Unit 1 Introduction

History of Computing and Computers

Evolution of computer is a study of past development of computer i.e. it is meant by the gradual improvements of accuracy, speed and efficiency of computers through generations, whereas generations of computers may be defined as the development of computer in an average period of time in which old computer technology may be replaced by newer technology.

Ancient people lived on the earth for centuries without counting. Then, they started to count their ten figures. It becomes so difficult to live and to remember anything. These phenomena were gradually replaced by the use of stones, counting notches on sticks or marks on walls. The different generations are described below which has helped the humans for keeping records with the passing of time.

The Mechanical Era (Zeroth generation)

The calculator of this age was developed by using mechanical components like wood, metal, stone, bone, etc. It was used for simple mathematical calculations. Some of the popular calculations used in this age are:

Abacus

In ancient period, it was used to calculate mathematical calculation. It was used for performing simple calculation like counting, addition, subtraction and multiplication of number. An abacus consists of a rectangular frame carrying a number of wooden rods. Mid-bar divides each of these rods in top unequal -upper and lower parts.

The upper part is called heaven, whereas lower part is called earth. The heaven consists of two beads, whereas the earth part consists of five beads to each rod. The value of bead on heaven part is five and earth is one. Each abacus consists of nine or eleven or thirteen rods.

John Napier (1550-1617 AD)

THE SCOTTISH mathematician John Napier first published the table of logarithms in 1614 AD. It was very used and consists of a large number of calculations. He invented bone rods and used bones to demonstrate by subtracting and multiplication by addition according to his principle. These are made of strips of bones on which numbers were carved and painted that`s why it is also called Napier's bone.

William Oughtred

It is a rectangular device-slide-rule. It was a calculating device based on the principle of a log. A rule consists of two graduated scales, one of which slips upon other. It is devised in such a way that suitable alignment of one scale against the other makes it possible to find products and quotient of any numbers.

Blaise Pascal (1623-1662AD)

The man name Blaise Pascal, was a brilliant mathematician and religious thinker. Pascal made a mercury barometer and measured atmospheric pressure to assist his father in his work accounting. Pascal invented the first mechanical calculation machine in Paris.

Baron Gottfried Wilhelm Von Leibniz (1646-1716AD)

He develops a new method of calculation called 'Calculus'. He modified the masculine machine and invented a first calculator, Stepped Reckoner, which was able to perform automatic addition, subtraction, multiplication, division, but could find out square root. Each with nine teeth of varying lengths instead of wheels it was called 'Leibniz Calculator' or 'Stepped Reckoner'.

Charles Babbage (1791-1871 AD)

The English Professor and Mathematician, Charles Babbage, invented the Different Engine at Cambridge University, in 1822 AD. This machine can solve differential equations and calculate various mathematical functions. It is also called "Analytical Engine ".

Lady Augusta Ada Byron Lovelace (1515-1852 AD)

The English intelligent and independent-minded woman, Lady Augusta, was a daughter of English poet Lord Byron and a very Great follower, assistant of Charles Babbage. Lady documents Babbage`s work and writes programs for Babbage.

This plan is now regarded as the first computer program. That`s why, she was considered the first computer programmer and a software language developed by the US Defense Department, was named Ada in her honor.

Herman Hollerith (1860-1929 AD)

An American Inventor, Herman Hollerith, also applied the Jacquard loom concept in computing and applies for patents for an automatic punch-card tabulating machine. He invented a machine knows as “Tabulating Machine ". This device

could process on the punch cards and perform census calculating faster than ever before.

John Von Neumann (1903-1975 AD)
The Hungarian Mathematician, John gave an idea of stored program computer in the sense that program is stored internally in the main memory of the computer along with its associated data, in 1945. So, he is called the "Father of Stored Program".

Before that, program required for the computer were integrated and written permanently in chips. So, modification of program was not possible. But, after Neumann, such programs were stored on a computer in some storage media, so modification was easy and flexible.

The Electro-Mechanical Era
The calculator of this age was developed by using mechanical and electronic component vacuum tube. Successful general purpose mechanical computers were built, in the 1930s. Konrad Zuse developed mechanical computer, the Z1, in 1983 in Germany.

