricated of plastic otherwise metal by magnetized material. Frequently, two faces of the disk are utilized as well as many disks may be stacked on one spindle by read or write heads obtainable on every plane. All the disks in computer turn jointly at high speed. The tracks in the computer are nothing but bits which are stored within the magnetized plane in spots next to concentric circles. These are usually separated into sections which are named as sectors.

Flash drive (pen drive): Flash drives have many names — jump drives, thumb drives, pen drives, and USB keychain drives. Regardless of what you call them, they all refer to the same thing, which is a small data storage device that uses flash memory and has a built-in USB connection. Flash drives are typically no more than two to three inches in length and less than an inch in width. Their size and shape may resemble a thumb or a small pen (which is where the names “thumb drive” and “pen drive” come from).Flash drives are also very thin, often having a depth of less than a centimeter. Because of their small form factor, they are highly portable and can easily fit in a pocket or on a keychain (hence the name “keychain drive”).Nowadays flash drives can store several gigabytes of information. Since they are small in size but have large storage capacities, flash drives have replaced most previous portable data storage mediums such as floppy disks and removable hard disks like Zip disks. Because they have a built-in USB connection, flash drives also don’t require a special disk drive to be used. Instead, they can be used on any computer with a USB port, which nearly all modern computers have. Below is the diagram of a pen drive.

F. Programming concepts

In order to communicate with others, and to express our feelings with another a language is must. Some of the basic natural languages that we are familiar with are English, Hindi, and Oriya etc. These are the languages used to communicate among various categories of persons. But, how can you communicate with a computer? Computer will not understand any of these natural languages for transfer of data and instructions. So there is a programming language must so that you could pass instructions to the computer to do specific job so that a computer can understand. You must have heard names like FORTRAN, BASIC, and COBOL etc. These are programming languages. So instructions or programs are written in a particular language based on the type of task. As an example, for scientific application FORTRAN and C languages are used. On the other hand COBOL is used for business applications [9].

Computer Programming Languages

There are two major types of programming languages. These are Low Level Languages and High Level Languages. Low Level languages are further divided in to Machine language and Assembly language.

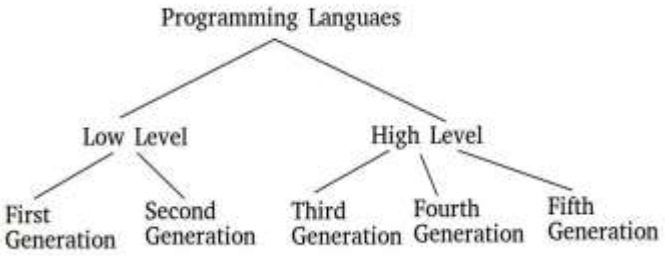

Fig. 8. Anatomy of programming languages

Low Level Languages

These are efficient for the computer but very inefficient for programmers. This is also called as machine language. The Machine Language is the only language that is directly understood by the computer. It does not need any translator program. The term low level means closeness to the way in which the machine has been built. Low level languages are machine oriented and require extensive knowledge of computer hardware and its configuration. We also call it machine code and it is written in the form of 1’s (one) and 0’s (zero). These are called binary digits. When this sequence of codes is fed to the computer, it recognizes the codes and converts it into electrical signals needed to run it. For example, a program instruction may look like this:

1011000111101
It is not an easy language for you to learn because of its difficult to understand. It is considered to the first generation language. It is also difficult to debug the program written in this language.

Assembly Language
It is the first step to improve the programming structure. Some combination of letters can be used to substitute for number of machine codes. The set of symbols and letters forms the Assembly Language. A translator program is required to translate the Assembly Language to machine language. This translator program is called '**Assembler**'. It is considered to be a second generation Language. Assembly language codes are called mnemonics.

High-level languages
Programs developed in assembly language very slow and tedious process. This problem overcomes by using high-level programming language. These are machine independent. Code which is written in high level language is easy to implement and easy to understand for human beings.

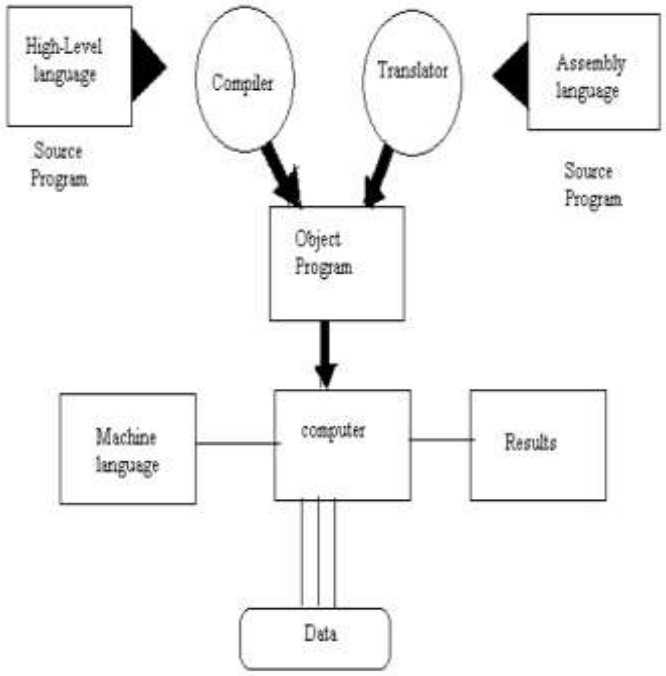

Fig. 9. A program implementation procedure with available languages

Machine code (object program) is created by assembler or compiler. Due to availability of computer system resources and tasks, the computer program execution modes are: Batch mode, On-line mode, and Time Sharing mode. In Batch mode the computer system executes tasks one after one. Some applications such as payrolls are processed in this mode. In on-line mode computer executes the instructions as when the data is entered into the computer. This mode of operation is suitable for inventory control, air lines reservations, and banking system. The time sharing mode refers to the use of a single computer system by many users at the same time. Although, many users share the system, a user feels that the computer system is attending to him all the time.

