For
6th Semester
Mathematics (Major)
Paper-M603 (Computer Programming in C)
Topic: Central processing, main memory, secondary memory, input/output devices, operating system and its need, representation of numbers and characters in computer

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Central Processing Unit

The CPU is the most essential unit of a computer. It guides, directs and governs the performance of a computer. That is why the CPU is sometimes also called the brain of the computer. The CPU consists of three units- i) Memory Unit ii) Control Unit (CU) and iii) Arithmetic and Logic Unit (ALU).

Control Unit (CU)

The control unit of a computer controls and guides the entire working of the computer. This unit sends control signals to perform required operation by the ALU and memory. An important operation of the CU is the program execution. The CU gets the instructions of a program from memory. When the CU gets an instruction, it is decoded and selects which operation is to be performed. Then the required operation is performed for that instruction. When the execution of the instruction is completed, the CU sends a signal asking for the next instruction to be executed. This unit also controls the transfer of data between memory and Input/output unit of a computer.

Arithmetic and Logic Unit (ALU)

The ALU performs the arithmetic and logic operations on the data coming from the memory unit. The data on which the arithmetic or logic operation is to be performed are sent from the memory to the ALU where the arithmetic or logic operation takes place and the result is returned to the memory.

Memory Unit (MU)

Memory unit is an important unit of a computer system. This unit is responsible for storing instructions, data and the intermediate results after doing specific operations on that data. The memory of a computer keeps instructions and data to perform some tasks. After finishing its tasks, it clears the memory and the memory space is then available for the other tasks. When a computer is switched off , the data stored in the memory gets lost.

Main Memory or Primary Memory

Primary or main memory is a part of the CPU. That is why, the primary memory is also sometimes called internal memory. The primary memory is a volatile memory. i. e. the data remains in the memory as long as the voltage is supplied to the computer. When the power supply to the computer is switched off, the data are lost. It is made up of electronic circuit. Primary memories are divided into types-

A. RAM (Random Access Memory)
B. ROM (Read Only Memory)

RAM (Random Access Memory)

It is a read write memory. i. e. information can be read from and write into the memory. It stores data temporarily. Information remains in the memory until the computer is switched off. RAMs with different capabilities are 128K, 256K, 512K etc. Two types RAMs are- Static RAM and Dynamic RAM.

Static RAM (SRAM)

Static RAM is simply called SRAM. It keeps information as long as the power is supplied to the computer. SRAMs are costlier and consume more power. They have higher speed than the Dynamic RAMs.

Dynamic RAM (DRAM)

Dynamic RAMs are simply called DRAM. DRAMs lose information in a very short time (a few milliseconds) even though the power is supplied to the computer. Therefore, the DRAMs have to be refreshed periodically, generally after every 2 milliseconds. These RAMs are cheaper and high packing density and moderate speed.

ROM (Read Only Memory)

ROMs are permanent type memory. As the name specifies, data can only be read from this memory. You cannot write data onto this memory. The contents of this type of memory are written at the time of manufacturing. It is held on chip inside the processor and is used to hold data. Different types of ROMs are – PROM, EPROM, ÈEPROM.

PROM, EPROM and EEPROM

PROM means Programmable Read Only Memory. Programmed data are stored in this ROM. EPROM and EEPROM are two types of PROMs in which programmed data can be erased.

EPROM means Erasable Programmable Read Only Memory and EEPROM means Electrically Erasable Programmable Read Only Memory. In EEPROM, programmed data can be erased electrically. But in PROM, once the data are written it cannot be erased.

Secondary Memory or Auxiliary Memory

Secondary or auxiliary memory is used for bulk storage (mass storage) of programs data and other information. Storage capacity of this memory is much larger than primary or main memory. This type of memory stores system software, assembler, compiler, useful packages, large data files etc. The secondary memory differs from primary memory in that it is not directly accessible by the CPU. Again, Secondary memories are non-volatile memory. i.e. data are stored permanently in this type of memory.. The most common memory devices used for secondary memory are hard disk and floppy disk.

Input Devices

An input device is a hardware component used to enter data, programs and commands into a computer. The most common input devices are keyboard, mouse, touch screen, touch pads etc. Besides these, there are some other input devices for voice input (e.g. mic), for video input (e.g. web camera), pointing devices other than mouse (e.g. trackball, light pen etc.) and scanning and reading devices (e.g. scanners, MICR,OCR, OMR, Bar Code Reader etc.).

Keyboard

Keyboard is the most common input device. It is similar to the typewriters. A keyboard contains alphabets, digits, special characters, function keys and some control keys. A keyboard contains a matrix of switches (one switch per key) and a keyboard controller. When a user presses a key its switch gets pressed and when the user releases the key, its switched gets released. The two broad categories of keyboards are- General Purpose Keyboard and Special Purpose Keyboard

A typical keyboard contains 101 keys which grouped as **Numeric Keys, Alphanumeric Keys, Function Keys** and **Cursor Control Keys.**

Numeric Keys: These keys are found on the right side of the keyboard which represent the ten digits from 0 to 9 and the arithmetic operators +, -, *, /.