The Mark I Computer (1937 - 1944)
A Professor of Physics, Howard H. Aiken designed a general purpose mechanical computer at Harvard University and IBM Automatic Sequence Controlled Calculator (IBM ASCC). It was the first fully automatic calculating machine and later as Harvard Mark I.

It used binary numbers for its operation. Later, Mark II was invented by Aiken and his colleagues that were working electromechanical relays for its operation. Mark II used 19000 valves.

The Mark II Computer
It used about 18 thousand vacuum tubes as the main memory device with 7 lakes 50 thousand parts. It is 51 feet long, 8 feet height and 3 feet wide as bulky in size. It was capable of performing five basic arithmetic operations; additions, subtraction, multiplication, division and table reference. The result was printed at the rate of one result per five seconds.

The Atanasoff-Berry Computer (1939 - 1942)

In 1939, John Vincent Atanasoff and Clifford Berry designed Atanasoff-Berry computer or ABC solving systems of mathematical simultaneous equation. It used 18000 valves and other 45 valves for internal logic and capacitors for storage.

It used punch cards as input and output operation i.e. secondary. It is considered as the first computing machine which introduced the idea of binary arithmetic, regenerative memory and logic circuits.

The Colossus (1941 - 1944)

In 1944, Colossus computer is designed by Alan M. Turing and build by British mathematician Alan Mathison Neuman, Alan with some colleagues, creates a computer named colossus at the University of Manchester, England, which comprised 1800 vacuum tubes.

It was one of the world's earliest working programmable electronic digital computers. Colossus was a special purpose machine that suited a narrow range of tax (for example, it was capable of performing decimal multiplication).

The Electronic Computer Era

The computers of this age are developed by using electronic components like a vacuum tube, transistors IC, VLSI, etc. These computers are smaller, faster and more reliable.

The ENIAC(1943-1946)

In 1946, John W. Mauchly and J.presper Eckert constructed ENIAC (Electronic Numerical Integrated and Calculator), at the Moore School of Engineering of the University of Pennsylvania. USA ENIAC was the first popular general purpose all electronic digital computers. John Von Neumann was the consultant of the ENIAC project.

It was a very large machine weighing about 30 tons and containing about 17,468 vacuum tubes, 70,000 resistors, 5 million soldered joints and it consumed 160 kilowatts.

The EDVAC (1946 1952)

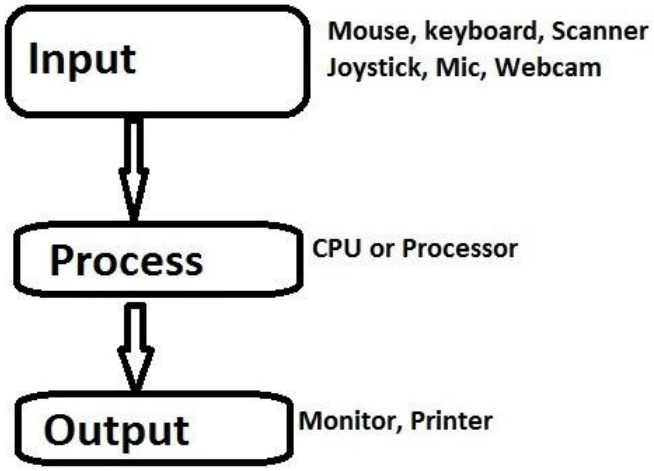
EDVAC (Electronic Discrete Variable Automatic Computer) was developed by Dr.John Von Neumann, and a member of the Moore School of Engineering of the Unversity of Pennslyvania, J.P Eckert, and J.W Mauchly. The EDVAC is used for more school personnel and the Ballistics Research Laboratory of the US Army, which was based on Jhon Von Neumann`s ideas of “Stored Program".

The UNIVAC (1951)
UNIVAC (Universal Automatic Computer) was developed by J.P.Eckert and J. Mauchly in 1951. It was the first computer manufactured for commercial use and general purpose digital computer. It was designed to handle both numeric and textual information. Before this, all the computers were either used for defense or census was by General Electrical Corporation in 1954.