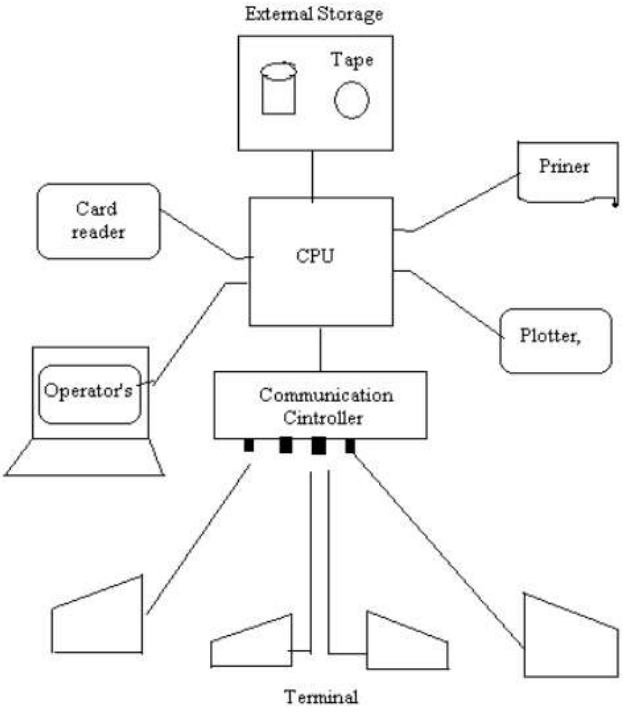

Fig. 10. Time sharing system in a computer

G. Structured programming concepts
Structured programming is a programming paradigm aimed at improving the clarity, quality, and development time of a computer program by making extensive use of subroutines, block structures, for and while loops—in contrast to using simple tests and jumps such as the *go to* statement, which could lead to "spaghetti code" that is difficult to follow and maintain. Structured programming is most frequently used with deviations that allow for clearer programs in some particular cases [10].

Examples:-ALGOL 58 and ALGOL60 programming languages.

Subroutines; callable units such as procedures, functions, methods, or subprograms are used to allow a sequence to be referred to by a single statement.

This paper is organized into IV sections. First section tells about introduction, second section discusses on some related work i.e literature survey, third section explains about methods used, and section four describes conclusion. At last references are given which are used throughout the paper.

II. LITERATURE SURVEY

In this section, we would like to provide a historical background on the evolution of cornerstone ideas in the computing industry. We should emphasize at the outset that the effort to build computers has not originated at one single place. There is every reason for us to believe that attempts to build the first computer existed in different geographically distributed places. We also firmly believe that building a computer requires teamwork. Therefore, when some people attribute a machine to the name of a single researcher, what

they actually mean is that such researcher may have led the team who introduced the machine. We, therefore, see it more appropriate to mention the machine and the place it was first introduced without linking that to a specific name. We believe that such an approach is fair and should eliminate any controversy about researchers and their names [11].

A. Chronology of early computors

- 2500BC: abacus
- 1614: logarithms discovered by John Napier
- 1622: Invention of slide rule
- 1642: first mechanical calculator
- Charles Babbage (University of Cambridge): 1812-"Difference Engine". 1833-"analytical Engine"
- 1890: first electro-mechanical punched card data processing machine by Hollerith
- 1905: Vacuum tube/Triode invented
- 1939: ABC (Atanosoff & Berry Computer)- first electronic digital computer
- 1941: first programmable computer- Z3(Zuse)
- 1943: Harvard MARK-1 by Aiken
- 1945: ENIAC
- 1945: stored program concept by John Von Neumann
- 1947: Transistor Invented
- 1949: EDSAC- world first stored program computer by Wilkes and Wheeler
- 1954: first silicon
- 1959: first IC
- 1964: IBM system based on ICs
- 1971: Intel 4004, first Microprocessor
- 1978: Intel 8086/8088 processor
- 1980: first VLSI chip

A computer is a machine that can be instructed to carry out sequences of arithmetic or logical operations automatically via computer programming. The internet is run on computers and it connects hundred of millions of other computers. The Antikythera mechanism is believed to be the earliest mechanical analog "computer", according to Derek J. de Solla Price. It was designed to calculate astronomical positions. It was discovered in 1901 in the Antikythera.

The slide rule was invented around 1620-1630, shortly after publication of logarithms. It is a hand operated computer for doing multiplication and division. Slide rules with special scales are still used for quick performance of routine calculations, such as the E6B circular slide rule used for time and distance calculations on light aircraft. In the 1770s, Pierre Jaquet-Droz, a Swiss watchmaker, built a mechanical doll (automaton) that could write holding a quill pen. By switching the number and order of its internal wheels different letters, and hence different messages, could be produced.

In effect, it could be mechanically "programmed" to read instructions. In 1831–1835, mathematician and engineer Giovanni Plana devised a Perpetual Calendar machine which could predict the perpetual calendar for every year from AD 0 (that is, 1 BC) to AD 4000, keeping track of leap years and varying day length. The tide-predicting machine invented by Sir William Thomson in 1872 was of great utility to navigation in shallow waters. It used a system of pulleys and wires to automatically calculate predicted tide levels for a set period at a particular location. In 1876, Lord Kelvin had already discussed the possible construction of such calculators, but he had been stymied by the limited output torque of the ball-and-disk integrators.

Charles Babbage, an English mechanical engineer and polymath, originated the concept of a programmable computer. Considered the "father of the computer", he conceptualized and invented the first mechanical computer in the early 19th century. The input of programs and data was to be provided to the machine via punched cards, a method being used at the time to direct mechanical looms such as the Jacquard loom. For output, the machine would have a printer, a curve plotter and a bell.

The machine would also be able to punch numbers onto cards to be read in later. The Engine incorporated an arithmetic logic unit, control flow in the form of conditional branching and loops, and integrated memory, making it the first design for a general-purpose computer.

B. Computer Generations

The main evolution of computer started from 16th century and resulted in the form that we see today. The present day computer, however, has also undergone rapid changes during the last fifty years. Actually computer technology advancement will be measured by computer generations. This period, during which the evolution of computer took place, can be divided into five distinct phases, basis of the type of switching circuits known as Generations of Computers [12].

