Computer system

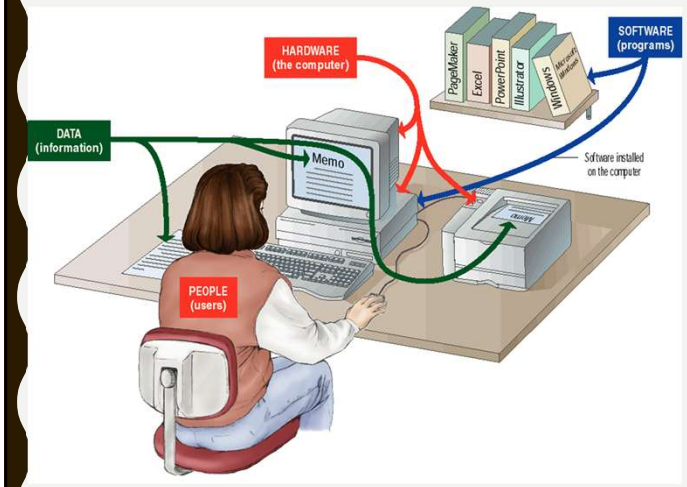
This is a collection of components that operate logically together to process information.

- The major components of a computer system are:

i) computer hardware- the tangible parts of a computer.

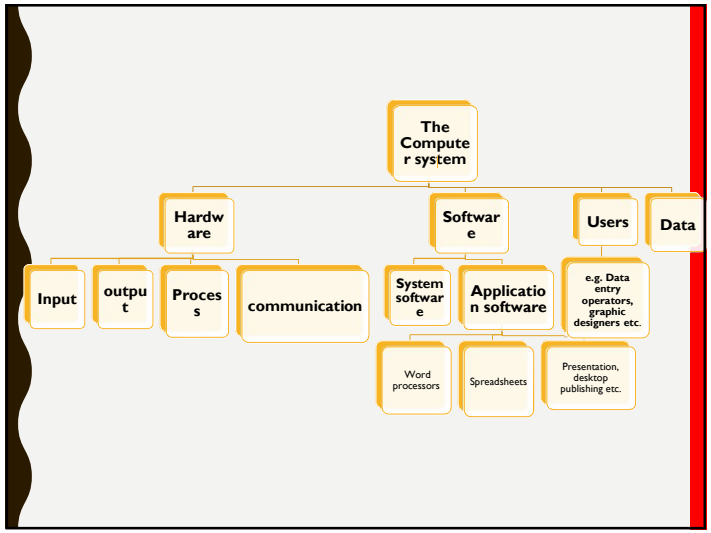
ii) computer software- the set of electronic instructions/programs that direct the computer how to operate

- iii) computer users (live ware).
- iv)Data
- V) Communication



Computer users

- The computer user is one of the components of a computer system. computer users include the ordinary users and computer professionals such as software programmers, system analysts, and system administrators, Network administrators and Database administrators.
- Computer users' role include entering data into the system to be processed, programming, administering the network, and administration of the computer system.

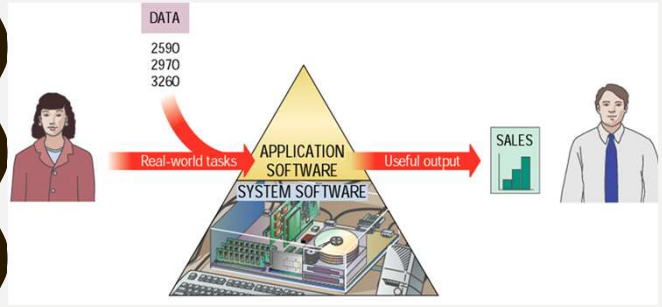


Computer software (programs)

- These are the digital step by step instructions that tell the computer system how to operate and how to process data.
- These include both the system software and application software.

