Computer Programming Paper I

Second Year Bachelor of Commerce

Semester III

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Unit - I : Computer Hardware

- Computer Generations, Types, Speeds, Binary

Computer Generations

The term Computer Generations is mainly used to help understand the various improvements that have taken place in computers used over the last few decades.

- First Generation
- Second Generation
- Third Generation
- Fourth Generation
- Fifth Generation

First Generation

- The First generation of digital computer were develop in the early 1940s (1942-1958) and were build using vacuum tube logic circuitry.
- They used magnetic drums for the main memory.
- Since vacuum tubes and drums were used the computer were very large in size, the consumed a great deal of electricity, generated large quantity of heat and hence had a high failure rate.
- They relied on machine language, the lowest-level they could only solve only one problem at a time.

First Generation (Continue)

- An example of the first generation computer is the Electronic Numerical Integrated and Advance Computer (ENIAC).
- They contained nearly 19000 vacuum tubes, weighed nearly 30 tons and occupied area of 3000 cubic feet.
- **They speeds of First Generation computers were measured in Milli-seconds(Thousand of a Second).**
- They had limited internal storage capacity and slow input output speed.
- Another example of a first generation computer is the IBM 650.

Second Generation

- The Second Generation of computer was developed in the late 1950s (1959-1964).
- They used transistors in place of vacuum tubes.
- The transistor was invented in 1947 but did not see use in computers until the late 1950s.
- The transistor was far superior to the vacuum tube.
- It was smaller in size, less expensive and generated less heat than vacuum tubes.
- Even though transistors still generated a lot of heat which could cause damage to the computer, It was a vast improvement over the vacuum tube.

Second Generation (Continue)

- The use of transistor increased the reliability of computers as their components did not deteriorate with time.
- The use of smaller components enhanced the internal storage capacity of the computers.
- Transistors replaced vacuum tubes in most of the military computers in 1956 and in most commercial computers in 1959.
- **The speed of second generation computers was typically measured in micro seconds (millionth of a second).**

Second Generation (Continue)

- Further, magnetic tape and punched cards could be used for input/output.
- They used mostly symbolic languages (Auto coder) and some high level languages like Fortran and Cobol.
- Operating System were developed and they accepted batch processing applications.
- IBM (International Business Machine) 7090 was a second generation computer.

Third Generation

- The Third Generation of computers was developed in the mid 1960s (1965-1971).
- They used Integrated Circuits in place of transistors.
- Transistors were miniaturized and placed on silicon chips, called semiconductors, which drastically increased the speed and efficiency of computers.
- Integrated Circuits were much more compact .

Third Generation

- One integrated circuit could do the job done by hundred transistors.
- This resulted in further reduction in size of the computers, and improvement in their internal storage capacity and input / output (I/O) speed.
- The computers generated less heat and were more reliable.
- The speed of third generation computers were measured in nano seconds (Billionth of a second)

Third Generation

- There was also an improvement in the peripherals used as magnetic disks were introduced.
- The users of the computers in third generation widely used keyboards and monitors to interface with the computers and used for administrative and scientific applications.
- Multiprogramming and time sharing became a reality.
- Fortran IV (For Translate) and Cobol 68 (Common Business Oriented Language) were developed and used as high level languages.

Fourth Generation

- The fourth generation computers were introduced in the 1970's and used large scale integrated (LSI) circuits.
- LSI chips can fit on the tip of one's finger and yet they contain thousands of transistors, diodes and registers.
- This made it possible for inexpensive micro-computers to be developed.
- They could be placed on a small table and consequently came within reach of small businesses establishments.
- Microprocessors were developed and used.
- Thousands of integrated circuits were built onto a single silicon chip.

Fourth Generation

- Hence the entire Central Processing Unit(CPU) was housed on a single chip.
- This paved the way for less expensive computers with high processing speeds.
- The speed of Fourth Generation computers was measured in pico seconds (10^{-12} of a second).
- Fortran 77, Cobol 74, Pascal etc. were used as high level languages.
- In 1981 IBM introduced its first computer for the home user and in 1984 Apple introduced the Macintosh.
- Microprocessors which were used only in computers were now used in many other everyday products as well.

Fifth Generation

- From the First to the Fourth Generation of computers the emphasis was on improvement of hardware used and hence there was vast improvement in the size and processing speeds of computers.
- The Japanese funded a project in the 1980's to make highly parallel computer architecture.
- Nearly $400 million was invested in this over a ten year period and the workstations and software were developed.
- However, the project did not meet with commercial success as these workstations were eventually surpassed in speed by less specialized hardware (for example, Sun workstations and Intel x86 machines).
- Hence this project was abandoned.

Fifth Generation

- Fifth Generation computers based on Artificial Intelligence are still under and development, however there are several applications using voice input that are already in use today.
- The goal of fifth-generation computing is to develop devices that respond to natural language input and are capable of learning and self organization.
- In order to make Artificial Intelligence a reality, parallel processing (using several CPU simultaneously) and superconductors are being used.
- Artificial Intelligence includes

a) Playing games such as chess, where there has been considerable success, as the super computer called Deep Blue could defeat Gary Kasparov the world chess champion

b) Use of Natural spoken Language to program computers

c) Robotics used for making computers see and react to stimuli, these computers are currently used in assembly plants

d) Expert in real life situations such as in the medical field

e) Neural networks that Systems which are developed by experts in their fields which help make decisions stimulate intelligence.

Types of Computers

- Analog Computers
- Digital Computers
- Hybrid Computers

Analog Computers

- They are special purpose computers and used for processing data that vary continuously such as humidity, speed, the amount of current flowing through an electrical circuit.
- In these computers the data is given in a continuous form and a especially useful in engineering designs.
- They are also useful in doing continuous us calculations as required in integration and differentiation in mathematics.
- These computers are incapable of taking decisions but find a wide variety of uses in industrial and scientific establishments, such as humidity, speed, or the amount of current flowing through an electrical circuit, but are seldom(rarely) used for business applications.

Digital Computers

- These are much more accurate than the analog computers and can be used manipulating data with great accuracy.
- They perform calculations by counting.
- Digital computers are of 2 types

(a) General purpose

Digital computers are capable of handling many diverse and complicated problems by using specially prepared programs.

Even in this category there at many classifications depending upon the speed and the power of the computer.

(a) Special purpose computers

Special Purpose digital computer is made for carrying out specific tasks and is designed keeping these tasks in mind. They have special in built programs which helps in performing the required tasks. They are widely used at airports to

Digital Computers

General Purpose

Digital computers are capable of handling many diverse and complicated problems by using specially prepared programs. Even in this category there at many classifications depending upon the speed and the power of the General Purpose

Special Purpose

The Special Purpose digital computer is made for carrying out specific tasks and is designed keeping these tasks in mind. They have special in built programs which helps in performing the required tasks. They are widely used at airports to monitor arrivals and departures and maintain up to date flight information. They have also been widely used by the army, banks and Government organizations.

Hybrid Computers

- They incorporate the best features of both Analog and Digital computers.
- Hence they can be used in all such problem areas where continuous and digital processing is required.
- For Example, in a weather monitoring systems the analog devices may measure humidity, temperature etc.
- These measurements are then converted into numbers and supplied to digital components of the systems.
- This component is used to monitor the Weather and predict cyclones etc.

Types of Computers based on Configuration

- Super Computers
- Mainframe Computers
- Mini Computers
- Micro Computers

Super Computers

Super Computers are the largest computer made today. Not only are they very powerful but they are extremely expensive as well. These computers are primarily used for scientific research in applications that are highly calculation intensive, such as weather forecasting, defense, aircraft design, oil and gas exploration, simulations of nuclear research areas, seismic activity etc.

The Super Computers have high speed due to the use of Multi processors i.e. several thousand processors are used, which enables Super Computers to carry out several tasks at the same time, as each task has been assigned to a different processor. The speeds of these computers are measured in nanoseconds (10^2 of a Second) and Gigaflop (1 Billion Floating Point Arithmetic Operations per second). They can process more than one billion instructions per second and support up to 10,000 terminals at one time

Super Computers

The CDC 6600, released in 1964, is generally considered the world's first Super Computer and was designed by Seymour Cray. He later left CDC (Control Data Corporation) and formed his own company, where he made Cray-1 in 1976, which was one of the more popular Super Computes, and Cray-2 in 1985 which performed at 1.9 gigaflops, being the fastest in the world then. The Hitachi SR2201 Super Computer obtained a peak performance of 600 gigaflops in 1996 by using 2048 processors.

A typical Super Computer which contains several thousand processors, consumes a large amount of electricity, due to which it generates massive quantities of heat. Hence special cooling measures have to be used where air conditioning is combined with liquid cooling. The energy efficiency of computer systems is generally measured in terms of "FLOPS per Watt". In June 2011 the Blue Gene machine in New York achieved 2097 MFLOPS/W which made it the most energy efficient Super Computer ever made.

Mainframe Computers

A mainframe computer consists of several computers in addition to itself. There is a

1. Host Processor which controls other processors and peripheral devices and carries out mathematical operations.
2. Front End Processor which is used to handle all communications with various remote terminals that are connected to the computer system.
3. Back End Processor which is primarily used for retrieving data.

They are used by large organizations and apart from being large in size they have higher data storage capacity as well as very fast processing speeds. They have to be placed in special rooms and require a regulated temperature.

Their speeds are measured in megaflop's (millions of Floating point Arithmetic Operations per second) and not gigaflops as used for Super Computers. They can support more than 1000 terminals(users), and supports all of them by keeping many programs in the primary memory and quickly switching back and forth between programs. This property of processing many jobs at the same time for many users is called as Multiprogramming'.

Mainframe computers find use with International Airline bookings, Network banking, Multinational companies and Government agencies. Powerful Mainframes are a very costly proposition and only large organizations can afford them.

Mini Computers

- They are considered as midrange computers and are size of refrigerator, which is slightly larger than the microcomputers but smaller than mainframe computers.
- They are used by medium sized companies in their manufacturing and assembly line facilities.
- They have higher processing speed as well as higher data storage capacity than micro computers.
- They can also be attached to wide variety of peripheral devices.
- They have networking capability i.e. they can be attached with a numbers terminals.
- A minicomputer can also be used by a number of users; however, they are less powerful than a mainframe.
- These computers came into existence in the 1960's with the advent of large scale integrated circuits, which allowed building of computers that were cheaper than mainframes.
- Further the cost of these computers was $1/10^{th}$ that of the mainframes.
- However with the introduction of high-end microcomputer workstations serving multiple users the need of minicomputers has somewhat diminished.

Micro Computers

- A microcomputer is a computer that contains a microprocessor chip which carries out all the functions of the central processing unit (CPU).
- The reason why they are often called personal computers (PC) is simply because; they have been developed to meet the needs of a single individual, and can only be used by one person at a time.
- Personal computers are typically used at home, at school, or at a business.
- They give the user the power of controlling the total processing cycle i.e. the input/output as well as processing and storage.
- One of the reasons for the popularity of microcomputers is that there has been a continuous improvement in its technology, with the microprocessors getting faster and the memory devices capacity being continuously enhanced.
- Hence today high end microcomputers have nearly the capability of minicomputers.
- Some of the more popular uses for microcomputers include word processing, surfing the Web, sending and receiving e-mail, doing calculations using spreadsheets, database management for e.g. Access, editing photographs, creating graphics, and playing music or games.

Micro Computers

- Microcomputers are of two types, desktop computers and notebook computers.
  1. Desktop Computers
  2. Notebook Computers

1. Desktop Computers:-

- In a desktop computer there is either cabinet or a tower cabinet in which are the motherboard, microprocessor and memory (both memory) which is on board memory and secondary memory such as a hard disk and CD/DVD drive.)
- There is an external mouse, keyboard and monitor attached to the cabinet.
- They are small enough to fit on top of or alongside a desk, but they are not small enough to carry around.

Micro Computers

2. Notebook Computers:-

- Notebook or Laptop computers are portable computers.
- They are lightweight enough to be carried around with the user and even placed in a briefcase.
- They use a thin built-in LCD screen that folds down to protect the display when carried around by the user.
- The screens are available in various sizes such as 14" or 15" etc.
- They also feature a built-in keyboard and some kind of built-in pointing device (such as a touch pad).
- They are called notebook computers, because they are small in size.
- The name Laptop was used as they can be conveniently placed in one lap while seated or travelling.
- They operate on batteries or can be connected to a wall unit.
- Today notebooks with a battery life of 8 hours are available, hence they have become very popular with travelers.
- Though some laptops are less powerful than typical desktop machines, this is not true in all cases.
- However, the cost of Laptops is generally higher than desktops of equivalent processing power because the components used in a laptop are smaller and hence are more expensive.
- There are also less-powerful versions of notebook computers called subnotebooks, and net books however; they are mainly used to access the Internet.

Tablet

- A Tablet Computer (often just called a tablet) looks more like a handheld slate which consists of a LCD touch screen which is used for both input and output.
- The touch screen is the substitute for a keyboard.
- It often uses an onscreen virtual keyboard, a passive stylus pen, or a digital pen.
- A tablet is generally equipped with a Camera, Wi-Fi capabilities and also has a cellular network data connection, such as one to access the Internet.
- Not only are they smaller and lighter than laptops, they are very convenient to carry around.
- Applications specifically designed for these touch screen devices run on these Tablets.
- During the 2000s Microsoft brought out the Microsoft Tablet PC as a mobile computer for field work in business.
- Due to price and usability problems the product did not achieve widespread usage.
- In April 2010 Apple released the iPad, a tablet computer with an emphasis on media consumption.
- The product achieved commercial success and is today the most sought after tablet in the market.
- The main reason for its success was a change of purpose, together with a light weight product which had a good battery life.
- Today these tablets are used by a large number of persons, as browse the internet and conveniently view and make/modify presentations on them.
- Even though there is no physical keyboard, word processing or spreadsheets activity can be carried using the onscreen virtual keyboard, but not as comfortably as on a laptop or desktop computer.
- Some of the more popular tablet computers include the Apple iPad which uses the Apple's iOS, the Samsung Galaxy tab 2 which use the Android OS 4.0, BlackBerry PlayBook which runs on BlackBerry Tablet OS.
- Aakash, manufactured in India is a low cost tablet initially developed for a better education for the students at the universities.
- Aakash 2 is a newer version of this tablet, which comes with calling facilities, both 3G and 2G.
- It also has a front and back camera, runs Android 2.3 operating system and can be used as a phone to make and receive voice and video calls.