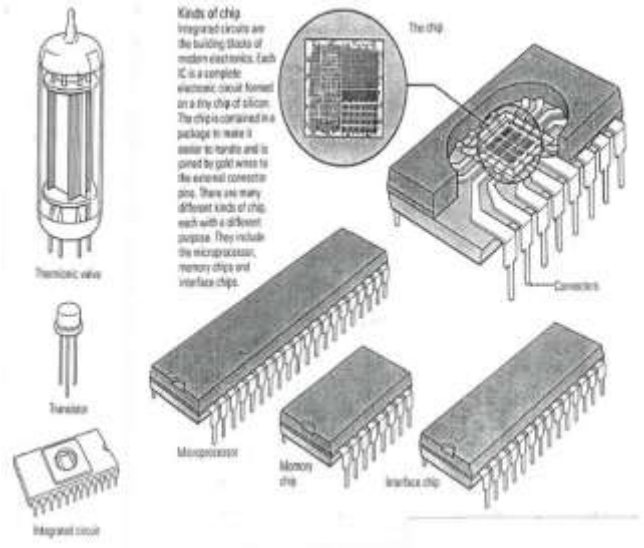

Fig. 11. Electonic devices used in various computer generations

First Generation Computers (1942-1955)

These computers were used vacuum tubes as major electronic component. The advantage of vacuum tubes technology is that it made the advent of Electronic digital computer. Vacuum tubes were only electronic devices available during those days which made computing possible. A vacuum tube was fragile glass device which use filaments as source of electronics and could control the electronic signals and also amplify electronic signals. These types of computers perform computations in milliseconds (10^{-3}). So, these computers used in scientific computations. The input method of these computers was a machine language known as the 1GL or the first generation language. The physical

methods of using punch cards, paper tape, and magnetic tape were used to enter data into these computers. First generation computers relied on machine language, the lowest-level programming language understood by computers, to perform operations, and they could only solve one problem at a time. It would take operators days or even weeks to set-up a new problem. Input was based on punched cards and paper tape, and output was displayed on printouts. Examples of the first generation computers include UNIVAC-Universal automatic Computer (The UNIVAC was the first general-commercial purpose computer delivered to a business client, the U.S. Census Bureau in 1951, invented by J. Prosper Eckert and John Mauchly makers of ENIAC.), ENIAC- Electonic Numerical Integrator and Computer invented by J.P. Eckert and J.W. Mauchly. It is the first successful electronic computer built during Second World War by U.S.) , EDVAC - Electronic discrete Variable Automatic computer), IBM-701 (International Business Machines), and IBM-650.

Second Generation Computers (1955-1964)

The second generation computers were used transistors instead of vacuum tubes. This made them far more compact than the first generation computers. Due to best properties of transistors these generation computers were more powerful, more reliable, less expensive, smaller in size, faster in operation, and cooler to operate than first generation computers. Around 1955 a device called Transistor replaced the bulky electric tubes in the first generation computer. It was made of germanium semiconductor materials rather than glass. John Bardeen, William Shockley, and Walter Houser Brattain invented transistor at bell laboratories in 1947. They shared Nobel Prize for this in 1956. Transistors are smaller than electric tubes and have higher operating speed. They have no filament and require no heating. Manufacturing cost was also very low. Thus the size of the computer got reduced considerably when compare to FG (First Generation) computers. High level programming languages like FORTRAN (Formulae Translation), COBOL (Common Business Oriented Language), ALGOL (algorithmic Language), and SNOBOL (StriNg Oriented and symbolic Language) were emerged in second generation.

Examples of the second generation computers include Honeywell 400, IBM 1620, IBM 7094, CDC 1604, CDC 3600, and UNIVAC 1108.

Third Generation Computers (1970's)

The third generation computers were introduced in 1964. These computers differed from the first and the second generations simply by the fact that a new circuit element like IC's (Integrated Circuits) was used. An integrated circuit is a small device that can contain thousands and thousands of devices like transistors, resistances and other circuit elements that make up a computer. Jack Kilby and Robert Noyce are credited with the invention of the Integrated Circuit or the IC chips. With the invention of IC's, it became possible to fit thousands of circuit elements into a small region and hence the size of the computers eventually became smaller and smaller. These ICs are popularly known as Chips. Computers of this generation were small in size, low cost, large memory and processing speed is very high. Instead of punched cards and printouts, users interacted with third generation computers through keyboards and monitors and interfaced with an operating system, which allowed the device to run many different applications at one time with a central program that monitored the memory. Computers for the first time became accessible to a mass audience because they were smaller and cheaper than their predecessors. Examples of the third generation computers include IBM-360 series, Honeywell-6000 series, PDP (Personal Data Processor) series, ICL 2900, TDC 316, and IBM-370/168.

Fourth Generation (1980's)

The present day computers that you see today are the fourth generation computers that started around 1975. It uses large scale Integrated Circuits (LSI) built on a single silicon chip called microprocessor. Due to the development of microprocessor it is possible to place computer's central processing unit on a single chip. These computers are called microcomputers.

Later very large scale Integrated Circuits (VLSI) replaced LSIs. Thus the computer which was occupying a very large room in earlier days can now be placed on a table. The personal computer (PC) that you see in your college is a Fourth Generation Computer. A GUI (Graphical User Interface) provides icons and menus to select particular operation.

Examples are IBM 4341, PUP 11, STAR 1000, CRAY-X-MP (Super Computer), DEC 10, PDP 11, CRAY-1.

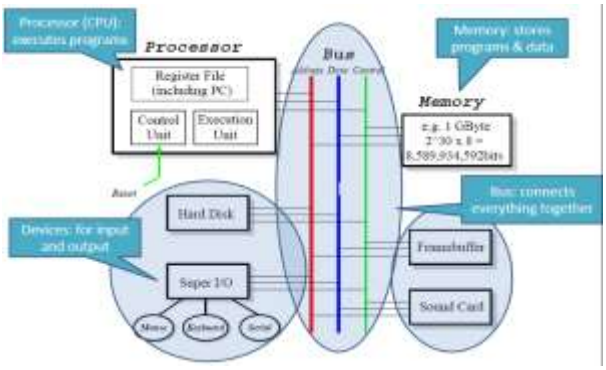

Fig. 12. A modern generalized computer system architecture

Fifth Generation (Late 1990's)

These computers use optic fiber technology to handle Artificial Intelligence, expert systems, robotics etc., these computers have high processing speeds and are more reliable. These are extremely reliable and employ the ULSI or the Ultra Large Scale Integration technology.

