

1.3 Hardware

1.3.1 Input, Output and storage devices

- *Identify hardware devices used for input, output, secondary storage*

Hardware refers to the physical components (electronic circuit) that make up the computers and are tangible.

Input devices are the means whereby computers can accept data or instructions from environment.

Output devices are the means to produce information or processed result to the environment.

Storage devices are the means to store data and programs permanently or temporarily.

Activity:

Identify these devices as input, output, storage devices

Speaker, keyboard, scanner, hard disk, sensors, floppy disk, mouse, light pen, optical character reader, microphone.

- *Show understanding of basic internal operation of following devices*

Keyboard:

It is input device with different types of keys (alphabet keys, numeric keys, special symbols, functional keys). When any key is pressed, broken circuit below pressed key is completed and unique binary coded signal is generated and computer recognizes respective character in its character set.

Scanner:

It is input device that converts a document into a series of pixels. Basic principle of scanner is to capture the image.

Printer :

These are output devices used for producing hardcopy output.

Inkjet printer:

It produce output by spraying colored inks onto the paper. The print-head consists of a number of ink cartridges-black, cyan, magenta & yellow- which spray ink onto the page to produce a vast range of color combinations. The print-head travels across the page a line at a time. The ink reservoir is heated & this vaporizes droplets of ink, which then forces a small ink blob onto the paper.

Laser printer:

It has drum that is mostly positively charged. The controller in printer manipulates a small laser to write on the drum with negative charge, creating a image.

Drum is rolled through toner (black powder), which is positively charged so it will cling to areas of negative charge on drum.

Image will transfer to paper then fed through a fuse, which heats toner & causes it to bind with the fibers in the paper.

Trackball mouse

A trackball is a pointing device consisting of a ball on the top of plastic case that moves a computer cursor around on the screen. Ball is held by a socket consisting sensors to detect a rotation of the ball about two perpendicular axes, which, in turn, move the pointer on the screen.

Laser mouse

It emits laser beam focused on the surface beneath the mouse by a special type of lens. The reflected light falls back to the light sensor integrated with camera. The camera takes image of the surface with a frequency range of 1500 to 6000 images per second. These images are send to digital signal processor, which detects patterns in images & calculates how far the mouse has moved & sends the corresponding coordinates to the computer. The computer moves the cursor on the screen based on the coordinates.

Trackball mouse

A trackball is a pointing device consisting of a ball on the top of plastic case that moves a computer cursor around on the screen. Ball is held by a socket containing sensors to detect a rotation of the ball about two perpendicular axes, which in turn, move the pointer on the screen.

Hard disk drive

It is secondary storage non-volatile memory. It consists of one or more than one circular disks coated by magnetic material fitted on the spindle and some other components.

Disk is logically divided into tracks and sectors. While reading data, sectors in which parts of particular file are stored are located from file allocation table (FAT). Disk controller makes actuator heads, on both side of the disk, to move around the disk to point sector and read data from there in form of binary bits.

Show understanding of the need for primary and secondary (including removable) storage

Primary memory can be directly accessed by CPU. Primary memory are used to store programs and data that are currently being processed or ready to be processed. It also stores some part of operating system required while computer is switched on.

Secondary memory cannot be directly accessed by CPU. Secondary memory stores long term programs and data. It is also used to carry programs and data.

1.3.2 Main memory

Main memory are primary memory that can be directly accessed by CPU.

Explain the differences between RAM and ROM memory.

Ram is volatile type of primary memory in which data gets erased once power is turned off. memory store programs and data that are currently being processed or ready to be processed.

Rom is non-volatile type of primary memory in which data is permanent. Programs and data in Rom cannot be modified. It is used to store such program, which need not be modified. Like boot strap loader is stored in ROM chip. They are also used to store instructions in machine embedded systems.

Explain the difference between Static RAM (SRAM) and Dynamic RAM (DRAM).

SRAM consists of flip-flop circuit consisting of few transistors (6 transistors in standard one) that can store a bit. In DRAM each circuit consists of capacitor and a transistor, in which a bit is stored in capacitor in form of fuse.

SRAM need not be refreshed, whereas DRAM need to be stored frequently as fuse in capacitor may leak.

Data access of DRAM is slower than SRAM as DRAM need to be refreshed and while refreshing data cannot be accessed.

Suitability of using SRAM and DRAM

SRAM is suitable where data access rate is of more concern compared to cost and data storage capacity.

Activity:

Identify either SRAM/DRAM, which one is suitable in cache memory and RAM. Why?

1.3.3 Logic gates and Logic circuits

Logic circuits are electrical circuits that consist of switches arranged to produce specific output. Logic gates are symbols that are used to represent these logic circuits that produce specific output.

- *Basic arrangement of switches in electric circuit:*
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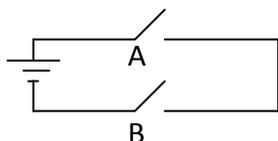
Series connection

Output is 1 when both switches are closed/ON.



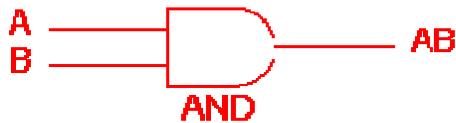
Parallel connection

Output is 1 even when any one of the two switches are closed



- Few basic gates

AND gate



It is representation of series circuit. Output is true when all inputs are true.

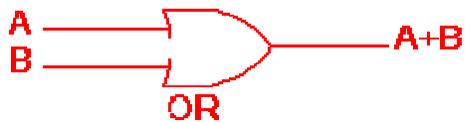
Boolean expression:

$$\text{Output} = A \cdot B$$

Truth table of two input AND gate

A	B	A.B
1	0	0
0	1	0
0	0	0
1	1	1

OR gate



It is representation of parallel circuit. Output is true even when one of the inputs is true.

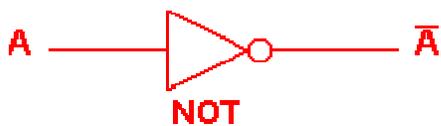
Boolean expression:

$$\text{Output} = A + B$$

Truth table of two input OR gate

A	B	A.B
1	0	1
0	1	1
0	0	0
1	1	1

NOT gate



The NOT gate is an electronic circuit that produces an inverted version of the input at its output. It is also known as an *inverter*. If the input variable is A, the inverted output is known as NOT A.

Boolean Expression:

$$\text{Output} = \overline{A}$$

NOT gate	
A	\overline{A}
0	1
1	0

NAND gate



It is combination of AND gate and NOT gate. Output is FALSE when all inputs are true.

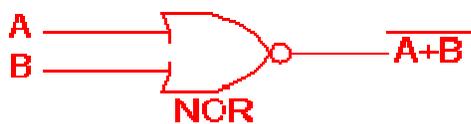
Boolean expression:

$$\overline{\text{Output}} = A \cdot B$$

Truth table of two input AND gate

A	B	$\overline{A \cdot B}$
1	0	1
0	1	1
0	0	1
1	1	0

NOR gate



It is combination of OR gate and NOT gate. Output is True when all inputs are FALSE.

Boolean expression:

$$\overline{\text{Output}} = A + B$$

Truth table of two input AND gate

A	B	$\overline{A+B}$
1	0	0
0	1	0
0	0	1
1	1	0

EXOR gate



The 'Exclusive-OR' gate is a circuit which will give a high output if either, but not both, of its two inputs are high. An encircled plus sign (\oplus) is used to show the EOR operation.

Boolean Expression

$$\text{Output} = A.B + A.\overline{B}$$

Truth table

2 Input EXOR gate		
A	B	$A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0