Android

- Alpha
- Beta
- Cupcake
- Doughnut
- Éclairs
- Farelo
- Ginger bread
- Honey comb
- Ice cream Sandwitch
- Jelly bean
- Kit Kat
- Lolipop
- Marshmallow
- Nought
- Oreo
- Pie

Smart phones

- Smart phones are nothing but top of the line mobile phones that typically run operating systems similar to the tablet computers.
- They also often share the same applications as tablets.
- They are very versatile as they combine the features of portable media players, compact digital cameras, pocket video cameras, GPS navigation units, music player etc. hence they can be termed as an all in one device.
- They use a touch screen for input, but some include physical keyboards.
- Modern smart phones also have high-resolution touch screens, and properly display standard web pages rather than just mobile-optimized sites using special web browsers.
- They have high-speed data access via Wi-Fi and use mobile broadband.
- There are several different mobile operating systems (OS) used by modern smart phones.
- They include Google's Android, Apple's iOS, Nokia's Symbian, RIM's BlackBerry OS, Samsung's Bada, Microsoft's Windows Phone, HP's webOS, and embedded Linux distributions such as Maemo and MeeGo.
- A feature of these operating systems is that they can be installed on many different phone models.

PDA's and Palmtop Computers

- A Personal Digital Assistant (PDA) can be termed a handheld microcomputer, which has sacrificed power for small size and greater portability.
- They are also known as a palmtop computer, or personal data assistant.
- Most PDAs employ touch screen technology and have a touch-sensitive LCD screen (touch screen) which is used for both output and input, while others use soft keys, a directional pad, and a numeric keypad.
- Normally a stylus (like a pen) is used to draw any character on the screen or to touch icons which are displayed.
- PDAs have the capability to connect to the internet and include a web browser.
- They can communicate with desktop computers and also with each other either by cable connection, Bluetooth, infrared (IR) beam, or radio waves.
- Some of the uses of PDAs include keeping track of appointments, various to-do lists, address books, and for writing notes (Memo).
- All current models of PDA also have audio capabilities enabling use as a portable media player, and also enabling most of them to be used as mobile phones.
- Most PDAs can access the Internet, intranets or extranets via Wi-Fi or Wireless Wide Area Networks.
- A palmtop or handheld PC is a very small microcomputer that also sacrifices power for small size and portability.
- These devices typically have a flip-up screen and small keyboard and look more like a tiny laptop.
- The operating system they use is generally Windows CE or similar for handheld devices.
- Some PDAs and palmtops contain wireless networking or cell phone devices so that users can check e-mail or surf the web on the move.
- Because of their small size, most palmtop computers do not include disk drives.
- However, many contain PCMCIA slots in which you can insert disk drives, modems, memory, and other devices.
- Palmtops are severely limited when compared to full-size computers, but they can be easily used for certain functions such as phone books and calendars.

Characteristic of a Computer

- The computer being an electronic machine has many Characteristics such as:-

1. Speed: In present world man's quest for completing tasks within prescribed time limits, have been well supplemented with the use of computers. The computer has phenomenal speeds and is capable of doing millions of calculations per second. Hence a job which would take a group of people a year to compute manually can be completed in less than an hour of a powerful computer. Weather forecasting involves analyzing large amounts of data, which would take weeks if not months to complete. It takes only few minutes for the computer to process this huge amount of data and give the result.

2. Accuracy: Not only are computers fast, but they are highly accurate in whatever tasks they are programmed to perform. It is not just important to be fast, there has to be accuracy as well. for e.g. a computer can divide 15 by 7 and give the answer 2.142857143 to the required number of decimals(say 9) not only very fast but also very accurately. The term "computer Error" as is commonly used is more of "Human Error" as the computer only carries out the programmer's instructions efficiently. If these instructions are faulty, errors are bound to appear in the computer's output. Hence if the data and instructions given to the computer are reliable, the results produced will be accurate.

3. Diligence :Human beings generally tire after a couple of hours of work and tend to make mistakes. A computer is free from tiredness, lack of concentration, fatigue, etc. A computer can continue doing the same job, hour after hour and yet produce results which are free of any errors. Moreover the computer will take the same time to do the first calculation as well as the 1000th calculation. Due to this capability it overpowers human beings in routine type of work.

Characteristic of a Computer

4. Storage: One of the most powerful features of the computer is its capability for storing a large amount of data. This data along with the instructions given by the programmer are stored in the primary (main) memory of the computer (which in most computers is around 2 to 8 GB) or if this is not sufficient in its secondary. (auxiliary) memory (measured in Giga or Terabytes). The secondary memory consists of various devices such as Hard Disks, Blue rays, DVDs, pen drives etc. all of which have fairly large data storage capacities.

5. Versatility: Even though the computer has no brain of its own, and mainly efficiently carries out human instructions, it is fairly versatile in performing arithmetic calculations, logic operation of comparison, moving data within the various sections of the computer, and in input and output operations. They can be used for home uses, for business oriented tasks, weather forecasting, space explorations, teaching, railways, banking, medicine etc. All Modern computers can perform different kind of tasks simultaneously.

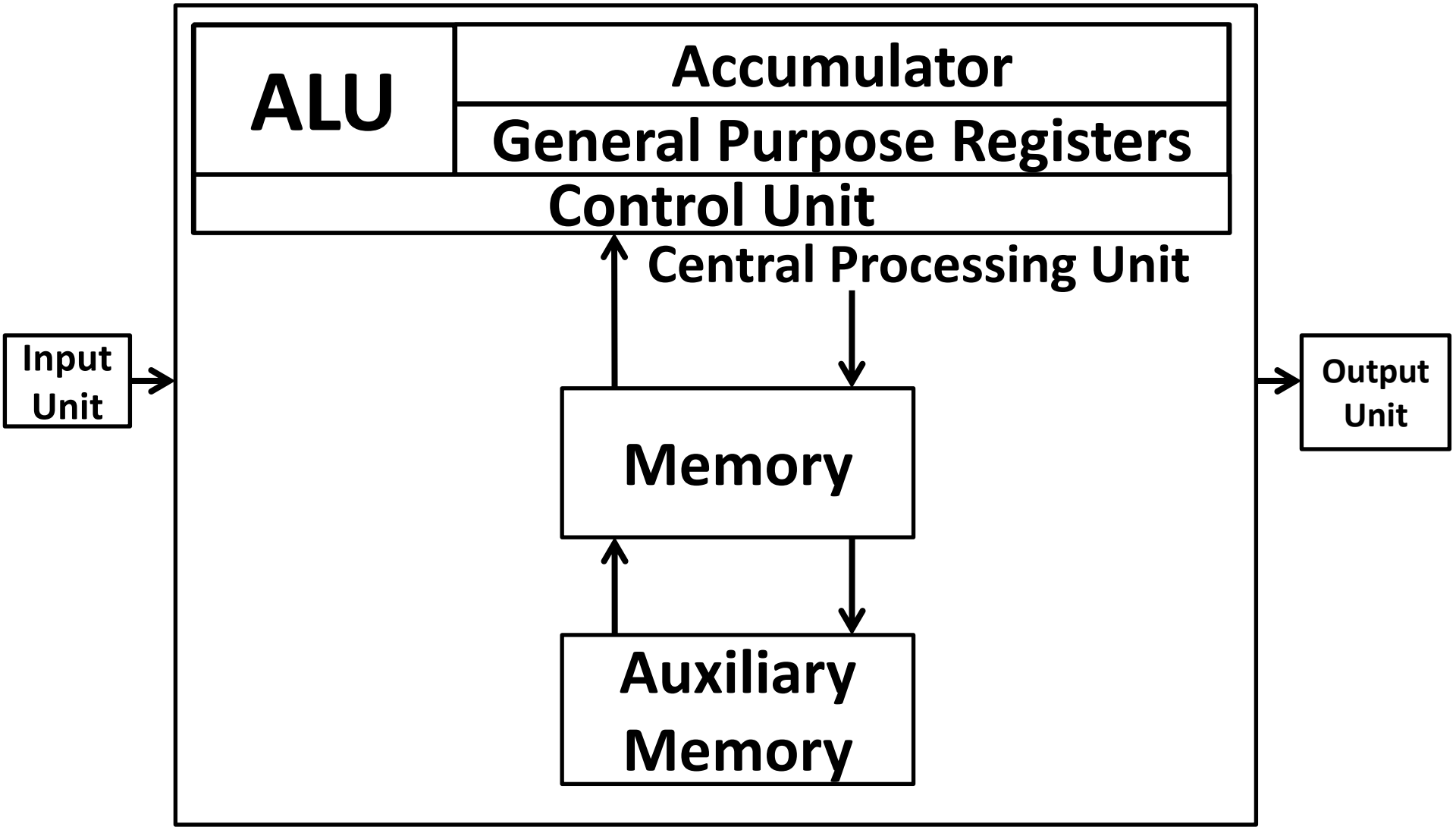
6. Automation :A computer is an automatic machine that is capable of receiving instructions in advance, store them and on receipt of message to execute them, retrieve, interpret and execute them without any human intervention. Most automatic machines are not capable of receiving instructions in advance which differ from time to time.
7. 7. No Common Sense : A computer has no common sense. It has to be given all instructions exhaustively and in appropriate logical sequence. If instructions are incomplete or in an incorrect sequence, it cannot produce desired output.

Basic Components of a Digital Computer

A digital computer is a machine which can be programmed to read instructions and process data available in binary form. Most of the computers that we use today are Digital. A computer can process data, pictures, sound and graphics. They can solve highly complicated problems quickly and accurately.

The following are the components of a digital computer.

1. Central Processing Unit (CPU)
   a) Arithmetic and Logic Unit (ALU)
   b) Control Unit
2. Memory or Storage Unit
   1. Primary or Main Memory
   2. Secondary or Auxiliary Memory
3. Input Unit.
4. Output Unit


ALU
Accumulator
General Purpose Registers
Control Unit
Central Processing Unit
Input Unit
Output Unit
Memory
Auxiliary Memory

Central Processing Unit (CPU)

- The CPU consists of

(a) Control Unit

(b) Arithmetic and Logic Unit (ALU)

Collectively they form the brain of the computer, where actual processing of data takes place on execution of the program. The CPU performs the following functions:

1. Calculations.
2. Takes decisions.
3. Controls all other units of the computer.

This unit receives the data from the input device, then processes it as per the set of given instructions (program) and then outputs the processed data either to the memory or to Output devices. In the process it controls the operations of all other units of the computer. Let us discuss the units of the CPU separately.

Central Processing Unit (CPU)

(a) Control Unit:- It controls all the other units of the computer. It is used for generating the electronic control signals for the synchronization of various operations which involve the other units of the computer. For example it controls the flow of data and instructions from the memory to the ALU and the subsequent flow of processed results back to the memory or output device. Hence it is called the central nervous system of the computer, as the entire control and synchronization of the working of the computer is done here.

Central Processing Unit (CPU)

(b) Arithmetic and Logic Unit (ALU):-

Mathematician John von Neumann proposed the ALU concept in 1945. The ALU which is part of the CPU is responsible to carry out the following functions:-

1. Arithmetic calculations like addition, subtraction, multiplication, division and I exponentiation take place in the ALU.
2. Logic operations like>, <, etc. using AND, OR, NOT are carried out in the ALU.
3. Increment, decrement, shift and clearance operations are also carried out in the ALU.

Within the ALU there are two types of registers, termed as Accumulator and General purpose registers. A register can be thought of as a unit, which can hold data (8 or more bits). Hence, registers are sets of Flip Flops which can hold data. Flip Flops are electronic circuits which store one bit temporarily.

The Accumulator is the main register of the Arithmetic logic unit of a CPU (microprocessor).The Accumulator holds the first part of data of any calculation. If a number from memory is added to that data, the sum replaces the original data in the accumulator. Hence successive results of arithmetic operations are held in the Accumulator, which may later on be transferred to memory, or to an output device.

Whenever calculations or comparisons are required the control unit transfers data from the storage unit to the ALU, and when these are completed the results are transferred to the storage unit by the control unit or to the output unit to display the results. Today even the most simplest of microprocessors must contain an ALU. The processors found inside latest CPUs and graphics processing units (GPUs) are very complex and may contain several ALU's. How a company designs their ALU has a significant impact on the overall performance of their CPU.

Memory or Storage Unit

Computer memory consists of a set of chips whose primary function is to store data and instructions either temporarily or permanently. Hence it is also called as a Storage unit. The main function of the memory is to store data and instructions in coded form obtained from the input device or from any other computer. This data and instructions may be used immediately by the computer or maybe stored for later use.

The smallest unit of memory is called as Bit. (Value either 0 or 1 called binary digits)

Units of measure of Computer Memory

- 1 Bit (0,1) Binary
- 8 Bit = 1 Byte (e.g. R = 01001101)
- 1024 Byte= 1 Kilo Byte
- 1024KB = 1 Mega Byte
- 1024MB= 1 Giga Byte
- 1024 GB= 1 TeraByte
- 1024 TB= 1 Petta Byte
- 1024 PB= 1 ExaByte
- 1024 EB= 1 ZettaByte
- 1024 ZB= 1 YottaByte
- 1024 YB= 1 BrontoByte
- 1024 BB= 1 GeopByte

Memory or Storage Unit

The memory can be classified into two categories.

1. RAM:- (Random Access Memory) It holds the data and program that is being currently processed. It is called as temporary memory as its contents will be lost when the electrical power to the computer is cut off.
2. ROM (Read Only Memory). The programs stored in ROM are permanent and are not lost or erased when the current is switched off. Some other types of ROM are given below.

Memory or Storage Unit

1. PROM:- This denotes Programmable Read Only Memory. It is a form of ROM that canbe programmed by the user.
2. EPROM:- This denotes Erasable Programmable Read Only Memory. It is a type of PROM, the contents of which can be erased by exposing it to strong ultraviolet light source.
3. EEPROM:- This denotes Electrically Erasable Programmable Read Only Memory. It is a type of PROM, the contents of which can be electrically erased.