Examples include: Intel P 4, i 3 – i10 series computers, AMD (Advanced Micro Devices) Athlon.

III. METHODS

We know that computer is a machine that processes the data according to given set of instructions, process the data into information, and finally gives the output. In order to process the data we must have to give the instructions to a computer with the help of input devices. Then it can process the data into valuable information using processing devices. Finally it produces the desired output with help of output devices. After processing the data, information must be displayed on a monitoring device (monitor). Then we can take the print by printer through computer. The Computer mainly consists of

the functions input, process, output and storage. The Block diagram of a computer is [15], [16]:

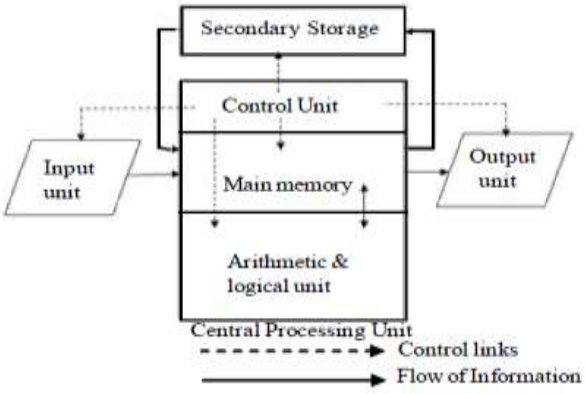

Fig. 13. Block diagram of a computer

All computer systems contain and perform following basic operations: Input unit, CPU (Control unit, Main Memory and ALU), Storage unit, and output unit.

A. Inputting

Input:

In computing, an **input device** is a piece of equipment used to provide data and control signals to an information processing system such as a computer or information appliance. Examples of **input devices** include keyboards, mouse, scanners, digital cameras, joysticks, and microphones. This is the process of entering data of programs into a computer. Therefore, the input unit takes data from us to the computer in an organized manner for processing through an input device such as keyboard, mouse, MICR, OCR, Etc. [17].

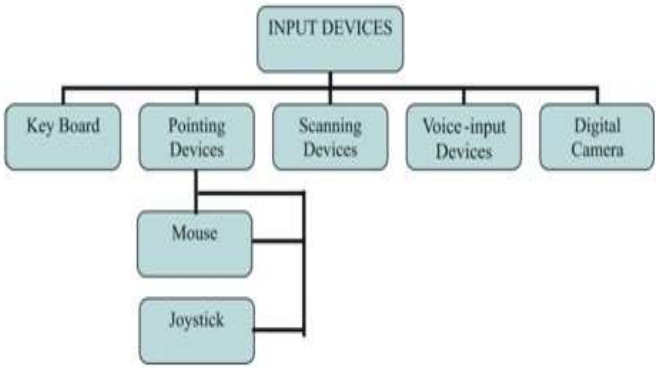

Fig. 14. Input devices

Examples: pointing devices (mouse, trackball, joystick, electronic pen, touch screen)

Scanning devices: image scanner, OCR, OMR, MICR, and a bar code reader)

Digitizer: it is a device which converts (digitizes) pictures, maps, and drawings into digital form for future usage. It consists of a digitizing tablet (graphic tablet) associated with a stylus.

B. Processing

CPU:

The CPU is the most important element of a computer system. The **CPU** is the brains of the computer where most calculations take place. CPU abbreviated for Central Processing Unit. Without it, we cannot imagine a computer. It is the heart and brain of the computer. Its function is to fetch, examine, and execute the instructions stored in the main memory of a computer. All type of processing is done in CPU only. Furthermore, it is divided into 3 parts: ALU, CU, and MU. The clock speed of a computer CPU will be measured in terms of Mega Hertz (MHz) or Million of cycles per second. Clock is another important component of CPU which measures and allocations a fixed time slot for processing each and every micro-operation (smallest functional operation). CPU speed also specified in terms of Million of instructions per Second (MIPS) or Million of FLOting Point Operations per second (MFLOPS) [18], [19].

Arithmetic Logical Unit (ALU): After you enter data through the input device it is stored in the primary storage. The mathematical calculations of the data are performed by Arithmetic Logical Unit. The major operations performed by the ALU are addition, subtraction, multiplication, division, logic and comparison. Data is transferred to ALU from storage unit when required. After processing the output is returned back to storage unit for further processing.

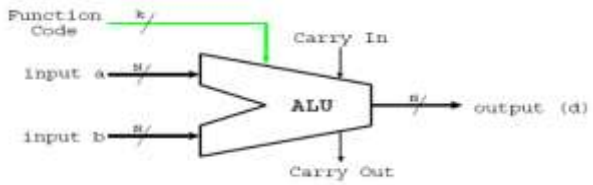

Fig. 15. N-bit ALU structure ina computer

Control Unit (CU): Control Unit, which acts like the supervisor seeing that things are done in proper fashion. Control Unit is responsible for co-coordinating various operations using time signals and also it controls the transfer of data instructions among other devices of a computer. The control unit determines the sequence in which computer programs and instructions are executed. Things like processing of programs stored in the main memory, interpretation of the instructions and issuing of signals for other units of the computer to execute them. It also acts as a switch board operator when several users access the computer simultaneously. So, this is called as nervous system of the computer.

Memory unit: Memory means storage of data and the program. In computer's memory both data and programs are stored in the binary form. The binary system has only two values 0 and 1. These are called bits. As human beings we all understand decimal system but the computer can only understand binary system. It is because a large number of integrated circuits inside the computer can be considered as switches, which can be made ON, or OFF. If a switch is ON it is considered 1 and if it is OFF it is 0. A number of switches in different states will give you a message like this: 110101.....10. So the computer takes input in the form of 0 and 1 and gives output in the same form, i.e., 0 and 1 only. Every number in binary system can be converted to decimal

system and vice versa; for example, decimal number 9 means 1001. Therefore, it is the computer that takes information or data in decimal form from you, converts it into binary form, processes it, producing output in binary form and finally again converts the output to decimal form. A fundamental unit of memory system is bit and acronym for it is binary digit, which stands for one binary piece of information. This can be either 0 or 1. Memory unit is made up of several small storage locations called cells. Each of these 8 cells can store a fixed number of bits called word length (byte). Each cell has a unique number assigned to it called the address of the cell and it is used to identify the cells. The address starts at 0 and goes up to (N-1).Byte is used to store one character such as (alphabets (a-z),digits (0-9) or special symbols +,-,$,% etc).You should know that the memory is like a large cabinet containing as many drawers as there are addresses of memory. Each drawer contains a word and the address is written on outside of the drawer.

