
PROCESSING, STORAGE & COMMUNICATION HARDWARE

Processing Devices

- The Motherboard
- The Central Processing Unit CPU
- Sound Cards
- MODEMs
- Video Graphics Cards

The System Unit

The system unit is a box-like case that houses the motherboard, the disks and drive bays, the power supply and cooling systems. This section is covered in the previous notes

The Motherboard

The motherboard is a single circuit board that provides the path through which the processor communicates with internal and peripheral devices. The motherboard is also called the system board

The components attached to the motherboard include the processor chip (the CPU), memory chips, support electronic circuitry, buses, and Expansion Slots for Adapter Cards.

Basic parts of a Motherboard

i). Expansion slots and Adapter cards

- An expansion slot is a socket on the motherboard that can hold an adapter card.
- An adapter card, also called expansion card, is a circuit board that increases the capabilities of the system or provides connections to peripherals.
- Some motherboards include all necessary capabilities and do not require adapter cards.
- Adapter cards are used for many supplemental capabilities, such as more memory, higher-quality sound devices, a modem, extra ports, or graphics capabilities.
- An adapter card being inserted into an expansion slot

Commonly used adapter cards and their functions

□ Plug and Play (PnP)

In the past, installing a card was not easy and required you to set switches and other elements on the motherboard. **Today, many computers support Plug and Play.**

PnP refers to the computer's capability to automatically configure adapter cards and other peripherals as you install them when the computer is still running.

□ **Buses**

The bus is a common electrical path, that enables data flow between the various system components.

□ A bus, allows the various devices inside and attached to the system unit to communicate with each other.

All buses consist of two parts:

□ The **data bus** which transfers actual data bits and

□ The **address bus** which transfers information about where the data should go in memory.

□ **Ports**

□ A port is the point at which a peripheral attaches the system unit.

□ Through a port, the peripheral can send data to or receive information from the computer.

□ A peripheral device, such as a keyboard, monitor, printer, mouse, digital camera, and microphone, often attaches by a cable to a port on the system unit.

□ A system unit has many ports

Examples of different types of ports on a system unit

□ Common ports

□ **A serial port** is a type of interface that connects a device to the system unit by transmitting data one bit at a time. It usually used to connect devices that do not required fast data transmission rates, such as a mouse or keyboard.

□ **Parallel ports** allow the parallel transmission of data;

□ that is, several bits are transmitted simultaneously. These ports provide the interface for such devices as high-speed printers.

□ **USB (Universal Serial Bus)** ports are used in high-speed device interfaces.

□ Bluetooth ports use radio waves to transmit data between two devices, without using cables.

□ Connectors

□ A connector joins a cable to a port.

□ A connector at one end of a cable attaches to a port on the system unit, and a connector at the other end of the cable attaches to a port on the peripheral.

□ Built into the power supply is a fan that keeps the power supply cool.

□ Processor chips generate heat, which could cause the chip to burn up.

□ A heat sink is a small ceramic or metal component with fins on its surface that absorbs and disperses heat produced by electrical components such as a processor.

THE CENTRAL PROCESSING UNIT (CPU)

The CPU is a microprocessor that executes instruction converting data into information output.

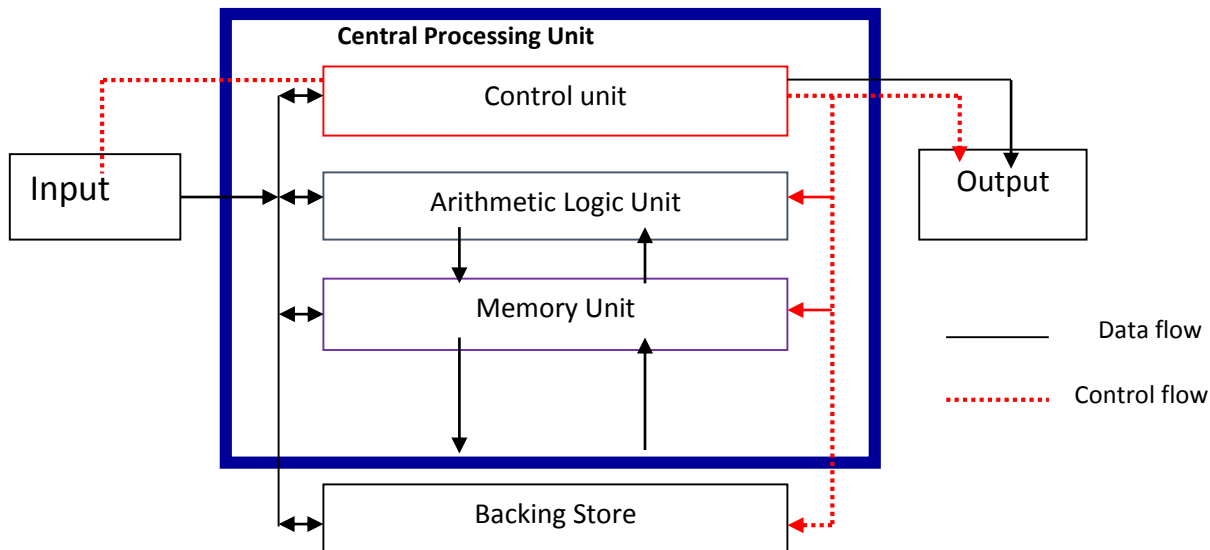
It performs operations of *Process* tasks like adding, multiplying, comparing, and controlling peripherals connected to the computer commonly said to be the brain of a computer.

FUNCTIONS OF THE CPU

- It controls devices under its care

- It helps in all the stages of data processing
- It is the chief brain of the computer which performs logical, computational and comparisons of data
- It determines how fast the computer performs a given function.
- It is used as yardstick to determine type and model of a computer.
- It helps the user to work with many programs at the same time.
- It controls which part to handle which category of task within the computer
- It stores data temporarily for the computer during processing of tasks.