- System software are programs for the computer's use, to help it manage its own tasks and devices. Eg the operating system and utility programs

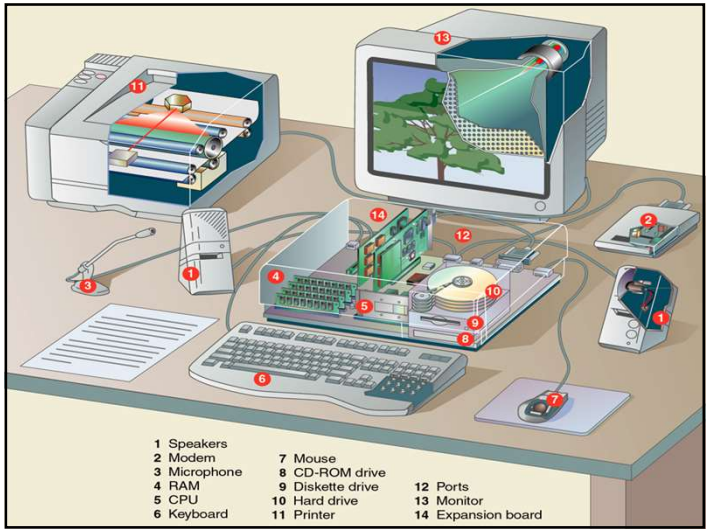
- Application software are programs for the computer to perform tasks for the user, such as creating documents. For example, a word processor, presentation software and spreadsheet software.



Computer hardware

These are the physical and tangible parts of a computer system;

they are largely electronic and electromechanical in nature:



They are broadly categorized into:

- Input devices
- Processing devices
- Output devices
- Storage devices
- Communication devices


IBM
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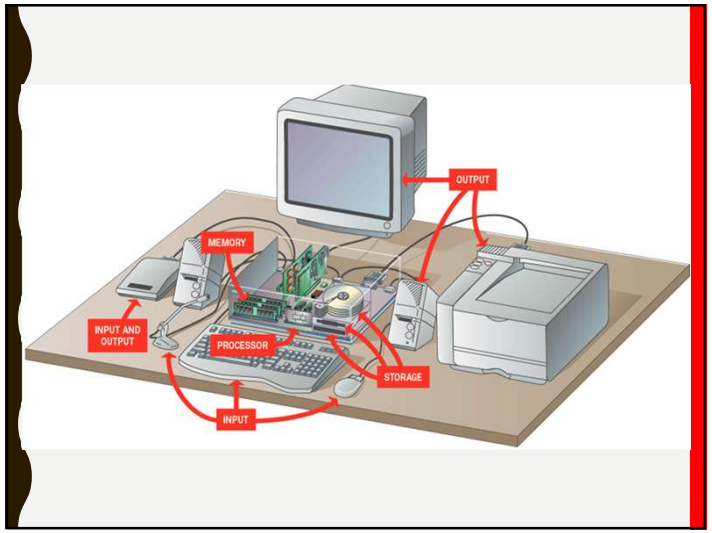
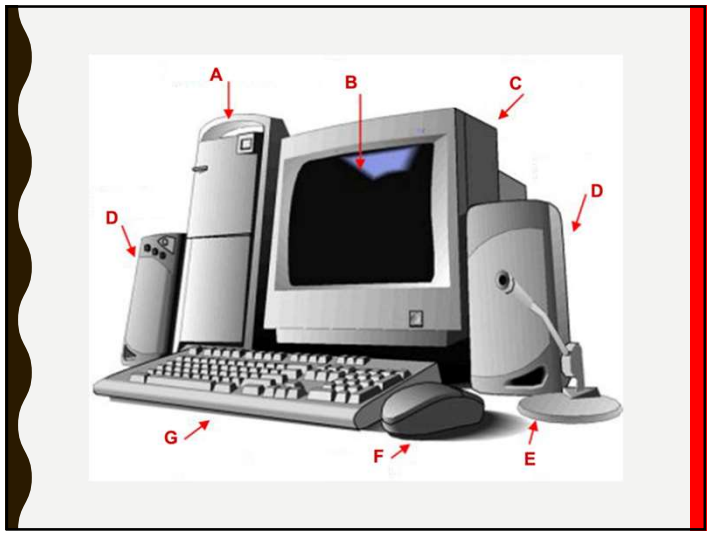