Memory or Storage Unit

1. Auxiliary or Secondary Memory

The most important kinds of Secondary memory are:-

a. Hard Disks

b. Solid State Storages

   a. Flash Memory Cards

   b. USB Flash Drives

c. Optical Disks

a. Hard Disks

They are used to store large data files and software (programs). Data and information is stored on rigid metallic platters using magnetic charge Read/write heads move over the platters to read and write data. Storage capacities range from 500 GB to 1 TB or more.

b. Solid State Storage They use less power have no moving parts and are more reliable.

Memory or Storage Unit

b. Solid State Drives are of two types

a) Flash memory cards32GBThey are electronic flash memory data storage device, used for storing digital information and is used in mobile phones, cameras etc. They are re-recordable and retain data even without power.

b) b) USB Flash drives:- They are removable and rewritable. Not only are they smaller and faster, but they have thousands of times more storage capacity and are easily transportable. As they have no moving parts they are more durable and reliable Typical capacities range from 2GB to 64GB. They are also called pen drives.

Memory or Storage Unit

c. Optical disks:-

They are round in shape, are single sided and use laser technology. They are now slowly being replaced by solid state storage devices. They are of three types, compact disks(CD), digital versatile disk(DVD) and high definitions disks(hi del). Blu-ray is the newest high-definition optical format. Developed by Sony, Bluray discs offer 25 GB per layer with up to two layers per disc.

Input Unit

The main function of the Input unit is to translate data and programs which we can understand into the form that can be received and processed by computers. The most common input devices are :-

a) Keyboard: Which accepts letters, numbers and commands
b) Mouse: Permits selection of options from on-screen menus by using the mouse.
c) Trackball: Is an upside down mouse.
d) Touch pad: The movement of a finger on a small surface controls the cursor.
e) Joysticks: It is a pointing device used for playing games.
f) Touch screen: Allows input by touching options displayed on the screen.
g) Stylus Pens: Used with PDA‘s
h) Scanners: Where documents, pictures, graphics can be captured and stored.
i) Voice Recognition Devices: Permits voice input to computers.

Output Unit

They translate the processed information received from the computer into the forms that can be understood by humans. The computer sends information to the output device in binary form. The output device converts it into the form which is suitable to the users. This output is can be obtained in the form of a hard copy (printed) or soft copy view on screen). The hard copy can be retained for long periods, while the soft copy displayed on the screen will be only temporarily available. However, it is possible to capture and store output on secondary storage devices. The common output devices are –

a) Monitors: They allow viewing a soft copy of the output on the screen.
b) Printers: They give a hard (printed) copy of the output.
c) Plotter: Produce output of high quality color graphics.

MEMORY ADDRESSING CAPABILITY OF CPU

The CPU is connected to the memory and Input / Output devices by a group of lines, which is called a bus. These lines are able to carry information and are of three types

1. Address Bus
2. Data Bus
3. Control Bus

The Address Bus is unidirectional and carries the address of an Input / Output device or memory location that has to be addressed by the CPU. This enables the CPU to address that location.

The Data and Control bus are bidirectional, which enables data to flow in either direction, from CPU to memory or Input / Output device or vice versa. Address Bus Memory or Input / Output Device CPU Data Bus Control Bus The memory addressing capability of the CPU depends on the number of lines in the Address Bus i.e. the width of the address bus. If the address bus of the CPU is 2 bit wide, then it can address $2^2 = 4$ memory locations. As in one memory location one byte of information can be stored, a CPU with a 2 bit wide Address bus can directly address 4 bytes of memory. Consider a CPU with 20 lines in its address bus. This CPU can then address 2^{20} (about 1 million) memory locations directly, which means about 1 MB memory.

1		20,97,152
2	2,048	4194304
4	4,096	8388608
8	8,192	1,67,77,216
16	16,384	3,35,54,432
32	32,768	6,71,08,864
64	65,536	13,42,17,728
128	1,31,072	26,84,35,456
256	2,62,144	53,68,70,912
512	5,24,288	1,07,37,41,824
1024 (1 GB)	10,48,576	2,14,74,83,648
		4,29,49,67,296
		92,23,37,20,36,85,47,80,000

1 Million = 10 Lakh or Lacs

1 Billion = 100 Crores

1 Trillion = 1,00,000 Crores

Decimal Number System

- This is the most common numbering system which is used by us in our day to day work.
- Symbols : 0,1,2,3,4,5,6,7,8,9
- Base : 10, as there are ten digits.
- Hence the units place is represented by 10^0=1, the tens place by 10^1=10, the hundreds place by 10^2=100 and so on.
- Using the various digits in different positions we can represent any number.
- The digit used to present a number, carries a specific weight when used in a particular position.
- e.g. Consider the number 459 which is 400+50+9.
- The third digit is 4 which is in hundreds place has a value 4 X 10^2 = 400.
- The Second digit is 5 which is in tens place has a value 5 X 10^1 = 50.
- The first digit is 9 which is in units place has a value 9 X 10^0 = 9.

Binary Number System

- The binary number system uses only two digits 0 and 1, hence it is called as binary.
- The computer being an electronic machine has only two states in its circuits, namely ON and OFF.
- These stages are represented in the Binary Number System, by these two digits 0 and 1 called binary digits or BITS.
- Symbol : 0,1
- Base : 2, as there are only two digits.

Binary Addition

- Binary numbers are added just like any other digits, except that 1+1 cannot become 2 as the binary digits are only 1 and 0.
- Hence the following rules should be followed during binary addition

Rules

0	+	0	=	0
1	+	0	=	1
0	+	1	=	1
1	+	1	=	0 with carry of 1 (10)
1+1+1			=	1with carry of 1 (11)

- e.g. Add the binary numbers 100 and 011.

  100

  \+ 011

  111

- e.g. Add the binary numbers 101 and 001.

  101

  \+ 001

  1 (as 1 + 1 = 0 with carry of 1)

  110

- e.g. Add the binary numbers 1011 and 1001.

  1011

  \+ 1001

  1 1 (as 1+1=0 with carry of 1 and 1 + 1 + 1 with carry of 1)

  10110

- 111 + 000 = 111
- 111 + 111 = 1000 (as 1+1=0 with carry of 1)
- 001 + 101 = 1010

1’s Complement and 2’s Complement

Generally negative numbers can be represented using either 1’s complement or 2’s complement representation. The ones’ complement of a binary number is defined as the value obtained by inverting all the bits in that binary number (i.e. replacing 0’s with 1’s with 0’s). For example consider the 4 bit binary

number 1001. Its 1's complement would be 0110. The ones' complement of the number then behaves like the negative of the original number in most arithmetic operations. However, 1's complement has not seen widespread use because issues like negative zero, end-around borrow, etc.

1's complement reverse all the bits

2's complement reverse all the bits + 1

The 2's complement of a binary number is obtained by replacing 0's with 1’s and vice versa and then adding 1, i.e. the 2's complement is obtained by adding to the 1's complement.

For example, if you consider the number 3 represented using 8 bit binary code 00000011. Its negative, or 2's complement, is 11111101 as explained below 00000011 (changing to 1's and vice versa, i.e. 1’s complement)

11111100 (adding 1):11111101e.g. Suppose we want to represent -5. So we begin with say the 4 bit patter of +5 which is 0101. The 2's complement of this is 1010+1=1011. Notice that the bit pattern of -5 starts with 1. Some more 4 bit patterns are given below.111111101101represents -1represents -2represents -31100 represents -41011represents -51010 represents -6 represents -71001Hence these negative numbers have bit patterns which start with 1. Howeve consider the 4 bit pattern of +8 which is 1000. Now using 2's complement the 4 bit pattern of -8 is 0111 + 1 which is 1000 which is the same as +8. However in the above cases positive numbers begin with 0 and negative with 1, one CE take 1000 as the 4 bit pattern for -8.We can generalize this as, using n bits, the range of integers we can sto using 2's complement is: -2n-1 to 2 n+1-1.

Binary to Decimal

1) 1 0 1 1 . 1 0

2^3 2^2 2^1 2^0 2^{-1} 2^{-2}

$1011=1x2^3+0x2^2+1x2^1+1x2^0$

$=1x8+0x4+1x2+1x0$

$=8+0+2+0$

$=10$

$.10= 1x2^{-1}+0x2^{-2}$

$=1x(1/2)+0x(1/4)$

$=1x(0.5)+0x(0.25)$

$=0.5$

$(1011.10)_2=(10.5)_{10}$

Binary to Decimal

- 1 1 1 1 1 1 1 1

2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0

128 64 32 16 8 4 2 0

$11111111=1x2^7+1x2^6+1x2^5+1x2^4+1x2^3+1x2^2+1x2^1+1x2^0$

$=1x128+1x64+1x32+1x16+1x8+1x+4+1x2+1x0$

$=128+64+32+16+8+4+2+0$

$=254$

$(11111111)_2=(254)_{10}$

Binary to Decimal

- 0 1 0 1 0 1 0 1
- $01010101=0x2^7+1x2^6+0x2^5+1x2^4+0x2^3+1x2^2+0x2^1+1x2^0$

$=0x128+1x64+0x32+1x16+0x8+1x4+0x2+1x0$

$=0+64+0+16+0+4+0+0$

$=84$

$(01010101)_2=(84)_{10}$

Binary to Decimal

- . 1 1 1 1 1 1 1 1

  2^{-1} 2^{-2} 2^{-3} 2^{-4} 2^{-5} 2^{-6} 2^{-7} 2^{-8}

  ½ ¼ 1/8 1/16 1/32 1/64 1/128 1/256

  0.5 0.25 0.125 0.0625 0.03125 0.0015625 0.0078125 0.00390625

$.11111111=1x2^{-1}+1x2^{-2}+1x2^{-3}+1x2^{-4}+1x2^{-5}+1x2^{-6}+1x2^{-7}+1x2^{-8}$

$=1x1/2+1x1/4+1x1/8+1x1/16+1x1/32+1x1/64+1x1/128+1x1/256$

$=0.5+0.25+0.125+0.0625+0.03125+0.0015625+0.0078125+0.00390625$

$=0.98203125$

$(.11111111)_2=(0.98203125)_{10}$

Home work

- $(11001011.101)_2$
- $(110001)_2$
- $(10101010)_2$
- $(10110.101)_2$
- $(1001110.01)_2$
- $(11011.101)_2$
- $(101101.1101)_2$
- $(10101.10101)_2$
- $(1101101.0101)_2$

$(11001011.101)_2$

- 1 1 0 0 1 0 1 1 .101

$=1x2^7+1x2^6+0x2^5+0x2^4+1x2^3+0x2^2+1x2^1+1x2^0$

$=1x128+1x64+0x32+0x16+1x8+0x4+1x2+1x0$

$=128+64+0+0+8+0+2+0$

$=202$

. 1 0 1

$=1x1/2+0x1/4+1x1/8$

$=1x0.5+0x0.25+1x0.125$

$=0.5+0+0.125$

$=0.625$

$(11001011.101)_2=(202.625)_{10}$

$(110001)_2$

- 1 1 0 0 0 1

$=1x2^5+1x2^4+0x2^3+0x2^2+0x2^1+1x2^0$

$=1x32+1x16+0x8+0x4+0x2+1x0$

$=32+16+0+0+0+0$

$=48$

$(110001)_2=(48)_{10}$

$(10101010)_2$

- 1 0 1 0 1 0 1 0

$=1x2^7+0x2^6+1x2^5+0x2^4+1x2^3+0x2^2+1x2^1+0x2^0$

$=1x128+0x64+1+32+0x16+1x8+0x4+1x2+0x0$

$=128+0+32+0+8+0+2+0$

$=170$

$(10101010)_2=(170)_{10}$

$(10110.101)_2$

- 1 0 1 1 0 . 1 0 1

$=1x2^4+0x2^3+1x2^2+1x2^1+0x2^0$

$=1x16+0x8+1x4+1x2+0x0$

$=16+0+4+2+0$

$=22$

$(10110.101)_2=(22)_{10}$

Decimal to Binary

- $(56.25)_{10} = (\ )_2$

	Number	Remainder
2	56	
2	28	0
2	14	0
2	7	0
2	3	1
2	1	1
	0	1

	Fraction	
	.25	Multiply by 2
0	.50	Multiply by 2
1	.00	

$(56.25)_{10} = (111000.01\ )_2$

Decimal to Binary

- $(324.625)_{10} = (\ )_2$

	Number	Remainder
2	324	
2	162	0
2	81	0
2	40	1
2	20	0
2	10	0
2	5	0
2	2	1
2	1	0
	0	1

324 = 101000100

	Fraction	
	.625	Multiply by 2
1	.25	Multiply by 2
0	.50	Multiply by 2
1	.00	

$(324.625)_{10}=(101000100.101)_2$

Rough
.625x2=1.250
.25x2=0.50
.50x2=1.00

Decimal to Binary

- 43.425
- 344.25
- 462.5625
- 23.3125
- 99.8125
- 765.625
- 334.625
- 48.1875

- 43.425=101011.01

	Number	Remainder
2	43	
2	21	1
2	10	1
2	5	0
2	2	1
2	1	0
	0	1

	Fraction		Explanation
	.425	Multiply by 2	0.425x2=0.850
0	.850	Multiply by 2	0.850x2=1.70
1	.70		As there is 3 decimal point value

- $(344.25)_{10}=(101011000.01)_2$

	Number	Remainder
2	344	
2	172	0
2	86	0
2	43	0
2	21	1
2	10	1
2	5	0
2	2	1
2	1	0
	0	1

	Fraction		Explanation
	.25	Multiply by 2	0.25x2=0.50
0	.50	Multiply by 2	0.50x2=1.00
1	.00		As there is 2 decimal point value

- $(462.5625)_{10}=(111001110.1001)_2$

	Number	Remainder
2	462	
2	231	0
2	115	1
2	57	1
2	28	1
2	14	0
2	7	0
2	3	1
2	1	1
	0	1

	Fraction		Explanation
	.5625	Multiply by 2	0.5625x2=1.1250
1	.1250	Multiply by 2	0.125x2=0.25
0	.25	Multiply by 2	0.25x2=.50
0	.50	Multiply by 2	0.50x2=1.00
1	.00		

Octal Number System

- The octal number system has 8 symbols and represent binary numbers in a compact form.
  - Symbols : 0,1,2,3,4,5,6,7
  - Base : 8 as there are 8 digits in all

Hexadecimal Number System

- In the Hexadecimal number system ‘hex’ means 6 and ‘dec’ means 10.
- Hence, the decimal number system uses 16 symbols.
- The need for the hexadecimal number system was felt as numbers expressed in the binary system are often very lengthy and difficult to use.
- Hence these long set of binary numbers can be conveniently expressed in a more compact form using hexadecimal number system.
  - Symbols : 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F
  - Base : 16 as there are 8 digits in all

Word Length of Computer

- The word length of a computer denotes the number of bits that a CPU can process at one time. The word length is generally expressed in multiples of four bits(nibbles) and eight bits(bytes), so sizes of 4, 8, 12, 16, 24, 32, 48, 64, and larger came into being as advances were made in the technology used in computers. The size of the address space in a modern computer is also described by the word size in that computer. For instance, a 32-bit computer usually allows 32-bit memory addresses; a byte-addressable 32-bit computer can address 2^{32} = 4,29,49,67,296 bytes of memory. A modern byte-addressable 64-bitcomputer with proper OS support can address 2^{64} bytes which is considered practically unlimited.