The structure of the Central Processing Unit



Write short notes on the following

Microprocessor/CPU. (Central Processing Unit) → This is an integrated circuit (chip) that does the entire full scale computing
 → A hardware component where all operations of the Computers take place.

The CPU consists of three main parts:

The two functional units and a set of workspaces that is Control Unit, Arithmetic Logic Unit and Registers as its workspace.

- The control unit (CU)
- The Arithmetic Logic Unit (ALU)
- The Registers.

Control Unit

→ It does the fetch, direct and forward activities within the CPU

→ It

controls directs and coordinates most of the activities carried within and outside the CPU during operations.

→ Interprets and carries out basic instructions that operate a computer.

→ It has the overall function of controlling and coordinating all the operations within the C.P.U.

In short, it fetches instructions from memory, translates it and interprets it to computer and sends instructions to other computer hardware units to execute them. And determine the next instruction to be executed

Arithmetic and logical unit. This is a section where the actual execution part of the instruction cycle takes place during the processing operation.

Function

→ It performs the arithmetic

→ It carries out comparison of data items

→ It carries out logical operation

Arithmetic operation includes-addition, subtraction, multiplication and division.

Comparison- involve comparing one data item to another by using three conditions;

greater than (>),

less than (<), or equal to (=)

Registers.

speed temporary storage locations used to hold data and instructions.

It stores data within the CPU during, before and after processing temporary instructions during data processing.

Registers are high-

Holds data or

Examples Of Registers

→**Accumulator**: this temporarily holds the results of the last step of ALU

→**Instruction register**: this temporary holds an instruction just before it is interpreted into a form that the CPU can understand

→**An address register**: this temporarily holds the next piece of data waiting to be processed

→**Storage register**: this temporary holds a piece of data that is on its way to and from the CPU and the main memory

The Four Operations Of The Machines Cycle Of A Central Processing Unit

This is a series of operations needed to execute a single instruction and these are;

1.

Fetching: The process of obtaining data items from memory. The time taken to fetch an instruction from the computer memory/device is called **Instruction Time (i-Time)**

2. **Decoding**: This is the process of translating the instruction into commands that the computer understands.

3. **Executing**: This is the process of carrying the commands. The time taken to execute an instruction from the computer memory/device is called **execution Time (e-Time)**

4. **Storing**: This is the process of writing the results to memory. Is when the result of the instruction is written to its destination?

NB. Storage medium; physical material on which a computer keeps data, instruction and information for future use.

Storage capacity. The number of bytes (i.e. characters) a storage can hold.

Reading: the process of transferring data, instructions and information from a storage medium into memory

Writing: the process of transferring items from memory to storage medium

The processing speed:

How fast information is processed depends on the type and performance of the CPU and within the CPU there is a device called the clock that controls the reception and execution of instructions given to the CPU and the faster the clock pulses, the faster the CPU, Hence the faster the computer can process data. **System clock**-this controls the functional speed of the processor. To determine the system speed

Ways Of Processing Data

Parallel processing: The use of multiple processors to execute a program at same time

Multiprocessing: The execution of more than one program by the same processor

Multiprogramming: The processing of two or more programs by the same processor at the same time.

Batch [group] processing -System in which data to be processed are first accumulated over a specified period of time and then processed as a group [batch]

Special Purpose Memories

Buffers. This is a region of memory that is used to hold data temporary while it is being moved from place to place.

Virtual memory-Type of memory that supplements the RAM space when the space of RAM is finished and the computer still has data to process, (usually on the hard disk)

Cache memory. - Faster memory which help to speed up computer processes by storing frequently used instructions and data. - It stores copies of data from the most

frequently used main memory. -Transfers frequently used information

Buffers-This is a region of memory that is used to hold data temporary while it is being moved from place to place

CMOS (complementary metal Oxide semiconductor)is memory used to store configuration information about the computer which includes amount of memory, types of drives current date, time

-Store system setup

COMPUTER STORAGE HARDWARE

What is computer storage?

Computer storage refers to the ability of a computer to keep data or information. The computer stores data in two ways:

1. Temporary storage
2. Permanent storage

Temporary storage

is the ability of a computer to store data or information for a short time as long as the computer is still on. This storage is also known as **Primary storage**.

PRIMARY STORAGE

Primary memory, also known as main memory, is the computer's main random access memory (RAM). All information that is processed by the computer first passes through main memory. It holds data temporarily.

Memory

This is a "scratch" pad space where programs and data is stored during operation. Computer memory plays a very vital role in computers, especially for the processor.

Memory is a temporary area for holding data, instructions, and information. The Computer usually loads the data and instructions from storage into memory and then executes them.

Characteristics of Memory

- Memory has much faster access time than backing storage.
- Memory can be volatile or nonvolatile.
- The role of memory to store both data and program is known as the stored program concept.
- The size of memory is measured by the number of bytes available for use.

Uses of Primary Memory in a computer

- It stores system information files for a computer
- It is necessary at a time of booting up a computer
- It improves efficiency of a computer by providing extra space for swapping files in and out of the hard drive to create more space RAM at a time of data processing.
- It establishes initial or basic communication between a computer and its basic hardware components at a time of booting up.
- It keeps a log of frequently visited files to enable quicker loading of these files when accessed.
- It stores data temporarily at a time of data processing.

The common examples of primary memory are:

- ↳ RAM,
- ↳ ROM,
- ↳ Flash Memory,
- ↳ BIOS,
- ↳ CMOS,
- ↳ Cache Memory
- ↳ Virtual Memory

Random Access Memory (RAM)

RAM, in computer science, acronym for Random Access Memory which is a Semiconductor-based memory that can be read and written by the microprocessor or other hardware devices. The storage locations can be accessed in any order. Note that the various types of ROM memory are capable of random access.

The term *RAM*, however, is generally understood to refer to volatile memory, which can be written as well as read.