Block Diagram of Computer

The word "computer "comes from the word "compute "which means to calculate. So a computer is normally considered to be a calculating device that performs arithmetic operations at enormous speed. A computer is an electronic device which is used to perform operation on raw data as per instruction given by user. They are

1) It accepts data or instructions through input.
2) It stores data.
3) It can process required data by the user.
4) It gives results as production, and
5) It controls all functions inside the computer.



Various Components of Computer
Computer is an electronic device which performs tasks given by user with extremely fast speed and accuracy. Like any other device or machine, a computer system has also a number of parts. A computer system can be blocked into mainly three parts:

1. Input Unit
2. Central Processing Unit

3. Output Unit

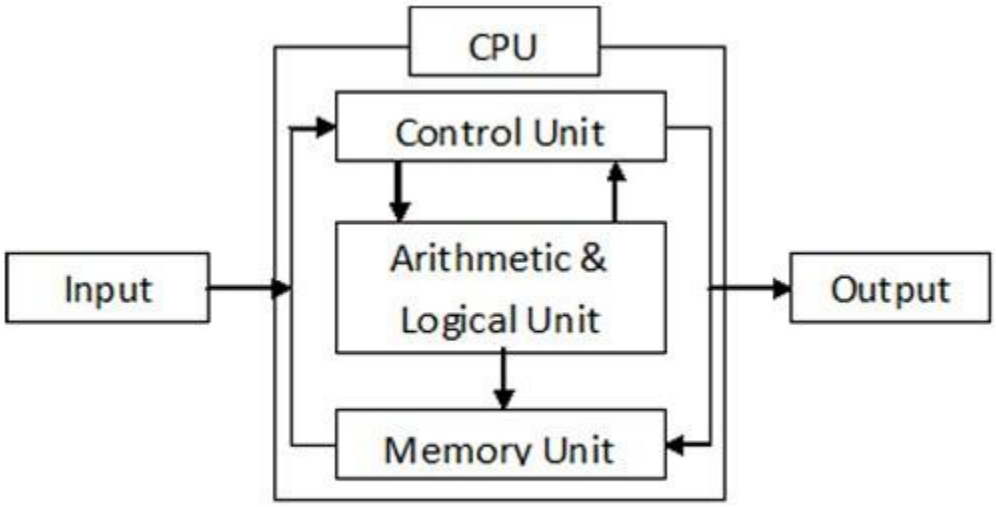


Fig. Block Diagram of Computer

1. Input unit – Input unit is a unit that accepts any input device. The input device is used to input data into the computer system.

Function of input unit:

1. It converts inputted data into binary codes.
2. It sends data to main memory of computer.

2. Central Processing Unit (CUP) – CPU is called the brain of a computer. An electronic circuitry that carries out the instruction given by a computer program. CPU can be sub classified into three parts.

i .Control unit (CU)

ii. Arithmetic & Logic unit (ALU)

iii. Memory Unit (MU)

i. Control unit (CU) - the control unit manages the various components of the computer. It reads instructions from memory and interpretation and changes in a series of signals to activate other parts of the computer. It controls and co-ordinate is input output memory and all other units.

ii. Arithmetic & Logic unit (ALU) – The arithmetic logic unit (ALU), which performs simple arithmetic operation such as +,-, *, / and logical operation such as >, <, =<, <= etc.

iii. Memory Unit (MU) - Memory is used to store data and instructions before and after processing. Memory is also called Primary memory or internal memory. It is

used to store data temporary or permanently.

Function of CPU

1. It controls all the parts and software and data flow of computer.
2. It performs all operations.
3. It accepts data from input device.
4. It sends information to output device.
5. Executing programs stored in memory
6. It stores data either temporarily or permanent basis.
7. It performs arithmetical and logical operations.

3. Output Unit –Output unit is a unit that constituents a number of output device. An output device is used to show the result of processing.

Function of Output unit:

1. it accepts data or information sends from main memory of computer
2. It converts binary coded information into HLL or inputted languages.

Generation of Computer:

Generation in computer terminology is a change in technology a computer is/was being used. Each generation of computer is characterized by a major technological development that fundamentally changed the way computers operate, resulting in increasingly smaller, cheaper, and more powerful and more efficient and reliable devices. The various generations of computers are listed below:

1. **First Generation**

The period of first generation was from 1946-1959. The computers of first generation used vacuum tubes as the basic components for memory and circuitry for CPU (Central Processing Unit). These tubes, like electric bulbs, produced a lot of heat and the installations used to fuse frequently. Therefore, they were very expensive and only large organizations were able to afford it.