PROCESSING SPEED OF A COMPUTER

The speed of a computer is linked to the technology used to build it.

In the First Generation computers, which used vacuum tubes the speed was measured in milliseconds i.e. one thousandth of a second(10^{-3}). These computers could perform 5000 additions per second and just over 3000 multiplications per second.

The speeds of Second Generation computers, which used transistors, was measured in microseconds i.e. one millionth of a second (10^{-6}). It was then common to hear that the computer could do one million additions per second.

The speeds of Third Generation computers which used integrated circuits was measured in nanoseconds i.e. thousand-millionth of a second (10^{-9}).

With the advent of Very large integrated circuits and the use of microprocessor, the unit of measure for the speeds of computers is picoseconds or one million-millionth of a second(10^{-12}).

The following comparison will give a better idea about the magnitude of these quantities.

A millisecond is to a second as a second is to 17 minutes.

A microsecond is to a second as a second is to 12 days.

A nanosecond is to a second as a second is to 32 years.

A pico second is to a second as a second is to 317 centuries.

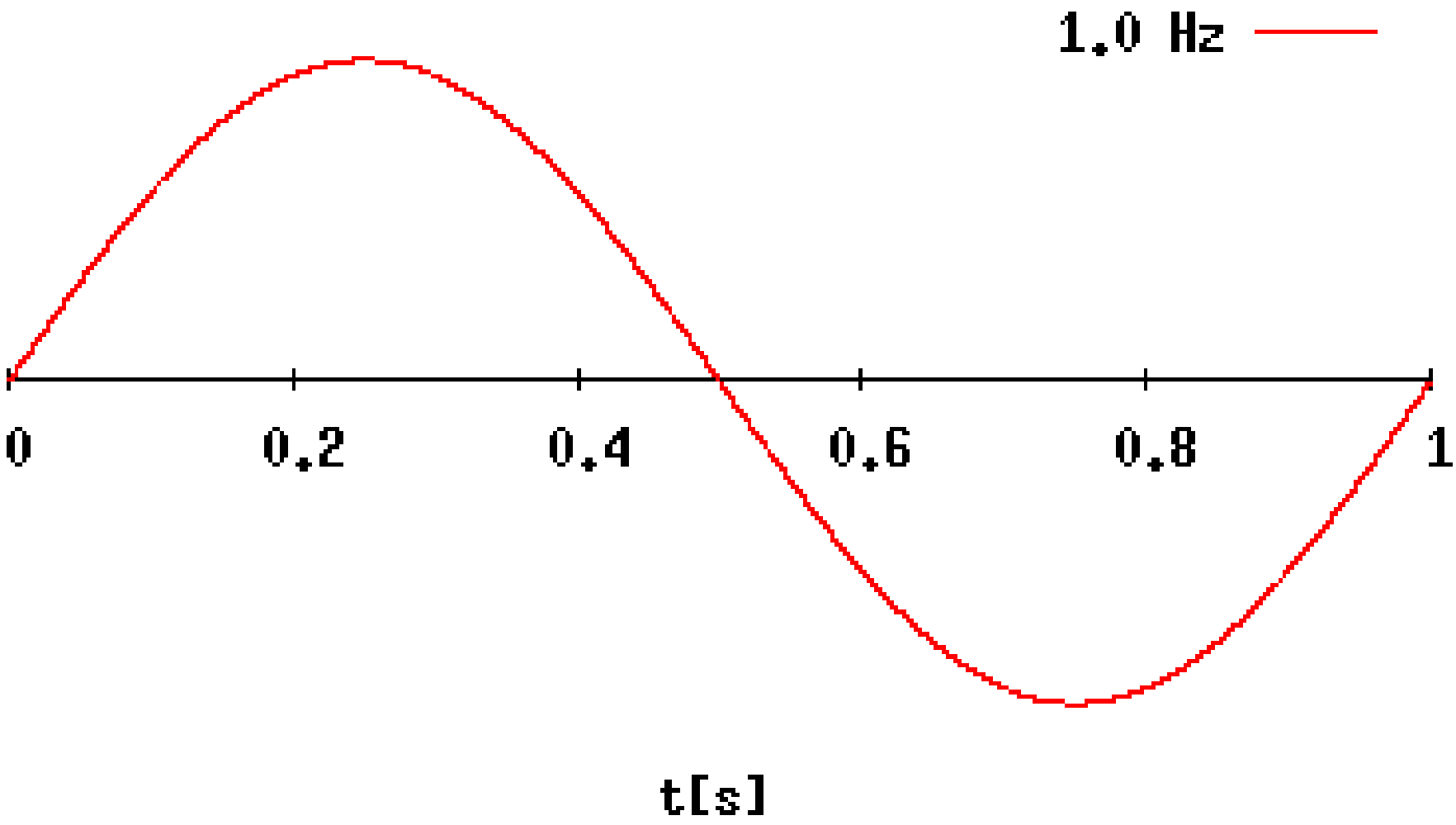
A computer's processor speed was earlier measured in MHz, which stands for mega-Hertz, which means million cycles per second. They give measurements like 600 MHz etc. Today computers speed is measured in Giga-Hertz (GHz) which means billion cycles per second. The higher this measurement is, the faster is the processor. The speed at which your computer runs programs or completes task is determined in great measure by your computer's processor speed What this represents is the speed of the clock driving the computer's processor All computers use a timing clock, actually a crystal, to drive them. This clock c crystal has high and low voltage changes, and changes at an exact frequency Each time the clock changes, the computer's processor processes some part of a instruction. So, a computer that has a 600MHz clock is doing something 600 million times per second. A 1GHz computer does something 1 Billion times per second.

Unit to Measure Frequency

1 Cycle

1000 Cycle	=	1 Hertz (Hz)
1000Hz	=	1 Kilo Hertz(KHz)
1000 KHz	=	1 Mega Hertz(MHz)
1000 MHz	=	1 Giga Hertz(Hz)
1000 GHz	=	1 Tera Hertz (THz)
1000 THz	=	1 Peta Hertz (PHz)
1000 PHz	=	1 Exa Hertz (EHz)
1000 EHz	=	1 Zetta Hertz (ZHz)
1000 ZHz	=	1 Yotta Hertz (YHz)

Sine wave Frequency



Unit II

Software and its need

- A computer system consists of hardware and software.
- The term hardware is used for the electronic parts that can compute and manipulate data.
- e.g. CPU, Memory, Keyboard, Mouse, Modem, Printer etc.
- But hardware cannot work on its own cannot do calculations.
- Hardware must be told ‘what’ calculation to do, and ‘how’ to do it.
- The hardware performs all calculations like addition, subtraction, multiplication, division etc. based on instructions given to it.
- These set of instructions, which control the sequence of operations are know as programs and a collection of program is called software.
- Thus the term computer system collectively means hardware and software.

Software

- Computer software is collection of programs and data that tell a computer what to do and how to do it.
- Software controls and manages the hardware components of a computer system.
- e.g. Software tells computer system, what to display on the computer screen, at which position on the screen, and in which colour or color.
- Software communicates with hardware and it organizes the sequence of instruction to be performed and display or prints the output for the user.
- Hardware is a tangible commodity; it can be touched and felt but software is intangible.
- This relation is similar to the relation between TV set and the programs that we see on the TV.

Computer Programming Languages

- A program is a set of instructions, in a logical sequence, written in a particular programming language, so as to give the correct output in a finite interval of time.
- A program is a precise sequence of instruction to solve a problem.
- Various programming languages are used for writing computer programs.
- There are over a thousand programming languages.
- But the most popular ones are languages like C, C++, C#(Sharp), Java, Visual Basic, Python, Ruby, FORTRAN etc.
- Different languages are used for different applications.
- e.g. C and C++ are used for scientific applications and system programs.
- Visual basic is used for developing applications with graphical user interface.

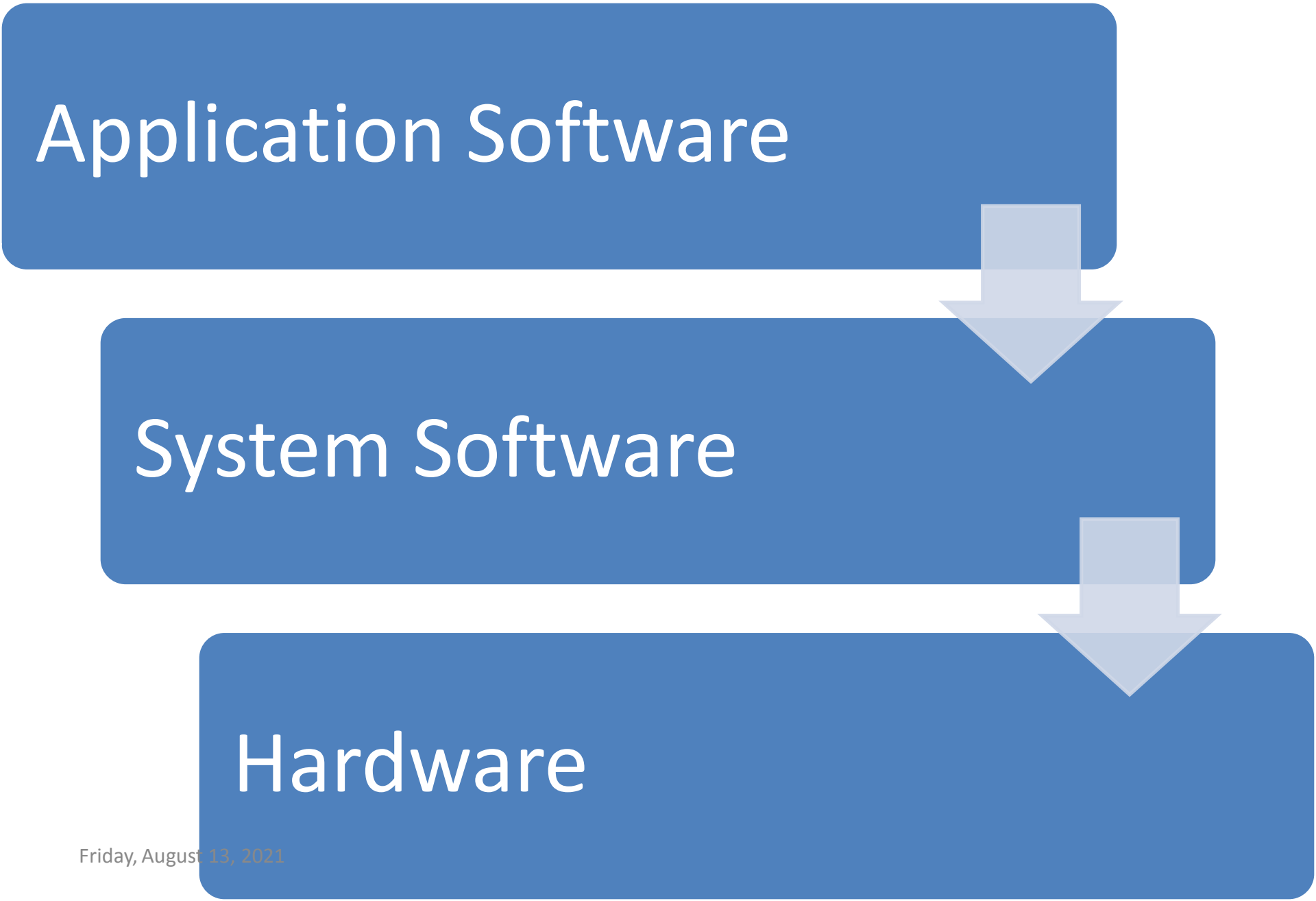
Types of Software

- The two main categories of software
  1. System Software
     I. Operating System
     II. Utility Programs such as disk defragmentation utility
     III. Library Programs
     IV. Languages Translators such as compiler, interpreter, assembler.
  2. Application Software
     I. General purpose Application
     II. Customized Application

System Software

- Software that controls the performance of a computer and permits to use the computer more conveniently is called systems software.
- Systems software consists of programs which interact with the hardware.
- They are essential for the operation of a computer system.
- They serves as the interface between the computer hardware and users.
- They not only controls the hardware but also allows other programs to run on the computers system.
- The relation between systems software, hardware and application software can seen below figure or diagram.

System Software



Operating System

- The most important type of system software is Operating System (OS).
- It is responsible for performing tasks such as accepting input from the keyboard or mouse, sending output to the display screen, keeping track of files and folders on the hard disk and controlling peripheral devices such as printer, scanner, modem.
- Since many programs can run on a computer at the same time, the operating system ensures that these programs do not interfere with each other.
- The OS provides a software platform on top of which other program can run.