Types of RAM

- 1) **SRAM** (*Static Random Access Memory*): it's a primary memory that is used primarily to create CPU's speed-sensitive cache, uses multiple transistors for each memory cell.
- 2) **DRAM** (*Dynamic Random Access Memory*): a type of primary memory that contains memory cells with a paired transistor. In order to activate the transistor at each bit in the column, DRAM sends a charge through the appropriate column (CAS).
SDRAM (*Synchronous Dynamic Random Access Memory*) enhances the system's performance brutalizing the burst mode concept with maximum transfer rate to L2 cache of 528 mbps.
- 3) **FPM DRAM**: (*Fast Page Mode Dynamic Random Access memory* waits through the process of locating a bit of data by column and row and then reading the bit and then starts on the next bit.
- 4) **EDO DRAM**: *Extended Data-Out Dynamic Random Access memory*
- 5) **RDRAM**: *Ram Bus Dynamic Random Access Memory* uses a special high speed data bus called the Ram bus channel. **DDR SDRAM**: *Double Data Rate Synchronous Dynamic Random Access Memory* is somewhat similar to SDRAM but has higher bandwidth. It has a maximum transfer rate to L2cache of about 1064 mbps.

Read Only Memory (ROM)



ROM, acronym stands for **read-only memory**. In computer this is a semiconductor-based memory that contains instructions or data that can be read but not modified.

ROM contains data, instruction or information which is recorded permanently and is stored by the manufacturer of computer and it is called **Firmware**.

BIOS (Basic Input Output System) are an example of a firmware.

FIRMWARE

Firmware, software routines stored in read-only memory (ROM). Unlike random access memory (RAM), read-only memory stays intact even in the absence of electrical power. Start-up routines and low-level input/output

instructions are stored in firmware. It falls between software and hardware in ease of modification.

BIOS

BIOS, stands for *basic input/output system*, a set of routines that work closely with the computer hardware to support the transfer of information between elements of the system, such as memory, disks, and the monitor. On IBM and compatible computers, the BIOS, or ROM BIOS, is inbuilt into the machine's read-only memory (ROM). Although critical to performance, the BIOS is invisible to computer users. The BIOS can, however, be accessed by programmers only.

Types of ROM

1) PROM

PROM, acronym stands for *programmable read-only memory*. This is a type of read-only memory (ROM) that allows data to be written into the device with hardware called a PROM programmer. After a PROM has been programmed, it is dedicated to that data, and it cannot be reprogrammed.

2) EPROM

EPROM is *erasable programmable read-only memory*. It is also called reprogrammable read-only memory (RROM). EPROMs are non-volatile memory chips that are programmed after they are manufactured. EPROMs are a good way for hardware vendors to put variable or constantly changing code into a prototype system when the cost of producing many

3) **EEPROM** is *Electrically Erasable Programmable Read only Memory*. This type of ROM can be electrically reprogrammed.

4) **MROM** is *Mask read Only Memory*. Once content are written on it by a manufacturer, it cannot be changed.

Differences existing amidst RAM and ROM

	RAM	ROM
1	Random Access Memory	Read Only Memory
2	It's the main memory of the computer	It's a kind of low-level memory
3	Necessary in processing information	Very necessary in performing tasks as starting the computer.
4	Volatile meaning that if you haven't saved data, data disappears when the power is switched off suddenly	Non volatile meaning that data remains even when power is switched off suddenly.
5	Temporary Storage	Permanent Storage.
6	You can read from it as well as write to it	You can't write to it but you can read from it
7	Often discussed when buying a computer	Seldomly mentioned when buying a computer

Similarities

- Both are computer memories
- There for storage

Flash Memory

A Flash Memory is a memory that *traps small amounts of electric charge in "wells" on the surface of a chip*. Such drives are useful for storing information that changes infrequently.

Disk Cache

Disk Cache, a portion of a computer's random access memory set aside for temporarily holding information read from disk.

For example, a program might need to read in repeatedly from disk either a portion of itself or the same portions of a data file. If the required information remains in a disk cache, access time is considerably faster than if the program must wait for the disk-drive mechanism to fetch the information from disk.

Virtual Memory

Operating systems can use a technique known as virtual memory to run processes that require more main memory than is actually available. To implement this technique, space on the hard drive is used to mimic the extra memory needed. Accessing the hard drive is more time-consuming than accessing main memory, however, so performance of the computer slows.

Data Presentation in a Computer Memory

In digital computers, the user input(s) is converted and transmitted as electrical pulses that can be represented by two digits “1” and “0” before processing. These two digits are referred to as **Binary** digits.

Bit

A **bit** (a contraction of **binary digit**) is the basic capacity of information in computing and telecommunications; a bit represents either 1 or 0 (one or zero) only.

In computing, *a bit can be defined as a variable or computed quantity that can have only two possible values.* These two values are often interpreted as binary digits and are usually denoted by the numerical digits 0 and 1. The two values can also be interpreted as logical values (*true/false, yes/no*), algebraic signs (+/-), activation states (*on/off*), or any other two-valued attribute.

Advantages of using binary numbering in computers are:

- Computers only understand base 2 that is a 0 (off) and a 1 (on).
- Base 2 makes a computer work quickly and faster

NB. The language the computer understands is only binary digits

There are several fundamental data units which include:

- Bit - A data unit which must be in one of the two binary states described above. It is the smallest data unit that exists.
- Byte - 8 bits of data which has a possible value from 0 to 255.
- Word - Two bytes or 16 bits of data with a possible unsigned value from 0 to 16535.

To help understand computers it is best to first learn about computer data. Computer data is information required by the computer to be able to operate. It is used to:

- Run programs - This is the actual executable program data that the computer will execute to run the program such as Microsoft Word.
- Store program or system configuration information.
- Store information that the computer user needs such as text files or other files that are associated with the program the computer user is running.

The table below summaries the equivalencies of various units of the Binary System.