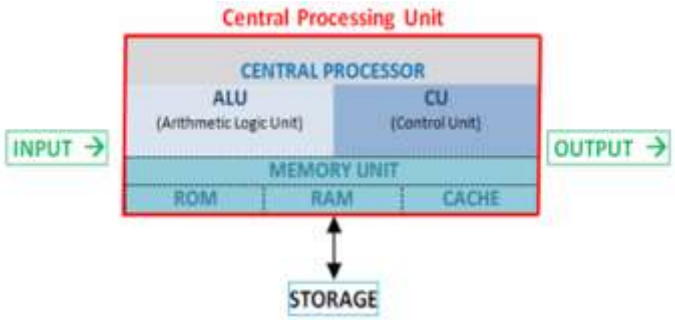

Fig. 16. Central processing unit

a. Arithmetic Logical Unit (ALU): After you enter data through the input device it is stored in the primary storage. The mathematical calculations of the data are performed by Arithmetic Logical Unit. The major operations performed by the ALU are addition, subtraction, multiplication, division, logic and comparison. Data is transferred to ALU from storage unit when required. After processing the output is returned back to storage unit for further processing.

b. Control Unit (CU): Control Unit, which acts like the supervisor seeing that things are done in proper fashion. Control Unit is responsible for co-coordinating various operations using time signal. The control unit determines the sequence in which computer programs and instructions are executed. Things like processing of programs stored in the main memory, interpretation of the instructions and issuing of signals for other units of the computer to execute them. It also acts as a switch board operator when several users access the computer simultaneously. This is also called as nervous system o the computer.

c. Memory unit: Memory means storage of data and the program. In computer's memory both data and programs are stored in the binary form. The binary system has only two values 0 and 1. These are called bits.

Memory sizes (Capacity):
The size of memory is termed in terms KB, MB, GB, TB, PB, etc.,
1 bit = 1 bit
4 bits = 1 nibble
1 Byte = 8 bits
1 Kilo Byte (KB) = 1024 Bytes(2^{10})
1 Mega Byte (MB) = 1024 KB
1 Giga Byte (GB) = 1024 MB
1 TeraByte (TB) = 1024 GB
1 PetaByte (PB) = 1024 TB
1 ExaByte (EB) = 1024 PB
1 ZettaByte (ZB) = 1024 EB
1 YottaByte (YB) = 1024 ZB
Suppose a memory card size is 2 GB means that it can store
2GB = 2 x 1024 MB
= 2 x 1024 x 1024 KB
= 2 x 1024 x 1024 x 1024 Bytes
= 2147483648 bytes
There are two kinds of computer memory: primary and secondary.

Memory Hierarchy
It is defined as the range of memory and storage devices within the computer system.

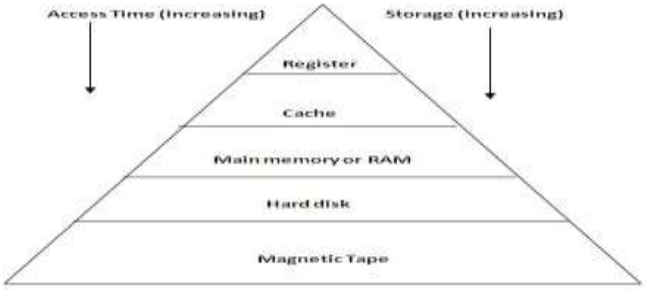

Fig. 17. Memory hierarchy of a computer

Computer memory hierarchy: Internal register, cache, RAM, hard disk (magnetic disks), magnetic tape. The first three hierarchies are volatile memories which mean when there is no power, and then automatically they lose their stored data. Whereas the last two hierarchies are not volatile which means they store the data permanently.

1) Internal register: Internal register in a CPU is used for holding variables and temporary results. Internal registers have a very small storage; however they can be accessed instantly. Accessing data from the internal register is the fastest way to access memory.

2) Cache: Cache is used by the CPU for memory which is being accessed over and over again. Instead of pulling it every time from the main memory, it is put in cache for fast access. It is also a smaller memory, however, larger than internal register.

Cache memory
Cache memory can also be found in the processor, however rarely it may be another IC (integrated circuit) which is separated into levels. The cache holds the chunk of data which are frequently used from main memory. When the processor has a single core then it will have two (or) more cache levels rarely. Present multi-core processors will be having three, 2-levels for each one core, and one level is shared.

Cache is further classified to L1, L2 and L3:

a) L1 cache: It is accessed without any delay.

b) L2 cache: It takes more clock cycles to access than L1 cache.

c) L3 cache: It takes more clock cycles to access than L2 cache.

3) Main memory or RAM (Random Access Memory): It is a type of the computer memory and is a hardware component. It can be increased provided the operating system can handle it. Typical PCs these days use 8 GB of RAM. It is accessed slowly as compared to cache. The main memory in the computer is nothing but, the memory unit in the CPU that communicates directly. It is the main storage unit of the computer. This memory is fast as well as large memory used for storing the data throughout the operations of the computer. This memory is made up of RAM as well as ROM.

4) Hard disk: A hard disk is a hardware component in a computer. Data is kept permanently in this memory. Memory from hard disk is not directly accessed by the CPU, hence it is slower. As compared with RAM, hard disk is cheaper per bit.

5) Magnetic tape: Magnetic tape memory is usually used for backing up large data. When the system needs to access a tape, it is first mounted to access the data. The memory access time is slower in magnetic tape and it usually takes few minutes to access a tape.

C. Outputting

This is the process of producing results from the data for getting useful information n th form of either soft copy or hard copy. Similarly the output produced by the computer after processing must also be kept somewhere inside the computer before being given to you in human readable form through the screen or printer. Again the output is also stored inside the computer for further processing [20].