In this generation, mainly batch processing operating system was used. Punch cards, paper tape, and magnetic tape were used as input and output devices. The computers in this generation used machine code as the programming language.

The main features of the first generation are −

- Vacuum tube technology
- Unreliable
- Supported machine language only
- Very costly
- Generated a lot of heat
- Slow input and output devices
- Huge size
- Need of AC
- Non-portable
- Consumed a lot of electricity

Some computers of this generation were −

- ENIAC
- EDVAC
- UNIVAC
- IBM-701
- IBM-650

2. Second Generation

The period of second generation was from 1959-1965. In this generation, transistors were used that were cheaper, consumed less power, more compact in size, more reliable and faster than the first generation machines made of vacuum tubes. In this generation, magnetic cores were used as the primary memory and magnetic tape and magnetic disks as secondary storage devices.

In this generation, assembly language and high-level programming languages like FORTRAN, COBOL was used. The computers used batch processing and multiprogramming operating system.

The main features of second generation are −

- Use of transistors
- Reliable in comparison to first generation computers
- Smaller size as compared to first generation computers
- Generated less heat as compared to first generation computers
- Consumed less electricity as compared to first generation computers
- Faster than first generation computers
- Still very costly
- AC required
- Supported machine and assembly languages

Some computers of this generation were −

- IBM 1620
- IBM 7094
- CDC 1604
- CDC 3600
- UNIVAC 1108

3. Third Generation

The period of third generation was from 1965-1971. The computers of third generation used Integrated Circuits (ICs) in place of transistors. A single IC has many transistors, resistors, and capacitors along with the associated circuitry.
The IC was invented by Jack Kilby. This development made computers smaller in size, reliable, and efficient. In this generation remote processing, time-sharing, multiprogramming operating system was used. High-level languages (FORTRAN-II TO IV, COBOL, PASCAL PL/1, BASIC, ALGOL-68 etc.) were used during this generation.

The main features of third generation are −

- IC used
- More reliable in comparison to previous two generations
- Smaller size
- Generated less heat
- Faster
- Lesser maintenance
- Costly
- AC required
- Consumed lesser electricity
- Supported high-level language
-

Some computers of this generation were −

- IBM-360 series
- Honeywell-6000 series
- PDP (Personal Data Processor)
- IBM-370/168
- TDC-316

4. Fourth Generation

The period of fourth generation was from 1971-1980. Computers of fourth generation used Very Large Scale Integrated (VLSI) circuits. VLSI circuits having

about 5000 transistors and other circuit elements with their associated circuits on a single chip made it possible to have microcomputers of fourth generation.
Fourth generation computers became more powerful, compact, reliable, and affordable. As a result, it gave rise to Personal Computer (PC) revolution.

In this generation, time sharing, real time networks, distributed operating system were used. All the high-level languages like C, C++, DBASE etc., were used in this generation.

The main features of fourth generation are −

- VLSI technology used
- Very cheap
- Portable and reliable
- Use of PCs
- Very small size
- Pipeline processing
- No AC required
- Concept of internet was introduced
- Great developments in the fields of networks
- Computers became easily available

Some computers of this generation were −

- DEC 10
- STAR 1000
- PDP 11
- CRAY-1(Super Computer)
- CRAY-X-MP(Super Computer)

5. Fifth Generation

The period of fifth generation is 1980-till date. In the fifth generation, VLSI technology became ULSI (Ultra Large Scale Integration) technology, resulting in the production of microprocessor chips having ten million electronic components.

This generation is based on parallel processing hardware and AI (Artificial Intelligence) software. AI is an emerging branch in computer science, which interprets the means and method of making computers think like human beings. All the high-level languages like C and C++, Java, .Net etc., are used in this generation.