Measurements	Equivalency	Actual Bytes
1 Binary Digit (0 or 1)	1 Bit	-
1 Character (8 bits)	1 Byte	2 ⁰
1 Kilo Bytes (Kb)	1,000 Bytes	1024 (2 ¹⁰)
1 Mega Bytes (MB)	1,000,000 Bytes	1,048,576 (2 ²⁰)
1 Giga Byte (GB)	1,000,000,000 Bytes	1,073,741,824 (2 ³⁰)

Nibble

A nibble or nybble is a group of four bits, or half a byte. This unit is most often used in the context of hexadecimal number representations, since a nibble has the same amount of information as one hexadecimal digit.

Word, block, and page

The table below illustrates these differences.

Symbol	Prefix	SI Meaning	Binary meaning
K	Kilo	$10^3 = 1000^1$	$2^{10} = 1024^1$
M	mega	$10^6 = 1000^2$	$2^{20} = 1024^2$
G	Giga	$10^9 = 1000^3$	$2^{30} = 1024^3$
T	Tera	$10^{12} = 1000^4$	$2^{40} = 1024^4$
P	Peta	$10^{15} = 1000^5$	$2^{50} = 1024^5$
E	Exa	$10^{18} = 1000^6$	$2^{60} = 1024^6$
Z	Zetta	$10^{21} = 1000^7$	$2^{70} = 1024^7$
Y	yotta	$10^{24} = 1000^8$	$2^{80} = 1024^8$

Memory quantities can be expressed in form of

Kilobytes (KB) = 1,024 bytes (approximately 1000 bytes)

Megabytes (MB) is 1,024KB or 1,048,576 ($1,024 \times 1,024$) bytes (approximately 1,000,000)

Gigabytes (GB) is 1,024MB or 1,073,741,824 ($1,024 \times 1,024 \times 1,024$) bytes (approximately 1,000,000,000)

Terabytes (TB) is 1,024GB or 1099511627776 ($1,024 \times 1,024 \times 1,024 \times 1,024$) (approximately 1,000,000,000,000)

Petabytes (PB) is 1,024TB or 1125899906842624 ($1,024 \times 1,024 \times 1,024 \times 1,024 \times 1,024$)

Converting KB, MB, GB & TR to bytes

Example

1 kilobyte = 2^{10} bytes

Solution

$$\begin{aligned}2^{10} &= 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \\ &= 8 \times 8 \times 8 \times 2 \\ &= 512 \times 2 \\ &= 1024\end{aligned}$$

Calculate for

1MB: (2^{20}) answer = 1048576 bytes

1GB = 1073741824

147GB = $147(2^{30}) = 157840048128$ bytes

Converting bits to KB, MB, GB and TB

Example

Find the number of GB in 157840048128 bytes.

Solution

Get the number of bits given divide by the number of bits in a GB.

ie. 157840048128

1073741824

Answer = 147 GB

EXERCISE

1. How many (i) Bits (ii) Bytes; are in the expression “Subsidiary ICT” including spaces and quotation marks?
2. A computer’s hard disk can store 40GB of data.
 - (i) How many Flash disk of 512MB are equivalent to the hard disk above?
 - (ii) How many bits can the hard disk store?
3. If a CD-ROM stores 700MB of data, how many characters, bytes and bits are stored by the CD-ROM?

PERMANENT STORAGE HARDWARE

is a memory storage of data or information uneditable/modified on storage medium. This storage is also known as **backing storage, Auxiliary storage or secondary storage.**

Data Storage is where we put data in a ‘known’ place (Save) which we can come back to later and get the data back again (Read)”.

- **Writing / Saving** Data is storing Data.
- **Reading / Opening** Data is getting our data back again from the storage location.

Storage refers to the media on which data, instruction and information are kept.

Storage Device

The hardware that saves (writes) or reads the data from the storage medium for example DVD Player is called storage device.

Storage Medium

Storage medium is the hardware that actually holds the data, for example Memory Sticks, Hard Disk Drives, DVD Disks etc. Storage can be divided into two that is **Primary** and **Secondary** Storage.

Reasons for Secondary Storage may include;

- ✓ Data and information sharing
- ✓ Back-up purposes
- ✓ Higher storage capacity.
- ✓ Safety of information
- ✓ Privacy of information

Storage devices refer to the electronic equipment that is used to keep data in a computer for future use.

Examples of computer secondary storage devices include:

- Hard disks
- Memory cards
- Flash disks
- Compact discs
- DVD Discs/Blu ray Discs
- Memory Sticks
- Microfilm
- Tapes
- Floppy Diskettes
- SIM Cards/Smart cards etc

The secondary storage device sometimes called the **backing storage**. It is a permanent type of storage which is capable of storing data for a long period of time.

Secondary (permanent) storage devices can be either:

- Internal (Located inside the computer)
- External (Plugged into the computer via USB).

Backing up is the process of using a storage device to copy files and data to a different storage medium in case of a problem with the original copy.

- Backing up data is considered 'good practice' in computing and protects us against accidental or deliberate loss of our work or files.
- Backups are often stored in a different place to the original copy. This is to protect against irretrievable loss such as damage by fires, floods or theft.

Advantages of secondary storage devices over primary storage

- Secondary storage is cheaper than primary storage as you can store data in a magnetic media than in main memory.
- Secondary storage provides high storage capacity than in a primary storage.
- The secondary storage facilitates easy movement of electronic data.
- Data stored in a secondary storage is very secure from unauthorized persons.
- They cannot lose data and information easily because they are nonvolatile.

Types of secondary storage

There are three main types of Secondary (permanent) storage namely:

- Magnetic (like hard disks and magnetic tapes)
- Optical (like CD-ROMS and Blu-Ray Disks)
- Solid State

1. MAGNETIC STORAGE DEVICES

These are storage devices that use magnetic material to store information or data. They include *Hard disk, Floppy, and Magnetic tapes.*

Magnetic Storage Media

Fixed Hard Disc



(Direct Access)

External Hard Disc



(Direct Access)

Floppy Disc



(Direct Access)

Magnetic Tape



(Serial Access)

a. Hard Disk



This is a magnetic storage device that can keep data permanently. It has much larger storage capacity than a floppy disk, flash disk and CD (Compact disc).