Examples: monitors (CRT, LCD, LD), printers (dot matrix printers, inkjet printers, laser printers, drum printers, plotters)

D. Compiling, Assembling, linking

The definition of compiling is converting the code from the high level language to machine level language. Means, human understandable form to computer understandable form (machine code). The compiler is the most complex step of process for a number of reasons. The compiler is only interested the actual code, however humans need things like comments and whitespace (spaces, tabs, indents, etc) to understand code. Compiling allows the computer to run and understand the program without the need of the programming software used to create it. The first **compiler** was developed by Grace Hopper while working on the Harvard Mark I computer. Today, most high-level languages will include their own compiler or have toolkits available that can be used to compile the program. Two popular compilers are Eclipse for Java and gcc command for C and C++. Depending on how big the program is, it should take a few seconds or minutes to compile. If no errors are encountered while being compiled, an executable file is created [21], [22].

The **compile time** is the total time it takes a compiler to compile code into a program that can be run by the computer. The process that the compiler takes to convert the human-written source code to its internal representation is called parsing. With C code, there is actually a step before parsing the source code called the pre-processor. The pre-processor is at its core a text replacement program. For example, any variable declared as #define variable text will have variable replaced with text. This preprocessed code is then passed into the compiler. Compiler strictly follows its syntax. Compiling a C program is a multi-stage process. At an overview level, the process can be split into four separate stages:

- Preprocessing,
- compilation,
- assemble, and
- linking.

Preprocessing

The first stage of compilation is called preprocessing. In this stage, lines starting with a # character are interpreted by the *preprocessor* as *preprocessor commands*. These commands form a simple macro language with its own syntax and semantics. This language is used to reduce repetition in source code by providing functionality to inline files, define macros, and to conditionally omit code.

Compilation: -The second stage of compilation is confusingly enough called compilation. In this stage, the preprocessed code is translated to assembly instructions specific to the target processor architecture. These form an intermediate human readable language. The existence of this step allows for C code to contain inline assembly instructions and for different assemblers to be used. Compilation is a process in which a program written in one language gets translated into another targeted language. If there are some errors, the compiler will detect them and report it.

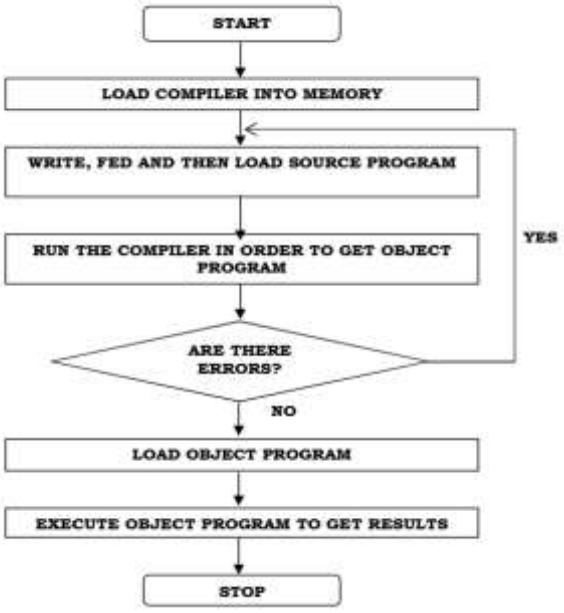

Fig. 18. Scemantic diagram of compiling process

Assembling: -During this stage, an assembler is used to translate the assembly instructions to object code. The output consists of actual instructions to be run by the target processor. Assemble code gets translated into machine code. You can call assembler a special type of complier.

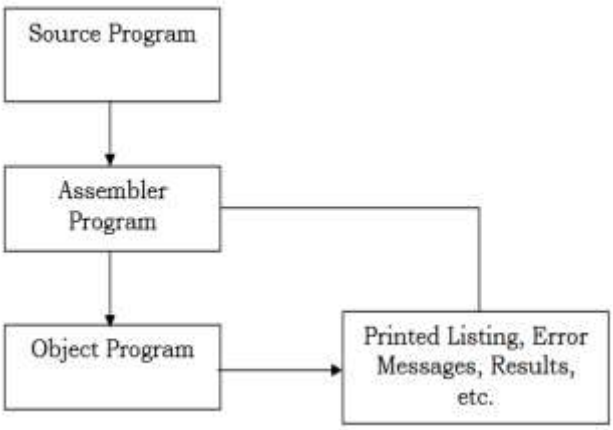

Fig. 19. Schemantic diagram of a assembler

Linking:-The object code generated in the assembly stage is composed of machine instructions that the processor understands but some pieces of the program are out of order or missing. To produce an executable program, the existing pieces have to be rearranged and the missing ones filled in. This process is called linking. If this piece of code needs some other source file to be linked, linker links them to make it an executable file. The result of this stage is the final executable program.

E. Optimization

This unit is independent of the CPU, i.e., there are two types of optimization. In **computing**, **optimization** is the process of modifying a system to make some features of it work more efficiently or use fewer resources. ... The optimized system may be a single **computer** program, a collection of **computers** or even an entire network such as the Internet [23].

1. Pre-optimization (CPU independent)
2. Post-optimization (CPU dependent)

This unit optimizes the code in following forms:

- Dead code elimination
- Sub code elimination
- Loop optimization

F. Interpreter

An interpreter is another type of program translator used for translating higher level language into machine language. It takes one statement of higher level languages at a time, translate it into machine language and immediately execute it. Translation and execution are carried out for each statement. It differs from compiler, which translate the entire source program into machine code and does involve in its execution [24].

The advantage of interpreter compared to compiler is its fast response to changes in source program. It eliminates the need for a separate compilation after changes to each program. Interpreters are easy to write and do not require large memory in computer. The disadvantage of interpreter is that it is time consuming method because each time a statement in a program is executed then it is first translated. Thus compiled machine language program runs much faster than an interpreted program.