Operating System

- Basic functions of Operating Systems:-
  i. Memory Management
  ii. Process Management
  iii. File Management
  iv. Device Management
  v. Security Management
  vi. User Interface

Memory Management

- It is responsible for memory management.
- When any program is to be run, it uses the primary memory i.e. the RAM(Random Access Memory).
- The program must request the operating system for the memory.
- The OS may allocate memory to this requesting program.

Process Management

- A running program is called a process.
- The OS manages which process can run, for how long and how much memory it can allocated

File Management

- The OS is responsible for creating, deleting, moving, renaming files and folders on the hard disk.
- The OS can also protect files and folders from being accidentally delete.

Device Management

- The OS manages all devices such as the Hard Disk, USB Pen Drive, Printer, Scanner, modem etc.
- If any device fails, the OS detects the device failure and informs the user.

Security Management

- Security management means preventing unauthorized users from using computer resources.
- The OS can do the task by asking username and password for using a computer system or for using a file / folder.

User Interface

- The OS provides the interface between the hardware and the user.
- This interface can be a graphical user interface (GUI) like Microsoft windows and Linux or it may be a character user interface (CUI) like MS-DOS (Microsoft Disk Operating System) and UNIX.

Examples of Operating System

- Windows 95
- Windows 98SE
- Windows ME
- Windows 2000
- Windows 2000 Server
- Windows XP
- Windows Vista
- Windows 7
- Windows 8
- Windows 8.1
- Windows 10

- Red Hat
- Ubuntu
- Knoppix
- Win BEE
- Kali
- BOS (Bharat OS)
- Choromium

Android OS

- Alpha
- Beta
- Cupcake
- Doughnut
- Éclairs
- Farelo
- Ginger Bread
- Honey Comb
- Ice Cream Sandwich
- Jelly bean
- Kitkat
- Lolipop
- Marshmallow
- Naught
- Oreo
- Pie

Utility Programs

- It perform specific task related to the management of hardware.
- e.g. Compression Programs, backup programs, disk management, disk formatters, disk defragmentation and other disk management tools.
- Many utility programs are part of Operating Systems.

Library Programs

- They are libraries of commonly-used routines.
- On a Windows System they have the file extension called DLL and are called as run-time libraries.
- The libraries are run-time because they are called upon by running programs when they are needed.
- Some library programs are provided within the operating systems like Windows.

Language Translators

- The programs we write in programming languages like C, C++, Java etc. are called source code.
- These languages are called high level languages because they cannot directly understood by CPU.
- The CPU and hardware can only understand instructions that are in binary language of 1 s(One's) and 0 s (Zero's) and this language is called machine language or low level language .
- The job of the language translator is to convert the high-level language instruction into machine code.

- The three main categories of language translator are:-
  1. Interpreter
  2. Compiler
  3. Assembler
     1. Interpreter:- Interpreter translates the source code at run-time i.e. when the program run.

        The Interpreter translates statements one-at-a-time as the program is executed.

        Interpreters are used to execute high-level language programs while they are being developed since this can help in in detecting errors easily.

        Interpreters are used with high-level languages like BASIC, PHP, JavaScript and many more.

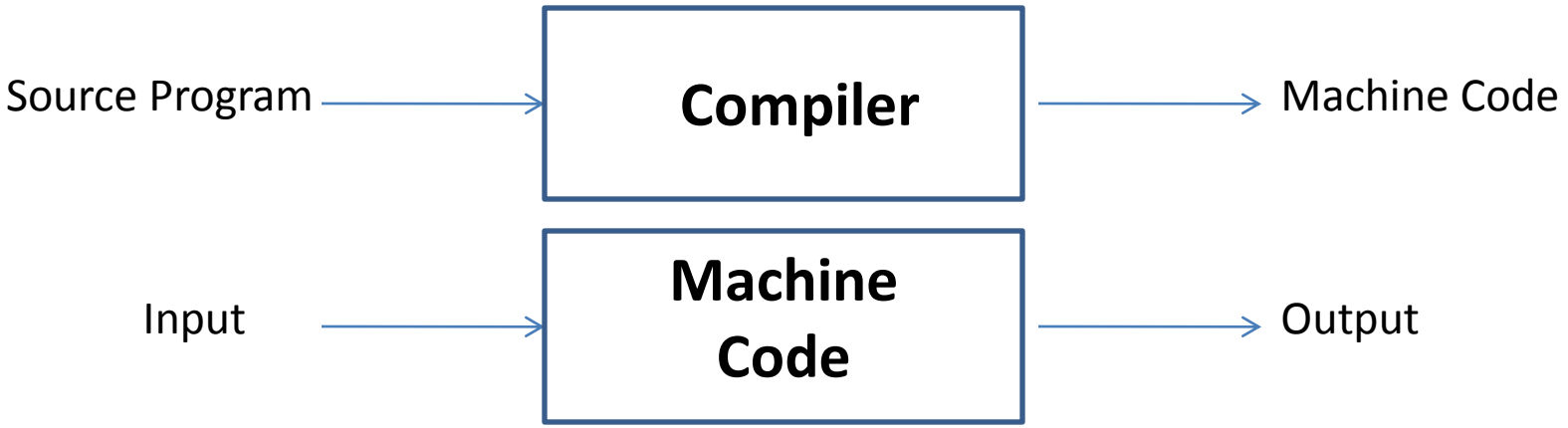
Characteristics of Interpreters

- Interpreter translates the source code one line at time.
- Each time the program is executed, every line of the program is checked for syntax errors and then converted to machine code.
- But this machine code is not saved on the disk and the translated statement is executed.
- The source code is needed for repeatedly executing the program.
- Thus, source code can be easily modified and hence there is no security of programs.

- It is useful for testing and debugging of programming as the machine code is not saved.
- A different interpreter is required for each programming language.
- e.g. a program written in Java language can only be executed by a Java interpreter.
- Java programs are partly compiled and partly interpreter.
- The disadvantage of interpreter is that since the machine code is not saved, each time the program must be translated into machine code.
- Hence interpreted programs run slowly.

Compiler

- A compiler translates a source code into machine code.
- The machine code can then be executed to give the output.
- This is illustrated in the figure below



- e.g. Turbo C, Turbo C++, Visual C#.

Characteristics of Compiler

- Compiler first scans the entire program and then translates it into machine code.
- It converts the entire program to machine code.
- When all the syntax errors have been removed the program is executed.
- The execution time for a program is less, compared to interpreter.
- Machine code is saved and used later when the program is to be run.
- Once the machine code is saved, the source code is no longer needed and hence this ensures the security of the source code.
- A different compiler is required for each programming language.
- e.g. a program written in C language can only be translated into machine code by C compiler.
- Compiler-based programs are slow for debugging.

Assembler

- Programs written in assembly language use special mnemonic codes such as ADD for addition, MUL for multiplication etc.
- An assembler is a program that translates the mnemonic codes into machine code.
- 1 ADD 2 = 3
- 1 MUL 2=2
- Each instruction in assembly language has an equivalent machine code instructions.

Application Software

- It is software that is used for specific task.
- A user interacts with a computer system by using application software.
- e.g. a word processing software such as Microsoft Word, notepad, wordpad etc. are used for typing reports, documents, letters etc.
- A spreadsheet such as Microsoft Excel, is used for numerical calculations.
- Similarly, a graphics-based software such as Corel Draw is used for graphical applications.
- A computer system without application software is of no use.
- It may consist of a single program such as the text editor notepad that is provided with Microsoft Windows, or it may be a collection of programs called a software package or software suite such as Microsoft Office.

- Microsoft Office is a collection of most commonly used application such as word processor (MS-Word), spreadsheet (MS-Excel), presentation software(MS-PowerPoint), publishing software (Publisher) and database management software (MS-Access).
- Application Software runs under the control of the operating system.
- It is created for a particular class of computer architecture such as PC cannot run on a computer with another architecture such as Macintosh System.
- Application software can be of two types:-
  1. General purpose application software such as Microsoft Office or Open Office. Many users can use the same software.
  2. Customized application software such as billing software for a trading company or income tax software for a tax consultant. This type of software is tailor-made according to the specifications of the client.

Algorithms

- The word algorithm is named after the ninth century scholar Abu Jafar Muhammad Ibn Musu Al-Khwarizmi.
- An algorithm is a step-by-step procedure by which a computer can produce the required outputs from the available inputs.
- An algorithm must have a finite set of steps in reaching the solution of the problem.
- We can say that an algorithm is a set of rules that precisely defines the sequences of operations that have to be performed to generate the required output.

- An algorithm can be written in English-like language.
- But since English language is not precise, most algorithms are written in notation called pseudocode (स्यूडोकोड).
- A pseudocode looks like statements form a programming language but it will not actually run on any computer.
- Pseudocode is simple, readable and has no grammatical rules.
- The words algorithm and pseudocode are often used interchangeably.

- Algorithm is useful because it can be used to state the sequence of step s that will eventually lead to the correct output.
- While writing an algorithm, the programmer need not be concerned about the syntax of the programming language.
- Thus, an algorithm can be used to write the program in any programming language because the logical steps are given in the algorithm.
- An algorithm can also be used to reduce the number of steps in computation and increase the speed of computation.

- The three types of algorithms we will study in this syllabus are:-
  1. **Based on Input-Process-Output:** In this type, we take input from the user, use a formula for calculations and display (output) the result.
  2. **Based on Input-Decision-Process-Output:** In this type, we take input from user, check whether the input is correct and then use a formula for calculations and display the result. If the input is invalid, we terminate the process.
  3. **Based on Simple Loops:** In this type, we take input from the user, use a formula for calculations and display result. We then perform the steps all over again as many times as indicated by the user or till a condition is true. These types of algorithms will usually also involve decision making.

1. Examples Based on Input-Process-Output:

Example 1: Computing total marks obtained by student.

Lets us consider a simple example of calculating total marks obtained by a student in three subjects. The following algorithm show the steps in performing calculations. Observer that the sequence of steps is important; we cannot change the sequence because it is in a logical order.

Step 1 : Enter the marks of subject 1 (Let us call this MKS1).

Step 2 : Enter the marks of subject 2 (MKS2).

Step 3 : Enter the marks of subject 3 (MKS3).

Step 4 : Calculate total marks: Total= MKS1+MKS2+MKS3.

Step 5 : Display MKS1, MKS2, MKS3 and Total.

Example 2: Algorithm to convert an amount in US Dollar ($) into equivalent amount in Indian Rupees (INR) (₹)

Step 1 : Enter the amount in US dollars (Let us call this D)

Step 2 : Let conversion rate be 1 US Dollar = INR 74.

Step 3 : Amount in Indian Rupees (R) = D * 74. (* Asterisk)

Step 4 : Display the amount in US dollars and the amount in Indian Rupees.

Home Work

Write algorithm for Computing the total marks obtained by you in SYBCOM Semester III.

Example based on Input-Decision-Process-Output

Example 3: An algorithm for a simple calculator.

Step 1: Get two numbers (A and B) and the operation desired

Step 2: Check the operation:

- Step 2.1: If the operation is addition, the result is A + B.
- Step 2.2: If the operation is Subtraction, the result is A - B.
- Step 2.3: If the operation is Multiplication, the result is A * B.
- Step 2.4: If the operation is Division, the result is A / B.
  - Step 2.4.1: If the second number (B) is zero, create an error message(Since division by zero is not defied).
  - Step 2.4.2: If the second number (B) is not zero, the result is A / B.
- Step 2.5: If the operation is Percentage, the result is A % B.
- Step 2.6: If the operation is Square root, the result is A & B.

Step 3: Display the result or the error message.

Example 4: An algorithm to find the largest of three numbers.

Step 1: Read the numbers A,B and C.

Step 2: Max=A(Assume A is the largest numbers.)

Step 3: If B>Max, then Max=B.

Step 4: If C>Max, then Max =C.

Step 5: Display Max.

A,B,C,MAX

A=5,B=20,C=25,MAX=0

MAX=A (MAX=5)

B>MAX (MAX=20)

C>MAX(MAX=25)

MAX=25

Examples based on Loops:

Example 5: Write an algorithm to find

the sum of first 10 numbers?

Step 1 : Initialize sum S = 0.

Step 2: Initialize N = 1 (N is a variable that will take on different values from 1 to 10).

Step 3 : Calculate S = S + N.

Step 4: Calculate N = N + 1.

Step 5: If N > 10, then go to Step 6 else go to Step 3.

Step 6: Display the sum S.

Step 7: Stop.

Examples based on Loops:

Example 6: An algorithm for a simple ATM machine.

The following example illustrates an algorithm for a simple ATM machine

Step 1 : Insert the ATM card into the slot.

Step 2: Get the password from the user.

Step 3: If the password is not valid, display an error message and go to step 7.

Step 4: Get the inputs

Step 4.1:Get the type of transaction

(deposit or withdrawal) and the amount from the user.

Step 4.2: Get the current balance form the bank.

Step 5: If the transaction type is deposit, add the amount to the current balance.

Step 6: If the transaction type is withdrawal, check the current balance.

Step 6.1: If amount is greater than the current balance, display an error message and go to Step 7

Step 6.2: If amount is equal to or less than the current balance, subtract the amount from the current balance.

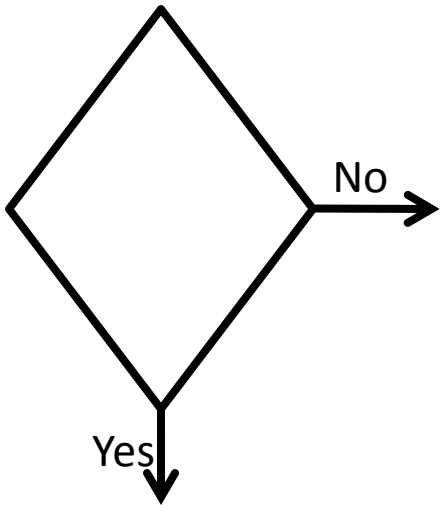
Step 7: Output the error message or the cash and Display the current balance.

Step 8: Ask the user whether to repeat Steps 1 through 6 for another transaction.