The hard disk is the principal mass or permanent storage device in a computer system. It holds the programs, data files, and so far no storage device has matched its speed and capacity.

Fixed Hard Disk

A hard-drive **built into the case** of a computer is known as 'fixed'. Almost every computer has a fixed hard-drive. Fixed hard-drives act as the **main backing storage device** for almost all computers since they provide almost instant access to files (**random access** and **high access speeds**).

Used on all computers and are the main method of storing data.

- The disc surface (Platter) is coated in a magnetic film which is where the data is stored.
- These have read/write heads which allow data to be written to (saved) or read (used) from the disc.
- Hard Disks are used to store Operating Systems, Software Applications and all other files.
- Typical storage spaces are 250 gigabytes up to 1 terabyte (1,024 gigabytes).
- Used to store the Operating System and Applications Software (Windows, Word, Excel etc.).
- Used for storing Files and Documents (music and homework for example).
- Real-time systems (Robots, Chemical Plant Control Systems) and Online Systems (Booking airline tickets etc.) use hard disc drives to store data.
- Used in File-Servers on computer networks to store files (Like the student Z: drive in our school is used to store your work).

It's mainly used for storing operating system software and main application software as well as files. The capacity of the hard disks ranges from 10GB to 320GB, etc.

Portable Hard Drive



A portable hard-drive is one that is placed into a small case along with some electronics that allow the hard-drive to be accessed using a USB or similar connection.

Portable hard-drives allow very large amounts of data to be transported from computer to computer.

The hard disk is always represented by the letter C or Local disk (C:) which is called the C- drive in the computer.

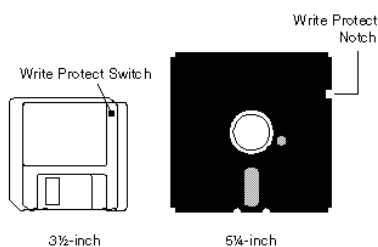
Advantages of hard disks

- ✓ Have large storage capacity
- ✓ Stores and retrieves data much faster than a floppy disk or CD-ROM
- ✓ Usually fixed inside the computer so cannot get mislaid.
- ✓ Cheap on a cost per megabyte compared to other storage media.
- ✓ Hard disks can be replaced and upgraded as necessary
- ✓ They are better protected against dust and dirt.
- ✓ They are not easily stolen or misplaced since they reside inside the system unit.

Disadvantages of hard disks

- ✓ Hard disks are less portable than floppy disks although it is possible to buy removable hard disks.
- ✓ They are very costly in case they get damaged.
- ✓ If hard disks crash, you are bound to lose a lot of your data.
- ✓ Data becomes less secure if left on the hard disk.
- ✓ Disks may fail due to violent shaking (vibrations)
- ✓ Hard disks expand and contract with temperature changes and this may lead to data loss.

b. Floppy Diskette



Is a thin, circular, flexible plastic disk with a magnetic coating enclosed in a square-shaped plastic shell. Floppy disks are read and written by a floppy disk drive (FDD)
Note: Before anything can be written on a floppy disk, it must be formatted, this tech has been fenced off with modern devices today.

Advantages of using floppy disks

- ✓ A Floppy disk is portable and inexpensive
- ✓ Data on a floppy disk can be accessed randomly.
- ✓ Data on a floppy disc can be write-protected from being changed accidentally.
- ✓ Can be used to transfer data from one computer to another.
- ✓ It is reusable.

Disadvantages of floppy disks

- ✓ They have a slow data transfer rate.
- ✓ Storage capacity is limited to only 1.44MB.
- ✓ Not durable due to dust and dirt and can be destroyed by magnetic fields.
- ✓ After reformatting, tracks and sectors go bad.

c) Magnetic tapes



These are storage devices coated with magnetic ribbon of plastic cable. They store relatively large amount of data compared to Floppy and Compact Disc (CDs). Magnetic Tapes are used for long term storage like backing-up data.

Advantages of magnetic tapes

- They are cheap
- Magnetic Tapes are light and portable.
- The storage capacity of a magnetic tape is much more larger than the Floppy or Compact Disc (CDs).
- Can be erased and re-used

Disadvantages of using Magnetic Tapes

- Magnetic Tapes are sequentially accessed hence kind of slow.
- Tapes have limited shelf life of about two years.
- Easily damaged by for example dust, heat, touching etc

Note:

A Floppy, Hard disk and Compact disc all use direct access or Random access which means a particular data item or file can be located immediately without having to move consecutively through all the stored items.

d) Zip disk



Zip disc is a **removable** and **portable** storage medium, similar in appearance to a floppy disk, but with a much **higher capacity** (100MB, 250MB or 750MB). Zip discs are **random access** devices which were used for data back-up or moving **large files** between computers.

Another **obsolete** storage device, zip discs were a popular replacement for floppy discs for a few years, but they never caught on fully before being superseded by cheaper media like CD-ROMs and CD-Rs

2. Optical Disks

CD-ROM



(Direct Access)

DVD-ROM



(Direct Access)

CD-R



(Direct Access)

DVD-R



(Direct Access)

CD-RW



(Direct Access)

DVD-RW



(Direct Access)

DVD-RAM



(Direct Access)

Blu-Ray Disc



(Direct Access)

Like Magnetic disks, optical disks are made from polycarbonates and measuring 4.75 inches (12 cm) in diameter. They are coated with a thin shiny layer of aluminium instead of magnetic oxide coated on magnetic disks.

They are called optical disks because they use a laser beam of light to read and write information.

They store large volumes of data (700MB) on a relatively small surface.

There are five versions of optical disks in use and they are:

1. CD-ROM (
2. CD-R
3. CD-RW
4. DVD
5. Photo CD

CD- ROM

CD-ROM: It stands for Compact disk- Read Only Memory. It holds approximately 750 MB of data. It is an optical disk from which a computer can only read information but cannot add or change recorded information.

A CD-ROM drive is used to read information from a CD-ROM.