An interpreter generally uses one of the following strategies for program execution: Examples of interpreted languages are Perl, Python and Matlab. High level languages may also be translated using interpreters. Using a compiler, the whole program is translated completely and then the resulting machine language version is executed. Whereas using an interpreter, each instruction is translated and executed. In other words, the interpreter takes one source program instruction, translates it into object code and executes it, then takes the next instruction, translates it, and so on. Use of an interpreter can save core space since the interpreter program itself is quite small in size. It also eliminates the need to store the program's translated object code in the computer. Interpreters are convenient and easy to use because they are totally interactive. The user can sit in front of the terminal and converse with the computer in order to solve his problems directly through the interpreter. That is, the program is corrected, re-compiled, and executed. Whereas using an interpreter, changes and additions can be made interactively

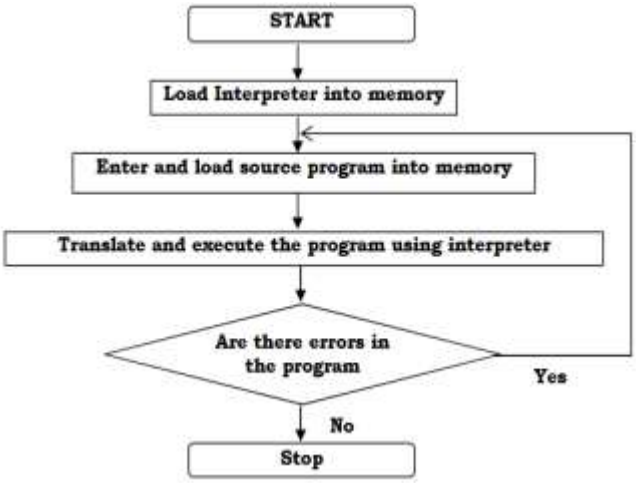

Fig. 20. Procedure of interpreter in a computer

G. Number System in Computers

A number system defines how a number can be represented using distinct symbols. A number system in computer ideology is regarded as the method or system of numbering and representing of digits in the computer 'inner' system. In other words, it is a technique used in representing numbers in the computer system architecture. The digital computer represents all kinds of data and information in binary numbers. This implies every value/number that you are saving or feeding into/fetching from the computer system memory has a defined number system. The value/data feed in/fetch from can includes but not limited to: audio, graphics, video, text file, numbers etc. The total number of digits used in a number system is called its base or radix. The base is written after the number as subscript [25].

Computer architecture supports following number systems:

1) Binary number system (Base 2),

2) Octal number system (Base 8),

3) Decimal number system (Base 10), and

4) Hexadecimal number system (base 16)

1) Binary Number System A Binary number system has only two digits, which are 0 and 1. Every number (value) is represented with 0 and 1 in this number system. The base of binary number system is 2, because it has only two digits. The word binary derived from Latin word bini (double). Though decimal (No 3) is more frequently used in number representation, binary is the number system form which the system/machine accepts.

2) Octal number system octal number system has only eight (8) digits from 0 to 7. Every number (value) is represented with 0,1,2,3,4,5,6 and 7 in this number system. The base of octal number system is 8, because it has only 8 digits.

3) Decimal number system Decimal number system has only ten (10) digits from 0 to 9. Every number (value) is represented with 0,1,2,3,4,5,6, 7, 8 and 9 in this number system. The base of decimal number system is 10, because it has only 10 digits.

4) Hexadecimal number system A Hexadecimal number system has sixteen (16) alphanumeric values from 0 to 9 and A to F. Every number (value) represents with 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E and F in this number system. The base of hexadecimal number system is 16, because it has 16 alphanumeric values. Here, we have 0 to 9, representing 0 – 9 but from 10, we have A is 10, B is 11, C is 12, D is 13, E is 14 and F is 15.

H. Developing a program

Program development - Computer Definition May refer to the coding of an individual software program or to the creation on an entire information system and all related software. See programming and system development life cycle [26], [27].

A program development process consists of various steps that are followed to develop a computer program. These steps are followed in a sequence in order to develop a successful and beneficial computer program. Following is the brief description about program development process.

Program Development Process

A programmer has to go through the following stages to develop a computer program:

1. **Defining and Analyzing The Problem**
2. **Designing The Algorithm**
3. **Coding or Writing The Program**
4. **Test Execution**
5. **Debugging**
6. **Final Documentation**

Step by step details of the program development process follows:

I. Software development

Software development is the process of conceiving, specifying, designing, programming, documenting, testing, and bug fixing involved in creating and maintaining applications, frameworks, or other software components. Software development is a process of writing and maintaining the source code in a structured way. Therefore, software development may include research, new development, prototyping, modification, reuse, re-engineering, maintenance, or any other activities that result in software products. A software development process (also known as a software development methodology, model, or life cycle) is a framework that is used to structure, plan, and control the process of developing information systems [28], [29].

A wide variety of such frameworks has evolved over the years, each with its own recognized strengths and weaknesses. There are several different approaches to software development: some take a more structured, engineering-based approach to develop business solutions, whereas others may take a more incremental approach, where software evolves as it is developed piece-by-piece.

One system development methodology is not necessarily suitable for use by all projects. Each of the available methodologies is best suited to specific kinds of projects, based on various technical, organizational, project and team considerations. Most methodologies share some combination of the following stages of software development:

- Analyzing the problem
- Market research
- Gathering requirements for the proposed business solution
- Devising a plan or design for the software-based solution
- Implementation (coding) of the software
- Testing the software
- Deployment
- Maintenance and bug fixing

These stages are often referred to collectively as the software development life-cycle, or SDLC. Different approaches to software development may carry out these stages in different orders, or devote more or less time to different stages. The level of detail of the documentation produced at each stage of software development may also vary. These stages may also be carried out in turn (a “waterfall” based approach), or they may be repeated over various cycles or iterations (a more "extreme" approach). The more extreme approach usually involves less time spent on planning and documentation, and more time spent on coding and development of automated tests. More “extreme” approaches also promote continuous testing throughout the development life-cycle, as well as having a working (or bug-free) product at all times. More structured or “waterfall” based approaches attempt to assess the majority of risks and develop a detailed plan for the software before implementation (coding) begins, and avoid significant design changes and re-coding in later stages of the software development life-cycle planning. There are significant advantages and disadvantages to the various methodologies, and the best approach to solving a problem using software will often depend on the type of problem. If the problem is well understood and a solution can be effectively planned out

ahead of time, the more "waterfall" based approach may work the best. If, on the other hand, the problem is unique (at least to the development team) and the structure of the software solution cannot be easily envisioned, then a more "extreme" incremental approach may work best.

J. Algorithms

Definition:-The sequence of steps to perform in order to solve a problem is known as an algorithm. In other words, an algorithm is a finite sequence of steps expressed for solving a problem [30], [31].