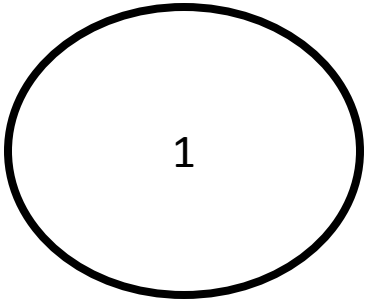
Flowcharts

- A flowchart is a graphical representation of an algorithm.
- They are useful in understanding complicated and lengthy problems.
- Once flowchart is drawn, it becomes easy to write the program in any high level language.
- They are helpful in explaining the program logic to others.
- It is a must for better documentation of complex program.
- The word flow indicates the flow of logic and is represented on the diagram by directed arrows.
- They have an advantage over algorithm.
- Since they are in the form of pictorial symbols, they are easy to understand.

Symbols used in Flowcharts

	Processing step : Represented by a rectangle. For example, N=N+1.
	Input / Output : Represented by Parallelogram Such as “Read X”, Output “N”
	Condition or Decision : Represented by the diamond shape. This is usually a Yes / No type or True / False test. There are two arrows coming out of it. One arrow comes out of the bottom of the diamond shape and the other arrow comes from the right side. The arrows should always be labeled.

Symbols used in Flowcharts

	Circle represents a connector for joining parts of a flowchart . There is a label inside circle. Labeled connectors are used in complex or multi-sheet diagrams to substitute for arrows. For each label, the “outflow” connector must always be unique but there may be any number of inflow connectors.
	Display. This is an alternative to the parallelogram that is used for both input and output. This symbol is used only for displaying output on screen.
	Flow of control : An arrow coming from one symbol and ending at another symbol represents that control passes to the symbol the arrow point to.
	Start or End : The Start or End of a flowchart is represented with rounded rectangles, usually containing the word “Start” or “End” / “Stop”

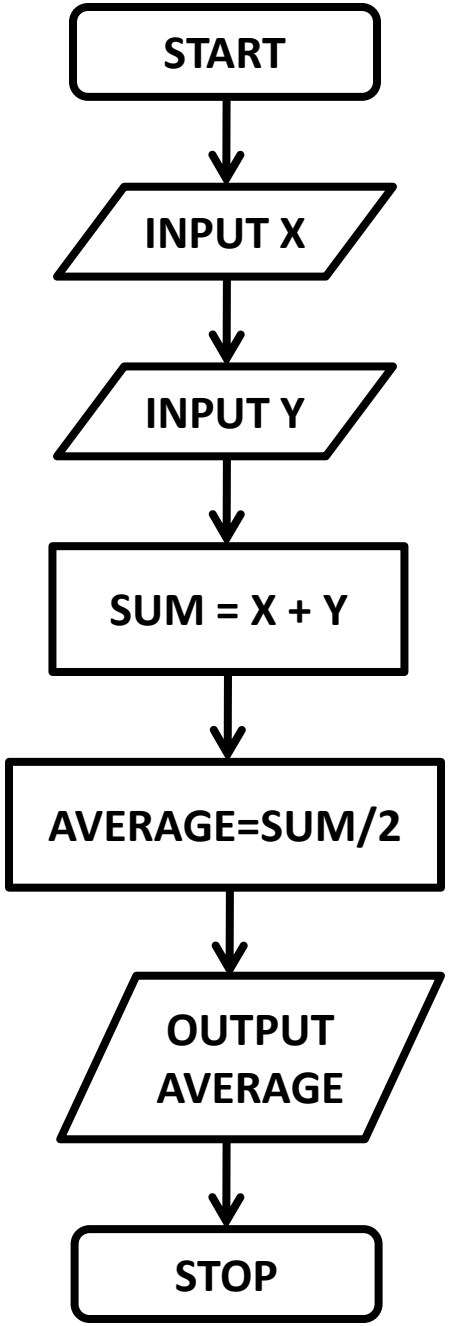
Guidelines in drawing flowchart:

1. The flowchart must be in a logical sequence and drawn using the standard flowchart symbols.
2. The flowchart should be clear, neat and easy to follow. There should not be any ambiguity in understanding a flowchart.
3. The direction of flow is from top to bottom and form left to right.
4. Only one flow line should come out form a process symbol.
5. Only one flow line should enter a decision symbol but two arrows, one form each answer, must leave the decision symbol.
6. Diamond shapes guidelines:
    I. Only one flow line is used with the terminal (Stop) symbol.
    II. If the flowchart becomes complex, it is better to use connector symbol to reduce the number of flow lines.
    III. Avoid the intersection of flow lines.

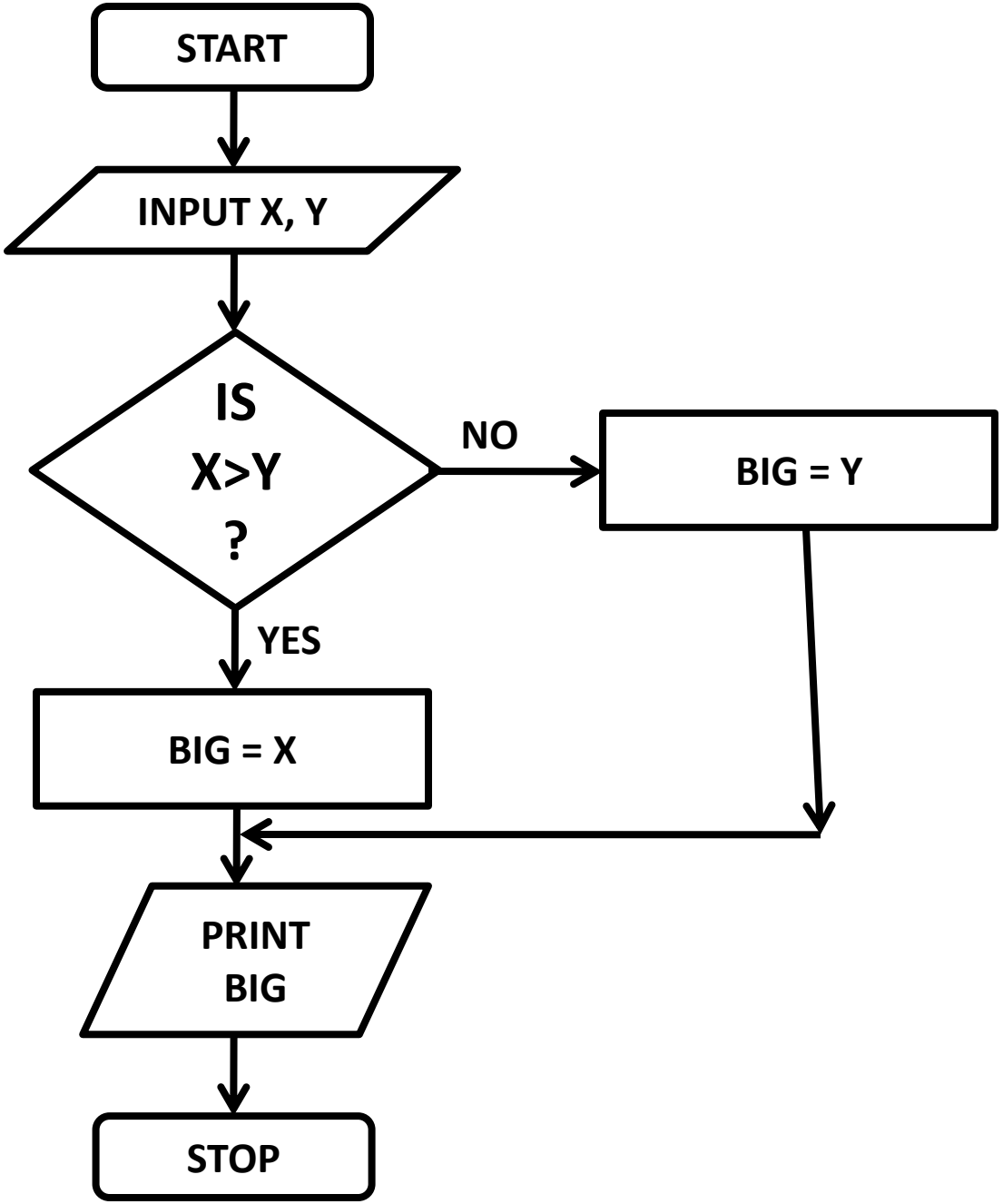
Limitations of flowcharts:

1. Complex:- When a program is very large, the flowchart may continue for many pages and may become difficult to follow. It is also very laborious to draw a flowchart for large problems.
2. Costly:- The time and cost factor for drawing a flowchart for a large program is very high.
3. Difficult to modify: Due to its symbolic nature, any change to a flowchart means redrawing the.
4. No updates: Programs are updated regularly but it may not be possible to redraw the flowchart due to its graphical nature. As more and more modifications are made to the program, the flowchart logic may not be the same as the program logic. This defeats the very purpose of drawing a flowchart which was to document the source code (Program).

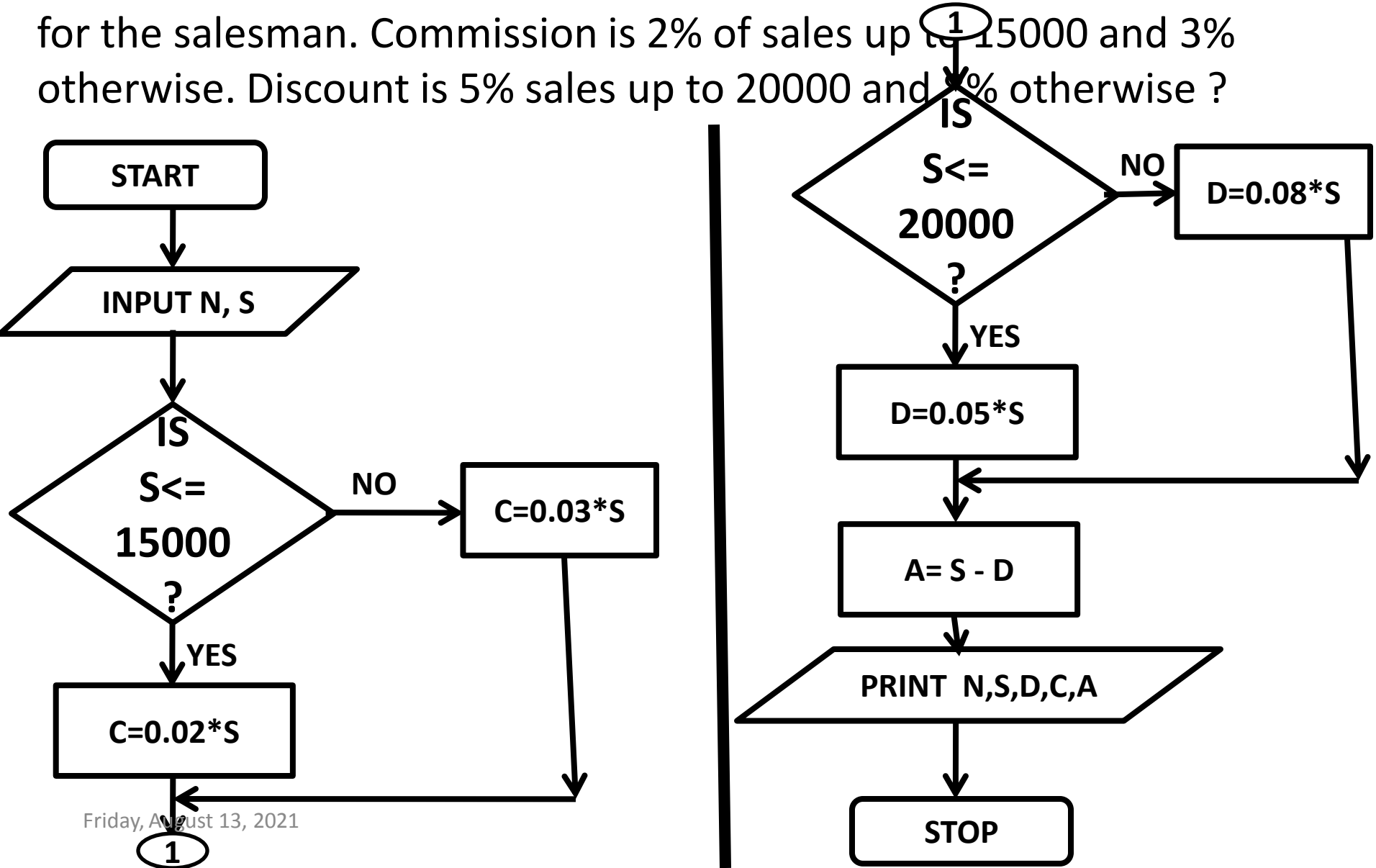
Example 1: Draw the flowchart for finding the average of two numbers?



Example 2: Draw the flowchart that reads two numbers and prints the large number?