Advantages of a CD-ROM

- ✓ Small and very portable than a hard disk.
- ✓ Has relatively large storage capacity compared to diskettes.
- ✓ Data on a CD- ROM is more secure since it cannot be changed or attacked by viruses.
- ✓ The average access time of CD-ROM is faster than that of a floppy disk.

Disadvantages of a CD-ROM

- ✓ Data on a CD-ROM cannot be edited.
- ✓ Data cannot be deleted to reuse the disk.
- ✓ The average access time of CD-ROM is less than that of a hard disk.
- ✓ The CD-ROM drives and disks are much more expensive than the diskettes and their drives.

CD-R

CD-R stands for Compact Disk Recordable. Data can be written on such a disk once using either a CD-R or CD-RW recorder.

Storage devices to which data is added in only one session are called WORMs (Write Once Read Many)

Data on a CD-R can be read or heard using CD-ROM drive but cannot be deleted. After adding information, the CD-R becomes a CD-ROM

CD-RW

CD-RW stands for Compact disk-Rewritable. It is similar to the magnetic disks because data written on them can be erased and replaced with other data. They are also called erasable optical disks or compact disk erasable (CDE)

A CD-RW drive is used to write to and read information from a CD-RW

Advantages of CD-RW disks.

- ✓ Very durable and store data up to 30 years and more.
- ✓ Have high storage capacity and therefore used for transporting large files e.g multimedia presentations, Computer Aided Design (CAD) drawings etc..
- ✓ They are light and compact and thus save space.
- ✓ Like magnetic disks, they allow random access to data and therefore faster than magnetic tapes which allow sequential access to data.
- ✓ Data stored on a CD-RW cannot be destroyed by a magnet.

Disadvantages of CD-RW

- ✓ They are more costly than magnetic diskettes.
- ✓ The drives are relatively slow to work with compared to hard disk drives.

DVD

Digital Versatile Disc (DVD)

Digital Versatile Disc (DVD) is an optical storage device that looks the same as a compact disc but is able to hold about 15 times as much information and transfer it to the computer about 20 times as fast as a CD-ROM.

A DVD, also called a Super Density disc (SD), can hold 8.5 gigabytes of data.

They store data in a similar way as the Compact Discs (CDs). The capacity of data that they can hold ranges from 4.7GB – 17GB. DVD disks can store so much data because both sides of the disk are used, along with data compression technologies. The *DVD-ROM drive* is used to write and read data from the DVD. DVDs come in two formats: the DVD-Video format and the DVD-ROM (DVD-Read Only Memory) format. Typical examples include:

- DVD-RAM - DVD Random Access Memory
- DVD-R - DVD recordable
- DVD –RW - DVD Re-written
- DVD – ROM – DVD Read Only Memory

The DVD-Video format is used for home movie entertainment through a DVD player. DVD players are backward compatible to existing technologies, so they can also play Audio CD and CD-ROM formats.

The DVD-ROM stores computer data. DVD-ROM uses include interactive games, video file storage, and photographic storage; it is called the “digital versatile disc” because it can be used in a variety of ways. A DVD-RAM (DVD-Random Access Memory) or a DVD-R (DVD-Recordable) disc can be used to record data. When compared to CD-ROM technology, DVD allows for better graphics, greater resolution, and increased storage capacity.

Other Types of Storage



M.O. (Magneto Optical) Disk

It combines both the best features of magnetic and optical disk technology. M.O has the high storage capacity of an optical disk but can be written over like a magnetic disk.

Magneto Optical Disk

A **magneto-optical drive** is a kind of optical disc drive capable of writing and rewriting data upon a **magneto-optical disc**. Both 130 mm (5.25 in) and 90 mm (3.5 in) form factors exist.

Micro-Film and Microfiche

A micro-film and microfiche are used to store microscopic images of documents on roll of sheet film. Microfilm uses about 100-215 feet of roll of the film.

Microfiche and microfilm are used for storing back issues of newspapers and magazines.

Exercise

1. Distinguish between Removable and fixed storage.
2. Give four examples of optical disks and how they differ from each other in terms of storage capacity.
3. Describe the difference between magnetic and optical storage media
4. Give the full meaning of the following
 - a. c) CD-RW
 - b) DVD
 - d) CD-R
5. Explain the following terms:
6. Cache memory
7. CMOS

Photo CD

Is a service provided bureaus that process photographic film or negatives to produce and store high quality photographs on a CD-R. The result is a CD-ROM that acts as an album whose contents can be viewed on a computer screen or a TV.

To load and view the photographs on a computer, you need either an ordinary or multi session CD-ROM drive installed on your computer plus a good photo processing software capable of reading photographs saved in photo CD.

Measures to keep a compact disk safely.

- ✓ Keep diskettes away from magnetic fields.
- ✓ Do not keep heavy objects on top of the diskettes.
- ✓ Do not fold or bend diskettes
- ✓ Do not touch the disk surface.
- ✓ Do not expose the disk to excessive heat or light.
- ✓ Do not splash liquids like water on the disk
- ✓ Do not bang, drop the disk.

SOLID STATE STORAGE MEDIA

The term 'solid-state' essentially means 'no moving parts'. Solid-state storage devices are based on **electronic circuits** with **no moving parts** (no reels of tape, no spinning discs, no laser beams, etc.). Solid-state storage devices store data using a special type of **memory** called **flash memory**.

Solid State Hard Disc



(Direct Access)

Memory Stick



(Direct Access)

Flash Memory



(Direct Access)

Micro Flash Memory



(Direct Access)



a. Flash disk

They are plug and play devices that connect through the USB port

Advantages

- ✓ They are portable
- ✓ They have large storage capacity
- ✓ They have random access of data



Disadvantages

- ✓ They are prone to virus attacks

b. Flash memory

They are micro storage devices found in a wide range of distance such as phones, digital cameras, video cameras, radios etc.

Flash memory is a type of Electronically-Erasable Programmable Read-Only Memory (**EEPROM**). Flash memory is **non-volatile** (like ROM) but the data stored in it can also be **erased** or **changed** (like RAM).