Algorithms are used for calculations, data processing, and many other fields. In computer computing, algorithms are essential because they serve as the systematic procedures that computers require. Using the wrong algorithm or one that is not clearly defined is like trying to cut a piece of plywood with a pair of scissors: although the job may get done, you have to wonder how effective you were in completing it. Let us follow an example to help us understand the concept of algorithm in a better way. Let's say that you have a friend arriving at the railway station, and your friend needs to get from the railway station to your house. Here are three different ways (algorithms) that you might give your friend for getting to your home. Problems that would be difficult to solve in entirety can be approached as a series of small, solvable sub-problems [5].

1. The taxi/auto-rickshaw algorithm:
Go to the taxi/auto-rickshaw stand.
Get in a taxi/auto-rickshaw.
Give the driver my address.
2. The call-me algorithm:
When your train arrives, call my mobile phone
Meet me outside the railway station.
3. The bus algorithm:
Outside the railway station, catch bus.
Get off near house.
Walk two blocks west to my house.

All these three algorithms accomplish the same goal, but each algorithm does it in a different way. Each algorithm also has a different cost and a different travel time. Taking a taxi/auto-rickshaw, for example, is the fastest way, but also the most expensive. Taking the bus is definitely less expensive, but a whole lot slower. You choose the algorithm based on the circumstances. In computer programming, there are often many different algorithms to accomplish any given task. Each algorithm has advantages and disadvantages in different situations.

Algorithm strategies

There are a number of well-known algorithm strategies:

Recursive algorithm
A combinatorial problem: Fibonacci numbers

Backtracking algorithms
The method is used for state-space search problems such as space search problems. The solving process solution is based on the construction of a **state-space tree**, whose nodes represent states, the root represents the initial state, and one or more leaves are goal states. Each edge is labeled with some operator.

Branch and bound algorithms
Branch and bound is used when we can evaluate each node using the cost and utility functions. At each step we choose the best node to proceed further. Branch-and bound algorithms are implemented using a priority queue. The state-space tree is built in a breadth-first manner.

Example: the 8-puzzle problem.

Divide and conquer algorithms
These are methods of designing algorithms that (informally) proceed as follows:
Given an instance of the problem to be solved, split this into several smaller sub-instances (*of the same problem*), independently solve each of the sub-instances and then combine the sub-instance solutions so as to yield a solution for the original instance. With the divide-and-conquer method the size of the problem instance is reduced by a factor (e.g. half the input size), while with the decrease-and-conquer method the size is reduced by a constant.

Examples of divide-and-conquer algorithms: Computing a^n ($a > 0$, n a nonnegative integer) by recursion, Binary search in a sorted array (recursion), Merge sort algorithm, Quick sort algorithm (recursion), The algorithm for solving the fake coin problem (recursion)

Dynamic programming algorithms
The idea behind *dynamic programming* is to avoid this pathology by obviating the requirement to calculate the same quantity twice. The method usually accomplishes this by maintaining a *table of sub-instance results*. Dynamic Programming is a Bottom-Up Technique in which the smallest sub-instances are *explicitly* solved first and the results of these used to construct solutions to progressively larger sub-instances. In contrast, Divide-and-Conquer is a Top-Down Technique which *logically* progresses from the initial instance down to the smallest sub-instance via intermediate sub-instances. Examples: Fibonacci numbers computed by iteration, Warshall's algorithm implemented by iterations

Divide-and-conquer Algorithms:
Divide-and-conquer algorithms revolve around 3 steps: divide, conquer, and combine. In the divide step, we divide the data into smaller, more manageable pieces. In the conquer step, we process each division by performing some operations on it. In the combine step, were combine the processed divisions. An example of the divide-and conquer algorithm is merge sort.

Greedy algorithms
The solution is constructed through a sequence of steps, each expanding a partially constructed solution obtained so far. At each step the choice must be locally optimal. This is the central point of this technique. Examples: Minimal spanning tree.

Brute force algorithms
Brute force is a straightforward approach to solve a problem based on the problem's statement and definitions of the concepts involved. It is considered as one of the easiest approach to apply and is useful for solving small – size instances of a problem.

Some examples of brute force algorithms are:

Computing a^n (a > 0, *n* a nonnegative integer) by multiplying
Bubble sort
Sequential search
Exhaustive search: Traveling Salesman Problem, Knapsack problem.

Heuristic algorithms

A heuristic is a mental short cut or "rule of thumb" that gives some guidance on how to do a task, but it does not guarantee solutions consistently. They often reflect some form if inductive reasoning. Heuristics can be very effective, but they can lead to completely incorrect conclusions, as well. Hitting a machine, like a computer, to make the screen work may reconnect a loose connection. But it works only when something like a loose connection is causing the problem, and it can damage the equipment. The following paragraphs describe several heuristics and some problems resulting from their uncritical use.

General Approaches in Algorithm Design:

In a broad sense, many algorithms approach problems in the same way. Thus, it is often convenient to classify them based on the approach they employ. One reason to classify algorithms is to gain an insight about an algorithm and understand its general approach. This can also give us ideas about how to look at similar problems for which we do not know algorithms. Of course, some algorithms defy classification, whereas others are based on a combination of approaches. This section presents some common approaches.

Randomized Algorithms:

Randomized algorithms rely on the statistical properties of random numbers. One example of a randomized algorithm is quick sort. Imagine an unsorted pile of cancelled checks by hand. In order to sort this pile we place the checks numbered less than or equal to what we may think is the median value in one pile, and in the other pile we place the checks numbered greater than this. Once we have the two piles, we divide each of them in the same manner and repeat the process until we end up with one check in every pile. At this point the checks are sorted.

Approximation Algorithms:

Approximation algorithms are algorithms that do not compute optimal solutions; instead, they compute solutions that are "good enough". Often we use approximation algorithms to solve problems that are computationally expensive but are too significant to give up altogether. The travelling salesman problem is one example of a problem usually solved using an approximation algorithm.

IV. CONCLUSION

Information and Communication Technology (ICT) has today become integral part of all domains as well as fields of academic and research. Here, we discuss major components, types of a computer. Also MU thoroughly explained with algorithms concept. Besides, history of computers described along with generations.

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