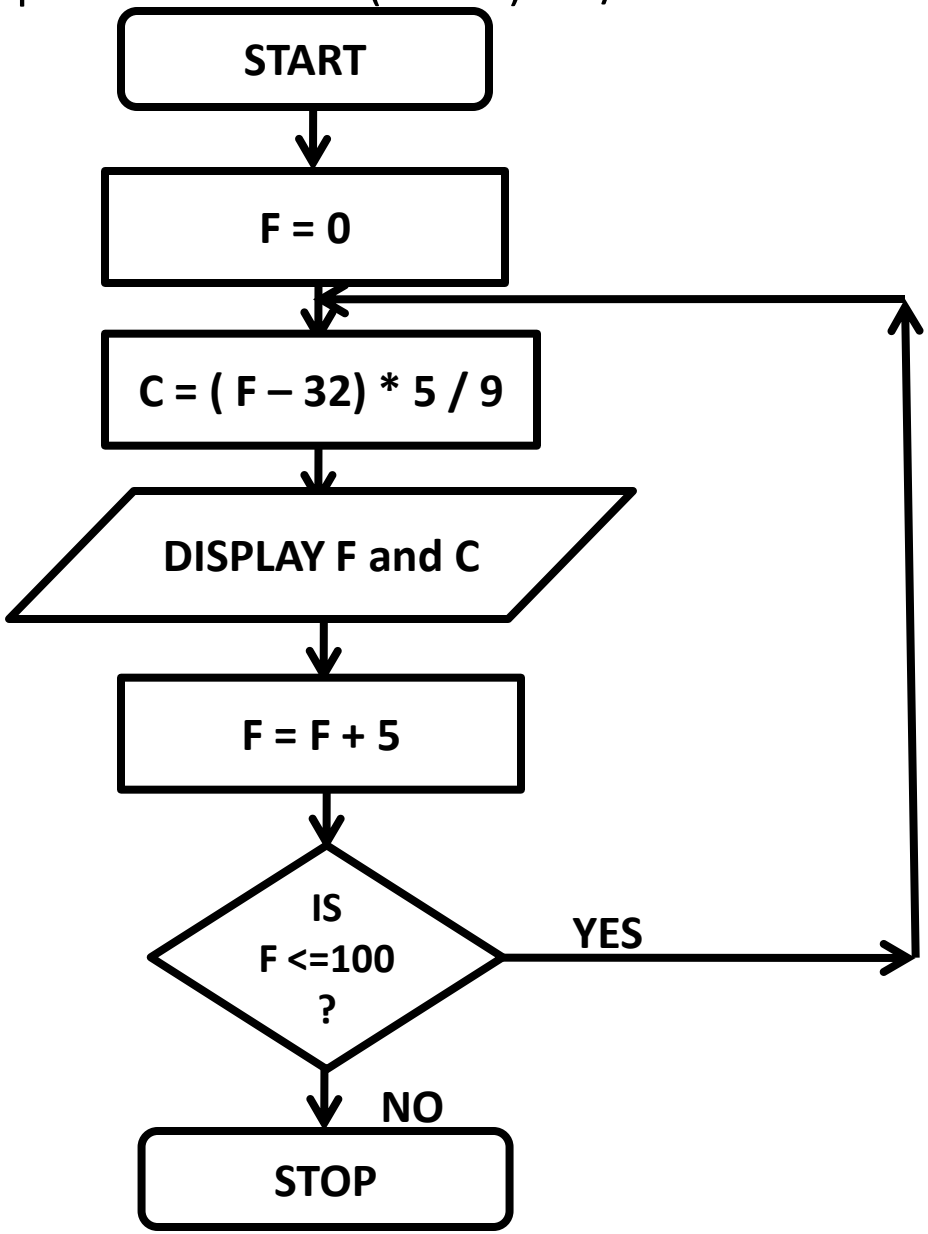
Example 3: Draw the flowchart for the following problem:
Input the name and sales of an employee and calculate and display the name, sales discount and net amount for the customer and commission for the salesman. Commission is 2% of sales up to 15000 and 3% otherwise. Discount is 5% sales up to 20000 and 8% otherwise ?



Example 4: Draw a flowchart to convert temperature in degree Fahrenheit into degree centigrade for all temperature from 0 ° to 100 °, in steps of 5°?

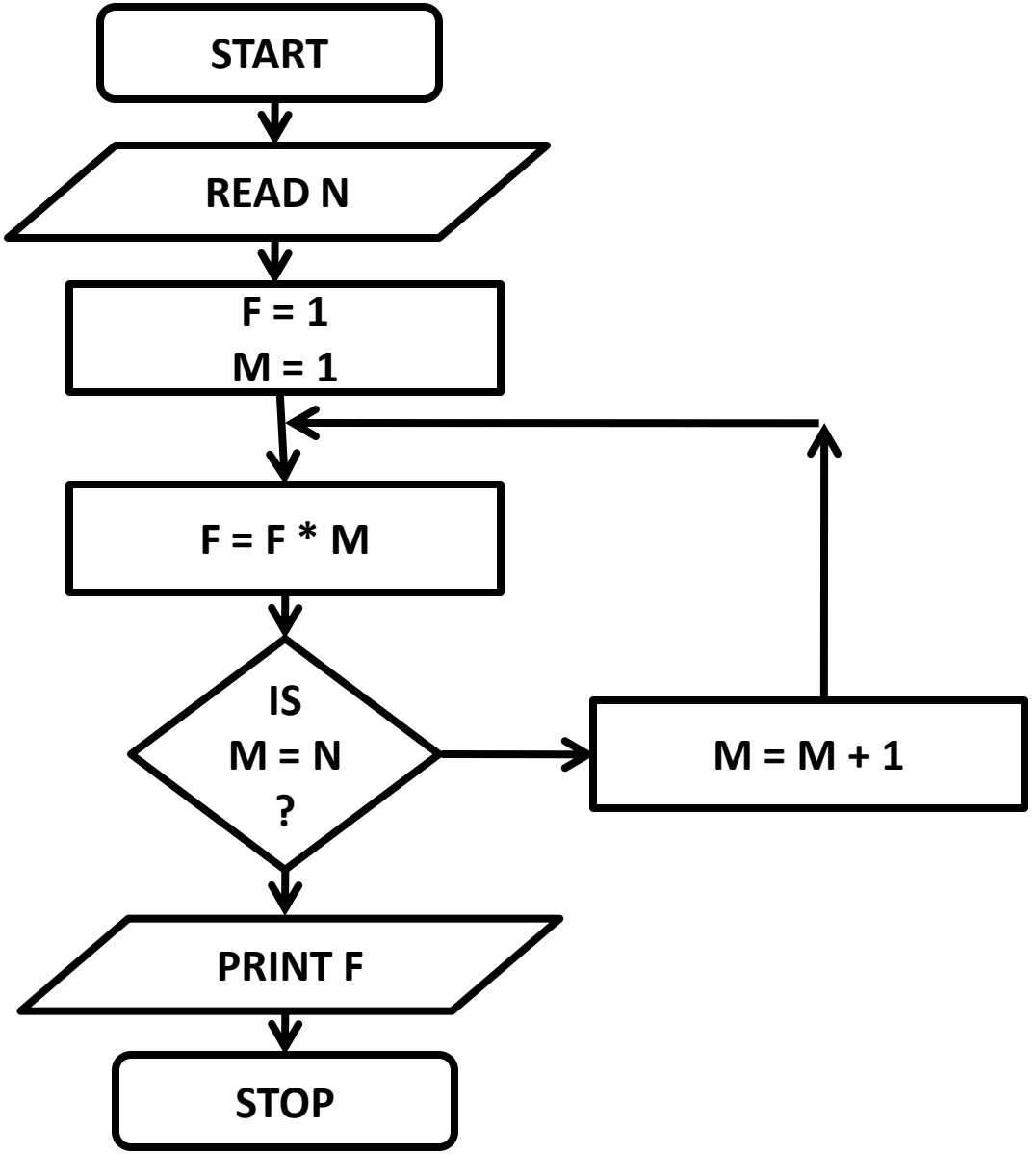
Formula for conversion : Temperature in °C = (°F -32)* 5 / 9

FAHEREIT	CENTIGRADE
0	-17.78
5	-15.00
10	-12.22
15	-9.44
20	-6.67
25	-3.89
30	-1.11
35	1.67
40	4.44
45	7.22
50	10.00
55	12.78
60	15.56
65	18.33
70	21.11
75	23.89
80	26.67
85	29.44
90	32.22
95	35.00
100	37.78



EXAMPLE 5: Draw a flowchart to compute the factorial of a Number N.
Factorial of a number say N is represented by N!. Factorial of a number say 5, is the product of all numbers from 1 to 5. Thus 5!= 1 x 2 x 3 x 4 x 5 i.e. 120

N = 6 NUMBER
F = 1 FACTORIAL
M = 6 TEMP
1 X 1 = 1
1 X 2 = 2
2 X 3 = 6
6 X 4 = 24
24 X 5 = 120
120 X 6 = 720



LAB 1 : Writing Algorithm and drawing flowcharts (Input-Process-Output).

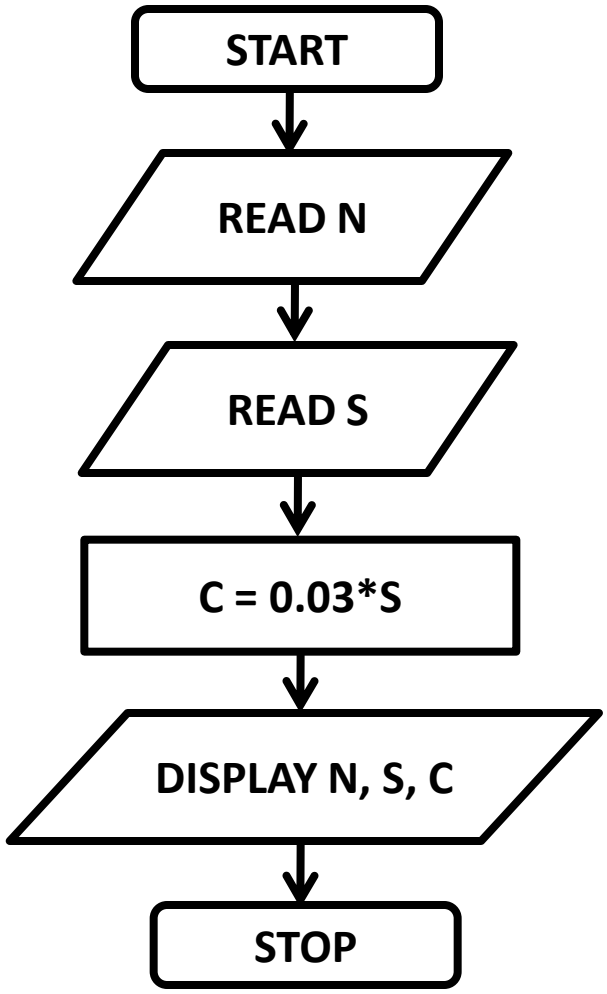
Example 1:

Write an algorithm and draw flowchart to input the name of an employee and sales achieved by him / her and output the commission. Assume commission is 3% of sales.

ALGORITHM

Step 1: Enter the name of the employee (N).
Step 2: Enter the sales amount (S).
Step 3: Calculate commission (C) = 0.3*s.
Step 4: Display name, sales and commission.

FLOWCHART



LAB 1 : Writing Algorithm and drawing flowcharts (Input-Process-Output).

Example 2:

Write an algorithm and draw flowchart to exchange values of two variables.

ALGORITHM

Step 1: Enter the first number (A).

Step 2: Enter the second number (B).

Step 3: T=A.

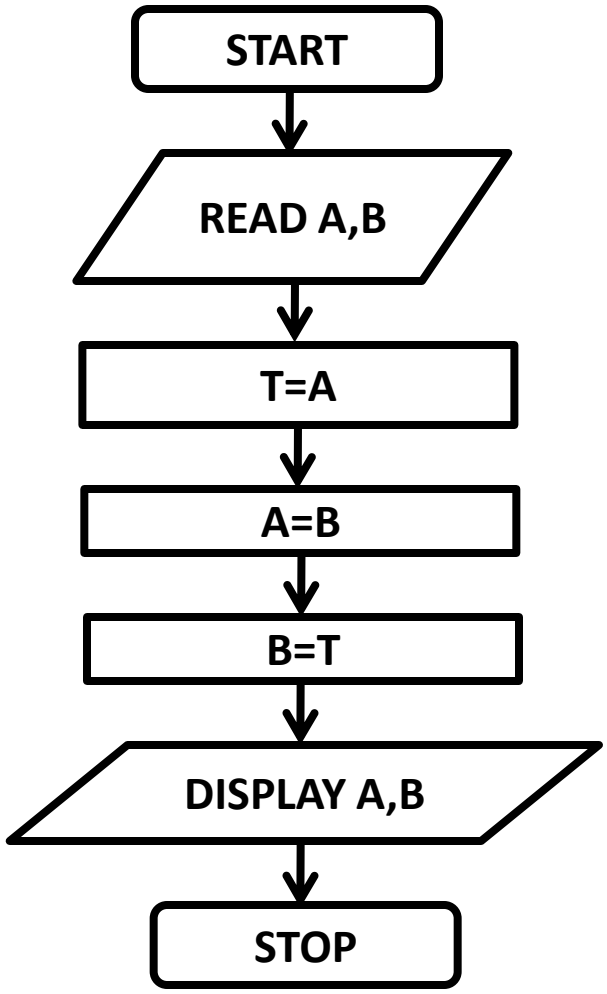
Step 4: Step 1: A = B.

Step 5: B = T

Step 6: Display A,B.

Step No.	T	A	B
1	-	5	-
2	-	5	7
3	5	5	7
4	5	7	7
5	5	7	5

FLOWCHART



LAB 1 : Writing Algorithm and drawing flowcharts (Input-Process-Output).

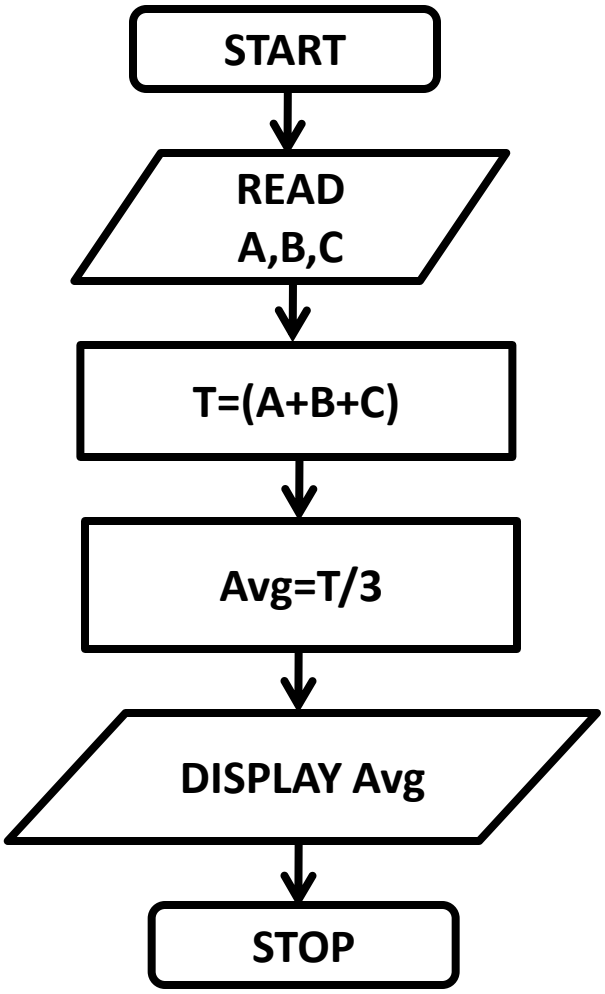
Example 3:

Write an algorithm and draw flowchart to get three data values a, b and c from the user and display the average of these three values.