Alphanumeric Keys: These keys represent the English alphabet (A-Z), numerals (0-9) and some special characters. It also contains some modifier keys such like **shift, ctrl** (control), and **alt** (alternate). These modifier keys are used in conjunction with other keys.

Function Keys: These keys are numbered from **F1** to **F12.** The function keys are found at top rows of the keys on the keyboard. These keys provide facility to the users to give commands directly to a computer.

Cursor Control Keys: The cursor movement keys are used to move the cursor in different directions on the screen. These keys contain the arrows (left, right, top, bottom).

Pointing Devices

The pointing devices are used to point to a display area to select an option from the screen. The following are the various pointing devices.

Mouse

A mouse is a pointing device. It fits under the palm of a hand. It controls the movement of the pointer which is called the mouse on the screen. The pointer moves on the screen in the direction in which the mouse moves on a flat surface. A mouse is handled by the palm of a hand and the fingers of that hand. A mouse generally contains two or three buttons. It may or may not contain a wheel. With the help of these buttons and wheel, a mouse performs the following operations-

- Point
- Click (Left Click)
- Right Click
- Double Click
- Drag
- Scroll Down
- Scroll Up

Three Basic types of mice are- 1. Mechanical Mouse
2. Optical Mouse
3. Wireless Mouse

Light Pen

A light pen is a pen shaped pointing device. It is a photosensitive device. It consists of a photocell mounted on a tube. It uses a lens on the tip of the device. When the pen is bought in front of an object on the screen, the light coming from the screen causes the photocell to respond by generating a pulse. This response is transmitted to a computer that identifies the position the light pen is pointing to. This device is used to draw images on the screen.

Touch Screen

A touch screen is a display screen which is covered by a touch sensitive transparent panel. By using our fingers, we can directly point to an object on the screen. These screens use optical sensors on the screens. When you touch the screen, the sensor detects the touching position on

the screen and communicate with the computer to understand the input. The touch screens are used in ATMs, Airports, Travel Agencies etc.

Touch Pad

A touch pad is a pointing device. It is a touch sensitive device that performs the similar function to a mouse. Without having an external device a touch pad enables user to communicate with a computer by using the fingers of the users. It has tactile sensor and a specialized surface that can detects the motion and position of a user's fingers and works accordingly on the screen. Touch pads are mostly used in notebooks, laptops etc.

Trackball

A track ball is pointing device that looks like a mouse. It has a ball inserted in a small box. Track ball are found in various shapes but have the functionalities.

Graphic Tablet or Digitizer

A graphic tablet is an input device that enables users to enter drawings and sketches into a computer. It consists of a flat pad on which you can draw with a special pen called stylus or with a special device called puck.

Joystick

A joystick is an input device which is used to move an object on the screen. A joystick consists of a stick set in two crossed grooves and can be moved left or right, forward or backward. The movements of the stick are sensed by a potentiometer. When the stick moves around, the movements are translated into binary instruction with the help electrical contacts with its base. This device controls the velocity of the screen cursor movement. It is popularly used for playing video games, training simulators and controlling panels robots.

Scanning Devices

These types of devices are used to enter data directly from a source document to a computer. The various types of input devices are-

Scanner

A scanner is similar to a photocopier. The difference is that a photocopier prints the given document on paper but a scanner creates an electronic form of the given document which can later be manipulated, changed and modified as required. The variety of scanners are-

A. Hand-held Scanner
B. Flatbed Scanner
C. Drum Scanner

Optical Character Reader

This device is used to read characters with special fonts printed on conventional paper with conventional ink. The characters are passed under a strong light and a lens system. This system differentiates light (no ink) from ink areas, and a logical system which attempts to determine which of the possible characters are being examined. Now, OCR is able to read handwritten text also. It takes the handwritten text as image and converts it into actual text which is editable in word processors.

Optical Mark Reader (OMR)

This device is used to read special preprinted forms that are designed with boxes which can be marked with a dark pencil or ink. OMR transcribes the mark into electrical pulses which are transmitted to the computer. The OCRs are mostly used for objective type answer scripts in the examinations where large numbers of candidates appear.

Magnetic Ink Character Reader (MICR)

Magnetic Ink Character is used to read printed documents on the human readable characters are printed by using a special magnetic ink that contains iron oxide. It reads these characters by magnetizing the ink and examining the shape of the characters. MICR is mostly used to read the bank cheques in which the branch code, account number and the cheque number are preprinted in the bottom using magnetic ink.

Smart card reader

Smart card readers are used to read data stored on smart cards. These cardsstore data in the form of magnetic stripe. These stripes contain lots of data per unit space. These type of devices hide data from normal and maintain secrecy and security of the data stored in it. The smart card reader decode data stored in magnetic stripes to transfer data to a computer. The smart cards can hold more dada with some processing capabilities and the data stored in it are almost impossible to duplicate. These cards can serve as multi-purpose card, like ATM card, credit card, ID card, electronic cash card etc. Some of the smart cards allow access to crucial information if they are given the correct passwords.