AI includes −

- Robotics
- Neural Networks
- Game Playing
- Development of expert systems to make decisions in real-life situations
- Natural language understanding and generation

The main features of fifth generation are −

- ULSI technology
- Development of true artificial intelligence
- Development of Natural language processing
- Advancement in Parallel Processing
- Advancement in Superconductor technology
- More user-friendly interfaces with multimedia features
- Availability of very powerful and compact computers at cheaper rates

Some computer types of this generation are −

- Desktop
- Laptop
- NoteBook
- UltraBook
- ChromeBook

Types of Computer:

1. On the basis of working principle

   There are three types of computer and they are:

a) Analog computer

- The computers which performs the functions on continuously variation in inputs which can be in form of fluctuation in voltage or temperature, electrical or mechanical parts are called analog computer
- The computers are used to measure the electrical signal, current, frequency of signal and voltage, resistance of capacitor, etc
- It has low memory and slow speed
- It is less reliable and used for special purpose.
- Example: Plesley

b) Digital computer

- The computers which present physical quantities with the help of symbols or numbers and provide us discrete information are called digital computer
- Accuracy rate of such computes is very high as compared to analog computer.
- It has very large storage capacity with high speed
- It is more reliable and used for general purpose
- Example: personal computers, laptops, smart phone etc.

c) Hybrid computer

- The computer that exhibit features of both analog and digital computers are called hybrid computer.
- It is a digital computer that accepts analog signal, converts them to digital and processes them in digital form.
- It has the speed of analog and accuracy of digital computer.
- Generally used in scientific application or in controlling industrial processes, hospitals to measure the heartbeat of the patients, etc.

2. On the basis of size of a computer

Computers are also categorized on the size of the computers. There are four types of computers and they are:

a) Super computer

- The most powerful computers in terms of performance and data processing and data storage capacity.
- Very expensive and large in size that is designed to perform specific tasks.
- Generally used by large organizations and government agencies for various purposes such as: weather forecasting, space exploration, missile and weapon controls, etc.
- Example: Tianhe – 2 (Milky Way – 2) (China), Titan, Cray Inc. (United States), Sequoia, IBM (United States), K Computer, Fujitsu (Japan), Mira, IBM, (United States)

b) Mainframe computer

- It is also large sized computer which occupies large room area.
- The computers are powerful enough to support several hundred uses simultaneously at remote terminals.

- It can process and store large amount of data.
- Generally bank, educational institutions, insurance companies etc uses such computer to store data about their customers and stakeholders.
- Example: IBM s/390, Amdahl 580, Control Data Cyber 176, Fujitsu's ICL VME, Hitachi's Z800, etc

c) Mini computer

- The computers are also multi user systems like mainframe computers.
- Such computers are used by small business firms but not for single user.
- Also known as Midrange computers or medium sized computers.
- Example: IBM AS / 400, IBM SYSTEM 360, HP 3000, PRIME 9755,K-202, Texas Instrument TI – 990, SDS – 92, IBM Midrange computers, etc

d) Micro computer

- The computers are cheapest and smallest in size among other computers.
- Such computers are specially designed for general usage like entertainment, education and various personal uses.
- Example: IBM PCs, Apple/Macintosh, Dell etc.

Software

Software is a means of communication between the computer system and computer users. It is the operating system and applications that are used in computers. Basically, it is the collection of computer programs, documentation and procedures performing several tasks on a computer system. Thus, it is considered to be the heart of computer systems.

Generally, computer software consists of a machine language consisting of groups of binary values, specifying the processor instructions. The instructions change the state of computer hardware in a sequence that is pre-determined. In conclusion, a computer system is a language in which a computer speaks. There are 2 types of computer software. They are:

1.) System Software:

It is a collection of operating system, servers, device drivers, utilities and windows systems which helps in running the computer hardware and the computer system. It

is designed to provide a platform to run application software and operate the computer hardware. This software helps an application programmer to view away memory, hardware and other internal complexities of a computer. Some of its common types are:

i) Operating system:

From performing basic tasks to running important programs, the operating system is the most important program to run a computer. It is the 1 program that loads into memory when the computer is turned on. Without the operating system, no other programs such as spreadsheet software, word processing software, etc. can be run. So, in a sense, this system brings the computer to life.