ALGORITHM

Step 1: Enter the first number (A).
Step 2: Enter the second number (B).
Step 3: Enter the three number (C).
Step 4: Total = A + B + C.
Step 5: Avg = Total / 3.
Step 6: Display Avg.

FLOWCHART



LAB 2 : Writing Algorithm and drawing flowcharts (Input-Process-Decision-Output).

Example 1:

Write an algorithm and draw flowchart to find the highest marks obtained in a class.

We assume that we do not know in advance the number of students in the class. We keep accepting the marks when the mark entered is -1, we stop accepting further input. We use the following variables in this algorithm.

Count – it count the number of students whose marks are entered.

Max – it keeps a track of the highest marks at any stage.

Mark – to accept the marks from the user.

ALGORITHM

Step 1: Count = 0.

Step 2: Max = 0.

Step 3: Read Mark.

Step 4: If Mark = -1, go to step 8.

Step 5: If Mark > Max, Replace Max with Mark.

Step 6: Count = Count + 1.

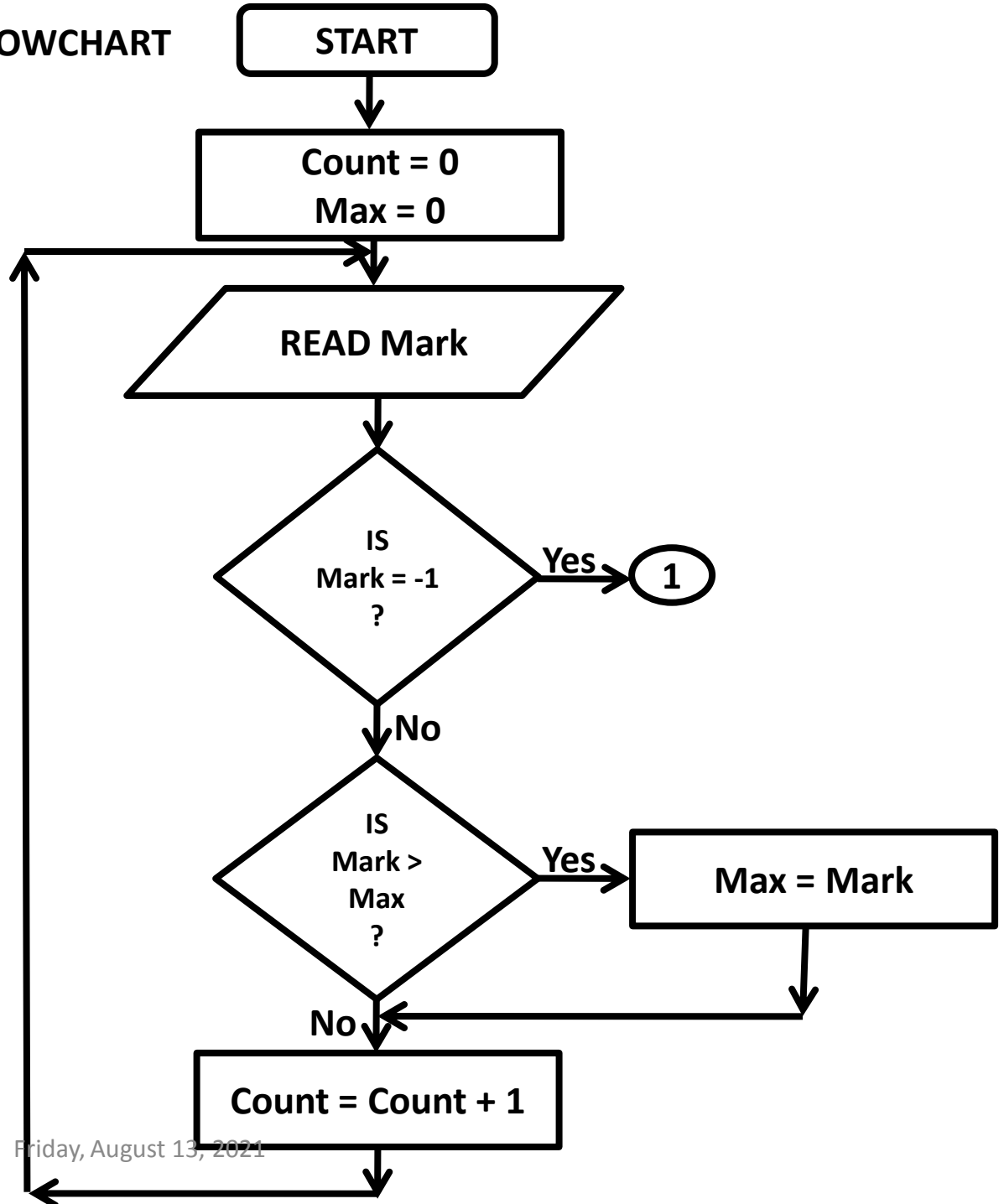
Step 7: Go back to Step 3.

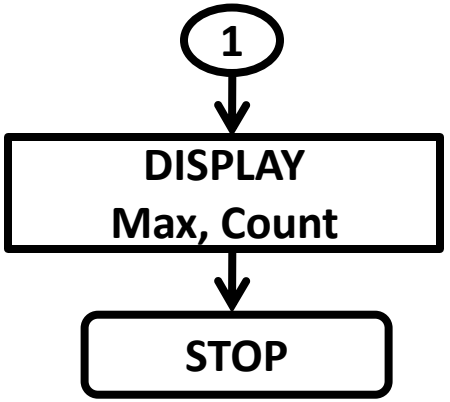
Step 8: Display Max, Count.

Aastha	45
Paresh	40
Yash	90
Pooja	55
Rahul	35
Rohit	65
Sai	60
7	90

Count =	7
Max =	90
Mark =	-1

FLOWCHART


START
Count = 0
Max = 0
READ Mark
IS
Mark = -1
?
Yes
1
No
IS
Mark >
Max
?
Yes
Max = Mark
No
Count = Count + 1

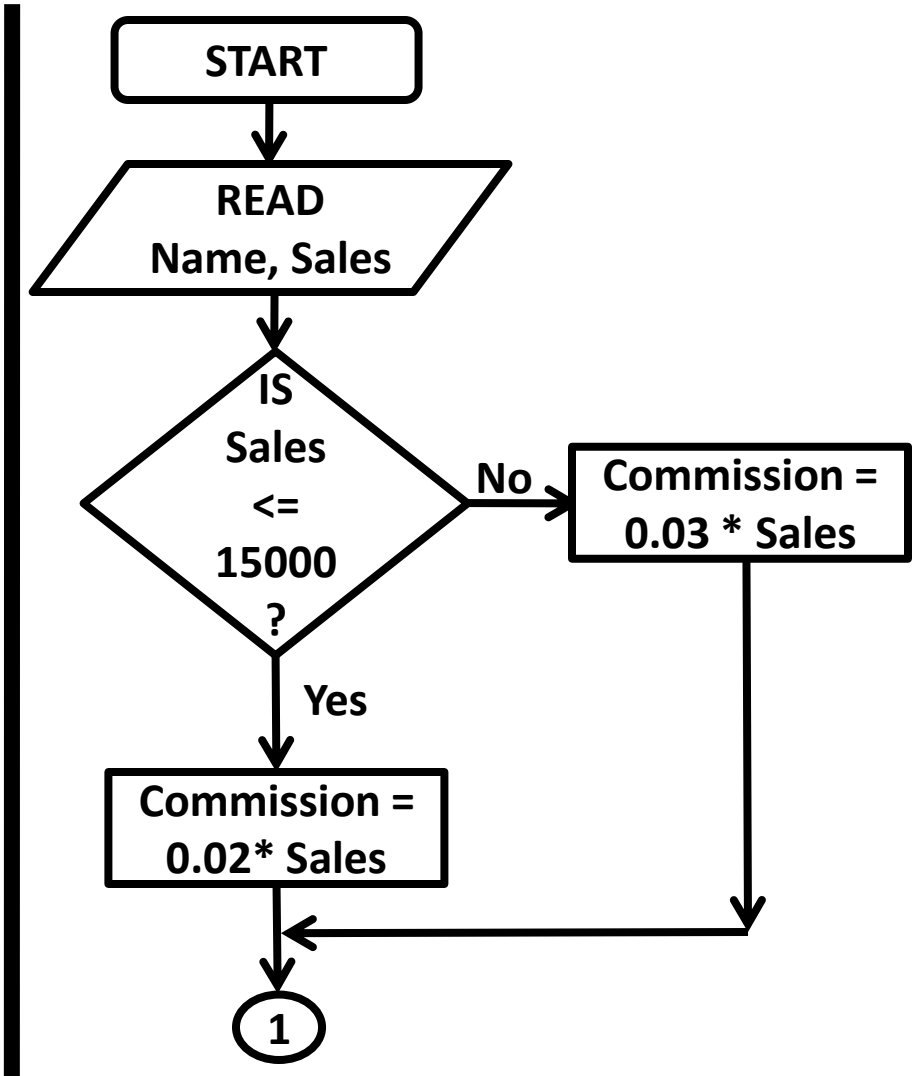

1
DISPLAY
Max, Count
STOP

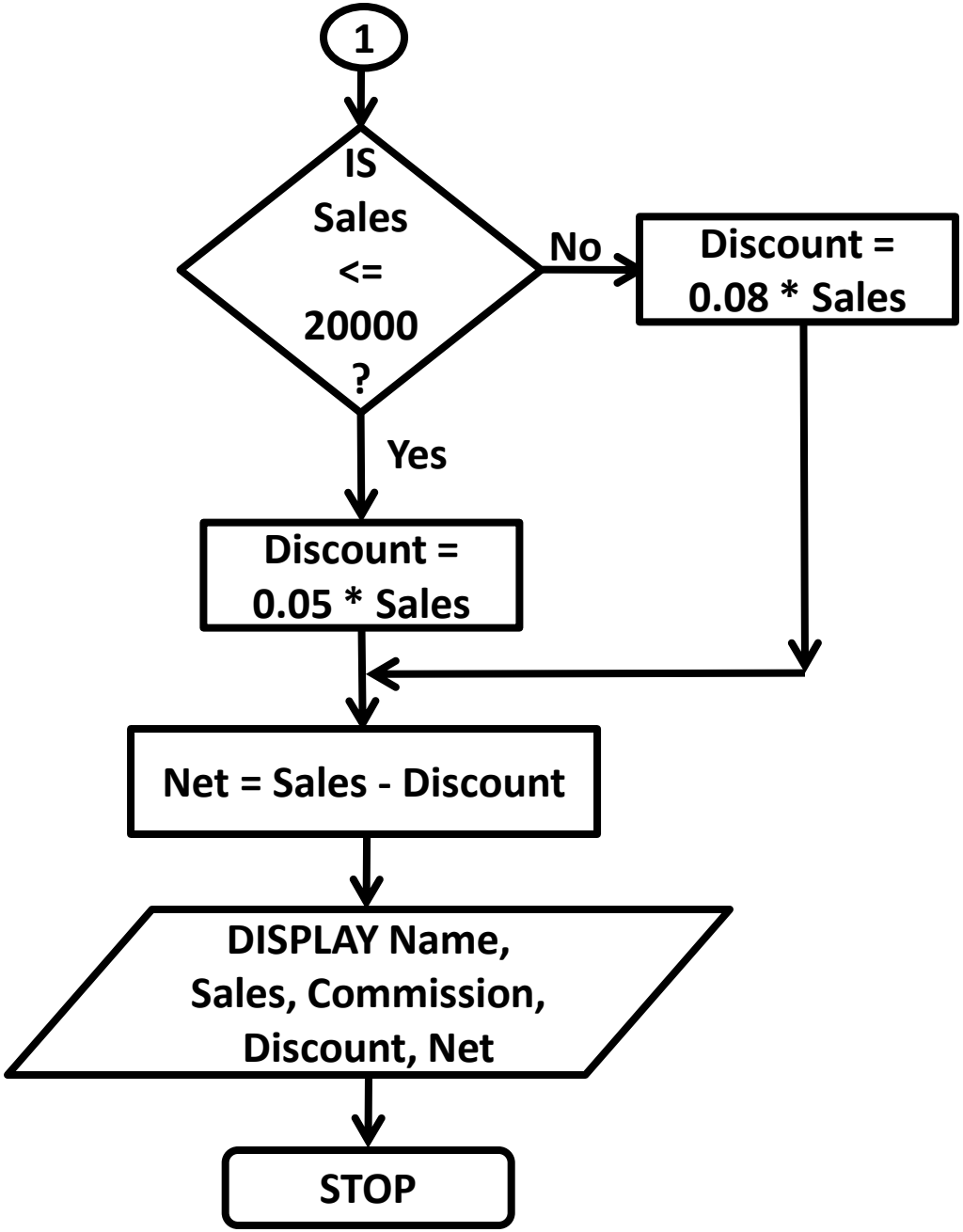
LAB 2:

Example 2: Write an algorithm and draw flowchart to input the name and sales of an employee and calculate and display the name, sales, discount and net amount for the customer and commission for the salesman. Commission is 2% of sales for sales up to 15000 and 3 % otherwise. Discount is 5% on sales up to 20000 and 8% otherwise.

Algorithm

Step 1: Enter name of employee (N).
Step 2: Enter sales (S).
Step 3: If S <= 15000, then commission (C) = 0.02 * S else C = 0.03 * S.
Step 4: If S <= 20000, then discount (D) = 0.05 * S else D = 0.08 * S.
Step 5: Net amount payable by customers A = S – D.
Step 6: Display Customer Name (N).
Step 7: Display Sales Amount (S).
Step 8: Display Discount (D).
Step 9: Display Net Amount (A).
Step 10: Display Commission (C).




1
IS Sales <= 20000 ?
No
Discount = 0.08 * Sales
Yes
Discount = 0.05 * Sales
Net = Sales - Discount
DISPLAY Name, Sales, Commission, Discount, Net
STOP