Flash memory can be found in many data storage devices.

You might wonder why, since flash memory is non-volatile, normal computers don't use it instead of RAM. If they did we would have computers that you could turn off, turn back on again and no data would be lost – it would be great!

The reason is **speed** – saving data to flash memory is very slow compared to saving it to RAM. If a computer were to use flash memory as a replacement for RAM it would run very **slowly**.

However some portable computers are starting to use flash memory (in the form of **solid-state 'discs'** as a replacement for **hard-drives**. No moving parts mean less to go wrong and longer battery life.

Advantages

- ✓ They are Portable/ flexible
- ✓ They have relatively large storage capacity compared to floppies
- ✓ They have random access of data.

Disadvantages

- ✓ They are prone to virus attacks
- ✓ They may be hard to handle because of their small size
- ✓ They can easily be misplaced or lost

c) USB Memory Sticks

Memory sticks (or ‘thumb-drives’) have made many other forms of portable storage almost obsolete (why burn a CD or DVD when you can more easily copy your files onto a memory stick?).

Memory sticks are **non-volatile, random-access** storage devices.

Each of these small devices has some **flash memory** connected to a **USB interface**. Plug it into your computer and it appears as a drive. You can then add files, erase files, etc. You can use it to **move any type of file** between computers.

Flash memory used to be very expensive, but in recent years it has become much **cheaper** and you can now buy a 16GB memory stick for just a few dollars.

d) Memory Cards



Many of our digital devices (**cameras, mobile phones, MP3 players, etc.**) require **compact, non-volatile** data storage. Flash memory cards provide this and come in a variety of shapes and sizes. One of the most common formats used by digital cameras is the SD Card. The cards store the digital images taken by the camera.



Mobile phones contain a Subscriber Identity Module (**SIM**) card that contains the Memory of phone’s number, the phonebook numbers, text messages, etc.

Many phones also have extra memory cards to store music, video, photos, etc. (e.g Tiny Micro-SD cards).

e) Smart Cards

A smart card is a plastic card about the size of a credit card, with an embedded microchip that can be loaded with data, used for telephone calling, electronic cash payments, and other applications, and then periodically refreshed for additional use.

Many credit cards (e.g. ‘**chip-and-pin**’ cards), door entry cards, satellite TV cards, etc. have replaced the very limited storage of the magnetic strip (the dark strip on the back of older cards) with **flash memory**. This is more **reliable** and has a much **larger storage capacity**.



Cards with flash memory are called **Smart cards**.

This communicates with external services via card-reading devices, such as ticket readers, ATMs, etc.

Smart cards can provide identification, authentication, data storage and application processing. It can also be used for recording patient’s record and other health care information.

COMMUNICATION HARDWARE DEVICES

Communication refers to the transfer of data from a transmitter/sender/source to a receiver across a distance.

Similarly for a computer to communicate with another completely different system, this will also require an interface of some kind. An interface is usually provided by a card, which contains ports for input and output devices, plus processing and memory microchips.

In effect it translates one form of communication from an external input device into that which can be understood by the computer and then, if necessary, into another that can be sent to any special output device, or another computer.

Examples of communication devices

1. MODEM (MODulator-DEModulator)

It is a communication device, which is used to convert digital signals from a computer to analogue signals prior to signal transmission through a telecommunication line.

Or

A device which allows the user to connect the computer system to another computer system.

A modem attaches to a telephone line and dials up another computer via the telephone. The modem converts the computer signals so that they work over the telephone circuits used by the telephone companies.

A modem can be internal that is to located inside the base unit or external device that attaches to the base unit via a cable.

An interface card may be inserted in one of the slots provided inside the computer or it may be external with its own power supply and plugged into the computer's serial communication port.

Modulation/demodulation

Modulation converts digital signals into analogue form so that data can be sent over phone lines.

Demodulation: Is a process of converting analogue signals back into digital form so that the transmitted signal can be processed by the receiving computer. It is needed for Internet, email, fax and video-conferencing communications using telephone cables.

2. NIC – Network interface Card -
3. Smart Phone
4. WiFi Routers
5. Hub/Repeaters
6. Network Switches

COMPUTER SOFTWARE

This is a sequence of instructions arranged in a logical way that make the computer work. In other words it controls the hardware. Without the software, the computer will never do any useful work.

CHARACTERISTICS OF A GOOD SOFTWARE

These are functionality related to the quality of software;

- a) **Correctness** – the software should meet all the specifications stated by the customer.
- b) **Usability/Learnability** – the amount of effort or time required to learn how to use the software should be less.
- c) **Reliability** – the software product should not fail while processing a task.
- d) **Efficiency** – the software should make effective use of the storage space on a computer and execute the tasks as required.
- e) **Security** – the software should not have negative effects on data it is processing or hardware on which its installed.
- f) **Safety** – the software should not be hazardous to the environment and life.
- g) **Cost** – it should be affordable in terms of cost.
- h) **Maintainability** – maintenance of the software should be easy for any kind of user.
- i) **Scalability** – software should be easy to upgrade for more functionality or for more number of users.
- j) **Portability** – the ability of software to perform same functions across different environments and platforms e.g. same performance on Dell, Acer and HP computers etc.

FORMS OF SOFTWARE (*Examinable*)

- **Across-platform application** is one that runs identically on Multiple Operating system
- **FreeWare.** This is one which is copyrighted at no cost to the users.
- **Shereware.** is copyrighted software that is distributed free for trial period and payment is required for using it at the end of trial period.
- **Public domain Software:** is a free software donated for public use and has no copy right restrictions.
- **Beta** – it's a general application downloaded from internet at no cost.
- NOTE: **Application Service provider (ASP)** is a third party organization that manages and distributes software and services on online(web)
-

FACTS ABOUT THE SOFTWARE

- These instructions are stored in memory with specific details of what is to be done.
- The preparation of these instructions is done by programmers and the act is called Programming.
- The computer software is made up of two main components:
 1. SYSTEM SOFTWARE
 2. APPLICATION / PROGRAMME SOFTWARE.