When given a command, the operating system issues the instructions to the 'brain' i.e. the CPU or microprocessor. While working on the application software, such as Microsoft Word, your given commands are sent through the operating system to the CPU. Some of its examples are Windows2000, Windows95/98, DOS, UNIX, Mac OS, etc. Below are some of its functions.

- Provide security and backup.
- Booting computers.
- Controlling peripheral devices such as a keyboard, disk drives, printers, etc. Provide interface between software and hardware.
- Scheduling processes.
- Memory management.
- Keeping track of files and directories on the disk
- Recognize input from the keyboard.
- Send output to the display screen

ii) Utility Software:

Utility software are set of collective programs, available to help you with the day to day chores that are associated with personal computing and to keep your computer system run at peak performance. These are designed to help manage, control and maintain computer resources.

Some examples of utility software are:

- Virus scanning Software / Antivirus: It protects computers from computer viruses. Scandisk: It scans disks for any potential problems on them, such as bad disk areas or any physical error.

- Backup software: It helps in making copies of your files and even an entire computer hard drive for backup and restoration.
- Debuggers: These are used mainly to solve programming errors.
- Disk Defragmenter software: It assists you in reorganizing those disk drives which have been scattered across several hard disk locations while files are saved, deleted and resaved again.
- File managers: They provide you a convenient method to perform routine data management, management tasks and e-mail recovery

iii) Language processor:

It is a special kind of computer software which translates the programs written in one language into another language. It is compulsory for both low and high-level language. The types of language translators are:

1. Compiler
2. Interpreter
3. Assembler

2) Application Software:

Application software is used to solve application type of problems. Business software, educational software and databases are some forms of application software. This software enables the users to accomplish certain specific tasks and utilizes the capacities of a computer directly to a dedicated task. It can manipulate numbers, texts and graphics. It can also focus on a certain single task like work processing, spreadsheet or playing of audio and video files. Its types are:

i)Package software:

Package software is for general purposes. Designed by software companies, it is mainly to generalize the tasks. Some common package software is:

- **Word Processing Software**: This software enables the users in creating and editing documents. MS-Word, Notepad, Word pad and some other text editors are some most popular examples of Word Processing Software.
- **Database Software**: It organizes the data and enables the users to achieve database operations. It also allows the users to store and retrieve data from databases. MS Access, Oracle, etc. are its examples.
- **Spreadsheet Software**: By displaying multiple cells that make up a grid, this software simulates paper worksheets and allows the users to perform calculations. Its examples are Apple Numbers, Excel, Lotus 1-2-3, etc.

- **Multimedia Software**: This software allows the users to create and play audio and video media. Audio converters, burners, players, video encoders and decoders are some forms of it. Real Player and Media Player are examples of this software.
- **Presentation Software**: This software is best used to display information in the form of a slide show. It includes 3 functions.
    1. Editing, allowing insertion and formatting of text.
    2. A functionality of executing the slide shows.
    3. Methods to include graphics in the text. Microsoft Power Point is its best example.

ii) Tailored software:

Tailored Software is also called small type of software. Tailored software is for specific purposes. Written in high-level languages such as C, JAVA, C++, COBOL (Common Business Oriented language), etc. these types of software are developed for a specific task. Banking software, hotel reservation software, hospital software, billing software, etc. are its examples.

Programming Languages:

Normally, language is a means of communication, through which any entity can share its feelings, emotions, to each other's i.e. the communication between two parties whether they are machine or human beings, always need a common language. The language used to communicate with the computer is known as programming language. A programming language consists of all the symbols, characters and set of rules that permit people to communicate with computer. To perform a particular task in the computer the programmer writes a sequence of instructions, called program. An instruction is a command given to the computer to perform a certain specified task on a given data.

A language is a means of communication. In our daily life we use various kinds of language such as Nepali, English, Sanskrit, Hindi, etc to communicate our ideas and emotions to others. Similarly a computer language is used by a programmer to instruct a computer what s/he wants it to do. A language that is acceptable to a computer system is called a computer language or programming language, and the process of writing instructions is called programming or coding.

A programming language is an artificial language designed to express computations that can be performed by a machine, particularly a computer. Programming languages can be used to create programs that control the behavior of a machine, to express algorithms precisely, or as a mode of human

communication. A programming language is a notation for writing programs, which are specifications of a computation or algorithm.