Bar code reader

The bar come readers are widely use input devices. It reads data stored in special bar codes. Bar code is a pattern of printed bars on various types of products. A bar code reader emits a beam of light which reflects off the bar code image. A light sensitive detector is used in this devise that identifies the bar code image by recognising the special bars at the both ends of the bar code image. After identifying the bar code pattern, they are converted into numeric code that can be processed later in any manner.

Other Input Devices

Microphone (Mic)

A microphone is used to send sound input to a computer. It works in tandem with a sound card. When any sound is placed in front of this device, the sound card translates the electrical signals from microphone into a digitized form that the computer can store and process.

Biometric sensors

Biometric sensors are used to identify a person's identity. By suing biometric technology, the Identification of a person is done by measuring the unique individual biological trait. This technology is used for signature verification, DNA identification, face recognition, voicerecognition fingerprint identification etc.This type of input device uses biometric sensors.

Digital camera

A digital camera takes images in digital form. After taking a picture through this device,it can betransferred to a computer system and then manipulated with the graphics program printed.

Web Cam (Or Web camera)

A Web Cam is an input device which is connected to a computer directly or wirelessly. It gathers a series of images and generates those that can be accessed by and displayed on web browsers through a server.

OUTPUT DEVICES

The output devices are use to display or print data coming from the memory of the computer. Various output devices are broadly categorized into the following categories-–

1. Display devices

2. Printers
3. Speaker
4. Plotter

Display Devices

These devices are used to display data on screen. These devices include-

Monitor

Monitor is the most common output device which displays information in the dame way as the television. Data or informations are displayed on the monitors are made up of s set of dots or pixels. The quality of the data depends on the number of pixels displayed by a monitor.

Two most common types of monitors are-

1. CRT (Cathode Ray Tube)
2. LCD (Liquid Crystal Display)

Multimedia Projector

Multimedia projector is an output device that projects information or data from a computer on to a large screen such that it can be viewed by a large number of people. It performs the same job as the monitors, the difference is that it requires an extra screen to project the output data or informations. This device is mainly used to give presentations.

Printers

Printers are the output devices which are used to print data on papers. It can produce texts and images on paper with black & white and colour print. Two broad categories of printers are-

1. Impact Printer
2. Non-impact Printer

Impact Printer

Impact printers prints data by using an electro-mechanical mechanism that causes hammers or pins to strike against a ribbon and paper to print the text. These printers are further classified into two categories-

(a) Line Printer and (b) Character Printer

Line Printer

A line printer is capable of printing one line at a time. The printing speed may vary from 300-3000 lines per minute.

Character Printer Or Serial Printer

A character printer prints one character at a time. The printing speed of this printer varies from 30-600 characters per second. Commonly used character printers are-

- Dot-Matrix Printer
- Letter Quality Printer
- Inkjet Printer

Non-Impact Printer

Non-Impact Printers print by chemical or photographic means. It is faster than an impact printer. Non-impact printers are categorized as –

i. Electromagnetic printer
ii. Thermal printer
iii. Inkjet printer
iv. Laser printer

Speaker

Speakers are the most common sound output devices. Computers having sound facility use sound cards. From these sound cards, the speakers receive the sounds in the form of electric current. Then the electric currents are transferred to a magnet which pushes the speaker core back and forth. In this way pressure vibrations are generated that create sound.

Plotter

Plotters are output devices that produces precise and good quality graphs and drawings under the control of the computer. It uses single-coloured and multi-coloured ink pen or inkjet to draw the graphs and drawings. Two types of plotters are- Drum Plotter and Flat-bed Plotter.

Operating System

An operating system is a system software that handles the needs of the computer by finding resources, applying hardware management and providing necessary services. Operating systems are essential for computers to be able to do everything they need to do.

An operating system communicates with the various parts of a computer. It sends information to and from the computer hardware and the desired application or action in order to carry out the tasks requested.

Needs of Operating System

1. Providing platform for application programs
2. Managing Input-Output unit
3. Providing consistent user interface
4. Performing multiple task

Representation of numbers and characters in computer

Digital Computers use Binary number system to represent all types of information in computers. Binary number system is suitable for this purpose due to following reasons:
• Electronic components in digital computers operate in binary mode. A switch is either on (1) or off (0); a transistor is either conducting (1) or non-conducting(0).
• Computers have to handle only two digits (bits) rather than 10. So binary system simplifies design, reduce the cost and improve the reliability of the computer.
• Everything that can be done with decimal system can also be done using a binary system.

Representation of alphanumeric characters in bits 0 and 1 is done by character codes. There are three widely used character codes:

1. Binary Coded Decimal (BCD) : BCD uses 6 bits and can represent 26 =64 characters.
2. American Standard Code for Information Interchange (ASCII) :
   Code ASCII-7 uses 7 bits and can represent 27 =128 characters.
   ASCII-8: uses 8 bits and can represent 28 =256 characters.
3. Extended Binary Coded Decimal Interchange Code (EBCDIC): It is an 8 bit code. It can represent 28 =256 characters.