SYSTEM SOFTWARE:

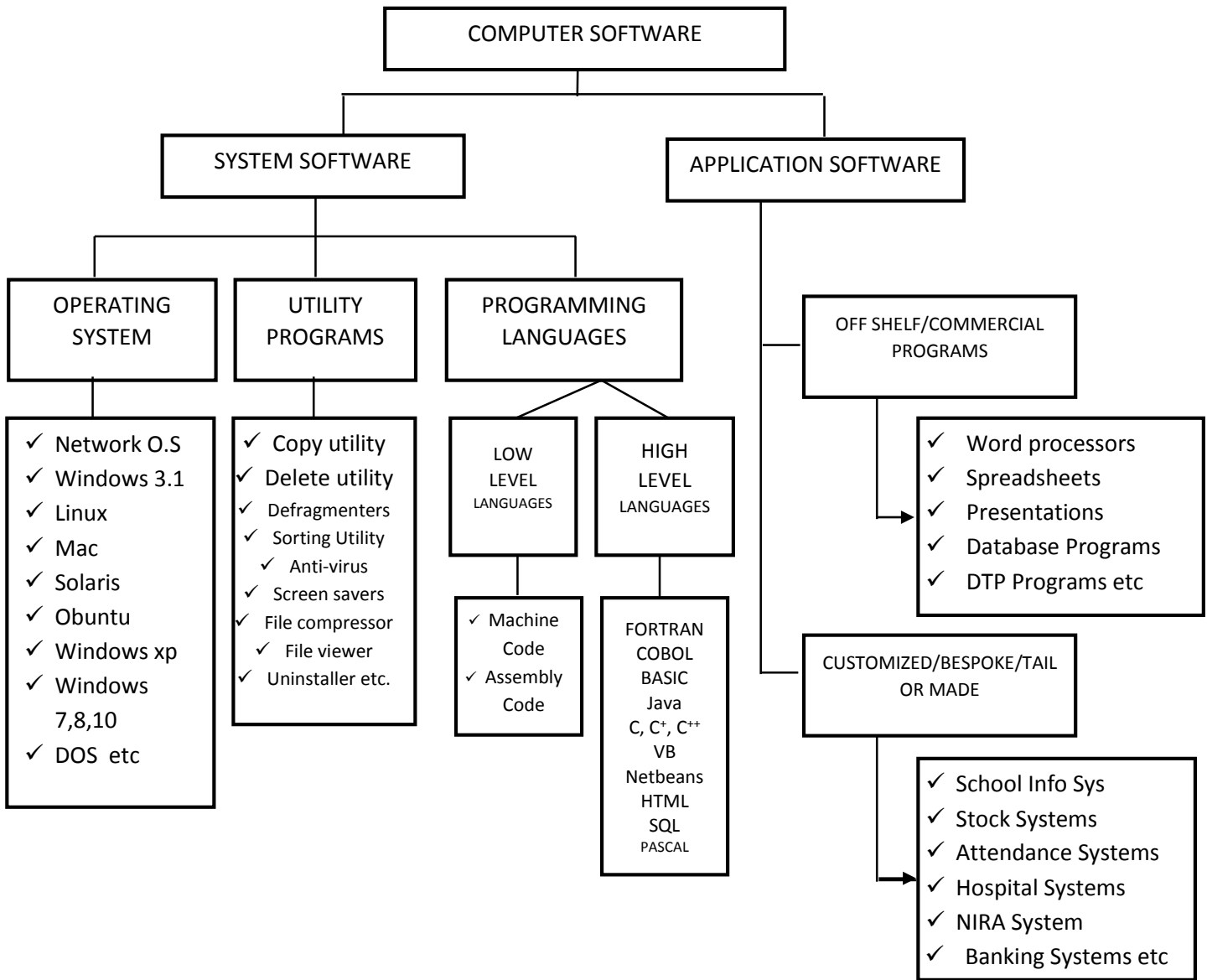
It's a set of programs designed to control and supervise the operations of a computer..

It is also a collection of programs and related data that provide instruction for telling a computer what to do and how to do it.

The structure of the system software has four sub divisions:

- Operating system
- Programming languages

- Utility programs.
- Device Drivers



1. OPERATING SYSTEM:

These are set of instructions that connect and direct all the hardware components to function.

Is an integrated system of programs that supervises the operations of the CPU, controls the Input / Output and Storage functions of the computer system.

In other words, it is a group of computer programs that help manage the computer's resources, acting as an interface between the user and the computer systems, which makes the computer easier to use.

FUNCTIONS OF OPERATING SYSTEM (frequently known as “Housekeeping” in that they perform essential tasks to allow the program applications work properly).

- It loads programs stored on a computer.
- It allocates the system resources e.g. CPU, Printers, Monitor etc, and main memory to data and application programs.
- It handles errors whenever they occur.
- It protects the hardware and software from improper use.
- It controls the input and output operations.
- It manages files on the secondary storage media.

- (vii) It coordinates the computer hardware.
- (viii) It determines the interface of the desktop.
- (ix) It manages files.

NB: Without the operating system, the computer cannot be used therefore it is advisable to load operating system before using the computer.

EXAMPLES OF OPERATING SYSTEMS:

- I. **DOS (Disk Operating System)**
- II. **WINDOWS 3.1, 95, 98, 2000, 2003, 2007:**
- III. **MACINTOSH:**
- IV. **UNIX**
- V. **LINUX**
- VI. **XENIX:** This evolved from UNIX and developed for Microcomputers.
- VII. **NOVEL Net ware**
- VIII. **Windows CE**
- IX. **Windows Vista.** Was developed by Microsoft to improve on the XP versions to run more advanced programs with few errors.
- X. **Windows 7 (Ultimate)** an environment that was constructed early 2007 with improved features and drivers that work on extremely faster processors.
- XI. **Windows 8.** Developed by Microsoft Company in late 2012.
- XII. **Window 10.** Versions of the latest