Classification of Computer Language

There are three type of computer language and they are: machine level language, low level language and high level language.

Machine level language

- A computer understands information's composed of only zeros and hence, it uses binary digits for its operation. The computer's instructions are coded and stored in the memory in the forms of 0's and 1's. a program written in the forms of 0's and 1's is called machine level language.
- The computer language understood by the computer without using translating program is known as machine level language.
- The machine language of computer is normally written as string of binary 0's and 1's.
- A machine language instruction normally has 2 parts format: opcode (operation code) and operand.

Opcode (operation code)	Operand (Address or Location)

The opcode tells the computer what function to perform and the operand tells the computer where to find or store the data or other instructions, which one to be manipulated. Hence, each instruction tells the computer what operation to perform, and the length and locations of the data fields, which are involved in the operation. Every computer has a set of operation codes, called its instruction set.

Advantage

- Programs written in such language can be executed very fast by the computer. Because instructions are directly understood by the computer and no translation of the program is required.

Disadvantage

- **Machine dependent**
  The internal design of every type of computer is different from every other type of computer, so machine language also differs from computer to computer. The program written for one processor (Intel) cannot be run in other processor (Motorola, via etc). The programmer would have to rewrite all the existing programs i.e. it is machine dependent language.
- **Difficult to program**

It is necessary for the programmer either to memorize the dozens of operation code, numbers for the commands in the machines instruction set or to constantly refer to a preference card. A programmer has to keep track of the storage locations of data and instructions. He must be expert about the hardware structure of the computer. So it is difficult to program the machine language.

- **Error prone**
  A programmer has to remember the opcodes and must keep track of the storage locations of data and instructions. This task is very difficult for a programmer to concentrate fully on the logic of the program. This frequently results in programming errors.
- **Difficult to modify**
  It is difficult to correct or modify machine level programs. Checking machine instructions and to locate errors is very difficult and time consuming process. Similarly, modifying a machine level program later is so difficult
  So it is rarely used today

Assembly Language

A language which allows instructions and storage location to be represented by letters and symbols (mnemonics) is called an assembly language or symbolic language. A program written in an assembly language is called assembly language program a symbolic program. It is similar to machine level language, mnemonics codes are used instead of binary digits. Mnemonics used: ADD, SUB, MOV, JMP, HALT, CLA (clear and add), STA (store A register)

Advantage

- ***Easier to understand and use***
  Assembly language programs are much easier to understand and use, because mnemonics are used instead of numeric opcodes and names for data locations
- ***Easier to locate and correct errors***
  Programmers need not keep track of storage locations of the data and instructions as well as mnemonics and used, fewer errors are made and those that are easier to find and correct. Additionally assemblers are designed to automatically detect and report errors of use of an invalid mnemonics opcode or a name that has never been defined.

- ***Easier to modify***
  Since they are easier to understand, it is easier to locate, correct and modify instructions of an assemble language program as compared to machine language.
- ***No worry about address***
  While writing an assembly language program, programmer need not keep track of storage locations of data and instructions.

Disadvantage

- ***Machine dependent***
  Assembly language differs from computer to computer, and an assembly language program can be executed only on the computer in which the assembly language has been written. Hence we have to convert all the existing assembly instructions into new computer, which required learning of new language.
- ***Knowledge of hardware required***
  A programmer must have good knowledge of the characteristic and logical structure of his/her computer to write an efficient and good assembly language programs, because it is machine dependent language.
- **Machine level coding**
  Since all instructions is substituted for one machine level instruction. So, writing assembly language program is still time consuming and not very easy.

High level language

The language written in English like structure and each of them has syntax. Such language is written using English words and familiar mathematical symbols and expressions.

Advantage

- ***Machine independencies***
  A program written in a HLL can be executed on many different kinds of computer.
- ***Easier to learn and use***
  HLL are easier to learn because they very similar to the natural languages used by us in our daily life. Programmer need not know the internal details of the computer for programming in a HLL i.e. they are easier to use.

- ***Fewer error***
  Programmer need not worry about how and where to store the instructions and data of the program. This allows the programmer to concentrate more on the logic of the program under development. All these factors lead to fewer programming errors during program development. Furthermore, compiler and interpreters are designed automatically detect and indicate syntax error.
- ***Lower program preparation cost***
  Writing programs in HLL requires less time and effort, which ultimately leads to lower program preparation cost.
- ***Better documentation***
  The statements of a program written in HLL are very similar to the natural language statements. Hence they can be easily understood by a programmer familiar with the problem domain. As a result very few or no separate comments statements are required I program written in HLL. Due to this reason, HLL are also sometimes referred to as self-documenting language.
- ***Easier to maintain***
  These languages are easier to understand, and hence it is easier to locate, correct and modify instructions as and when desired. Without any compilation, programmer can insert or remove any certain instructions from program i.e. major changes can be incorporated with very little effort.

Disadvantage:

- ***Lower efficiency***
  Programs written in HLL take more time to execute and require more main memory space. Hence, program written in HLL are less efficient than others.
- ***Less flexibility***
  HLL don not have instruction or mechanism to control the computers CPU, memory and register. An assembly language provides the programmer access to all the especial features of the machine they are using. Certain types of operations, which are easily programmed using the machines assembly language, are impractical to attempt using a HL. Hence, HLL are less flexible than assembly language.

Traditional and Structured Programming Concept

Structured programming (sometimes known as *modular programming*) is a subset of procedural programming that enforces a logical structure on the program being written to make it more efficient and easier to understand and modify. Certain

languages such as Ada, Pascal, and dBASE are designed with features that encourage or enforce a logical program structure.

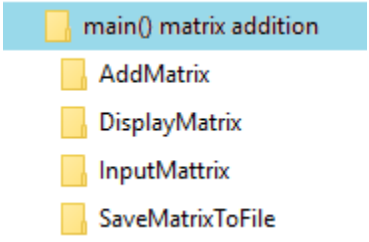
Structured programming frequently employs a top-down design model, in which developers map out the overall program structure into separate subsections. A defined function or set of similar functions is coded in a separate module or submodule, which means that code can be loaded into memory more efficiently and that modules can be reused in other programs. After a module has been tested individually, it is then integrated with other modules into the overall program structure.

Almost any language can use structured programming techniques to avoid common pitfalls of unstructured languages. Unstructured programming must rely upon the discipline of the developer to avoid structural problems, and as a consequence may result in poorly organized programs. Most modern procedural languages include features that encourage structured programming. Object-oriented programming (OOP) can be thought of as a type of structured programming, uses structured programming techniques for program flow, and adds more structure for data to the model.

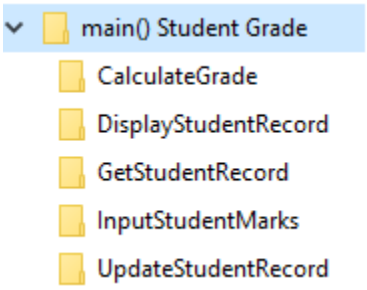
Why C is called a structured programming language?

C is called a structured programming language because to solve a large problem, C programming language divides the problem into smaller modules called functions or procedures each of which handles a particular responsibility. The program which solves the entire problem is a collection of such functions.

Here is an example of Matrix addition program, which is divided into these sub procedures - input matrix, display matrix, add matrix, save result matrix to file. Here is a pictorial structural view of the program.



Another good example is calculate student's grade. Program is divided into these sub modules - input student marks, get student record, update student record, display student record, calculate grade. Here is a structural view of the program.



One major drawback of C language is that similar functions cannot be grouped inside a module or class. Also functions cannot be associated to a type or structure. Thus data and functions cannot be bound together. C++ language overcomes these problems by introducing object oriented functionality in its programming capabilities.

Advantages

- C structured programming is simple and easy to understand and implement.
- It is well suited for small size implementation. However this is not restricted. A good design can extend it to large size implementation.
- Programmers do not require knowing complex design concepts to start a new program.

Disadvantages

- Data and methods and not be bind together in a module.
- Polymorphism and inheritance are not available.
- Complex design and full object oriented design cannot be implemented.
- Programmers generally prefer object oriented programming language over structured programming language when implementing a complex gaming applications or front end business applications.