OUTPUT
MEMORY
INPUT AND OUTPUT
PROCESSOR
STORAGE
INPUT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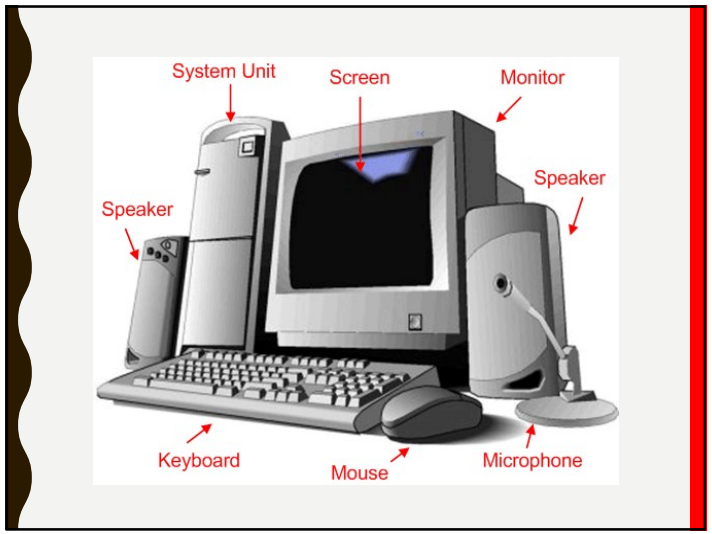

System Unit
Screen
Monitor
Speaker
Speaker
Keyboard
Mouse
Microphone

Input devices

These are physical computer components used to feed data and instructions into the computer system for processing;

There are four types of input into a computer system:

1. Data. This is the raw facts
2. Programs. These are the sets of instructions loaded into the computer system to guide it functioning.
3. Commands. These are fed into the system alongside the data input to tell what to do with the data.
4. User responses to the system requirements in order to process data.

Task

• Name some commonly used input devices

Input devices are of the following categories:

- Pointing input devices
- The Keyboard
- Scanning input devices
- Speech recognition input devices
- Audio input devices
- Multimedia input devices

Pointing devices

Devices that are used to input data and commands into the computer system using a pointing mechanism that controls the movement of the pointer on the screen to select items.

The user gives commands and responses by physical movements of the cursor like pointing, clicking, and dragging it .

Examples of pointing devices

Pointing devices are either based on motion of an object; common examples in this category include:

❑Mouse

- Joystick
- Trackball and Track pad
- Light pen
- Touchpad,
- Stylus,
- Digitiser.

Joystick

Light Pen

Pointing Devices

Stylus used on a smartphone

A virtual keyboard on an iPad

A graphics tablet with a pen

Track pad on an Apple MacBook Pro

Trackball

A gamepad with a trackball

Using a light pen

Using a touch screen

The computer Mouse

- This is a small handheld device pushed over a horizontal surface to control the coordinates of the cursor on the computer screen as the user moves it around on a flat surface and as he/she clicks on the mouse's buttons.

Types of mouse

- The mechanical (ball) mouse has moving parts of a ball beneath it and two freely rotating rollers to direct the movement of the pointer on the screen.

- Optical-mechanical (optomechanical) mouse.

This consists of a ball that rolls two wheels inside it, uses LED light whose movements is detected by optical sensors.

- The optical mouse: which emits a light to detect movement relative to the underlying surface to direct the cursor on the computer screen.

Using a computer Mouse

- The user has to move the mouse to move the cursor in the same direction.
- he or she can move the cursor over a command and uses the left button to click" that option.
- By default, the right mouse button is used to open an appropriate menu that depends on the position of the cursor on the screen.

- A mouse may have a scroll wheel to help navigate up/down a displayed page on the screen.

Uses of a computer mouse

- Used to move the insertion point from one location to another in a document.
- Used to select text on the document
- Used to point/select a desired command. e.g. by activating drop down arrow.
- used to confirm a command by clicking
- Used to activate appropriate menu by using the right button

- Used to navigate the document when used in combination with the scrollbar of the window
- Used to move selected text or icons by the drag and drop method.

The advantages of using a computer mouse:

- It provides a natural sense of movement . E.g. while drawing because to move the cursor in a particular direction requires moving the mouse in the same direction.
- It requires little training to use

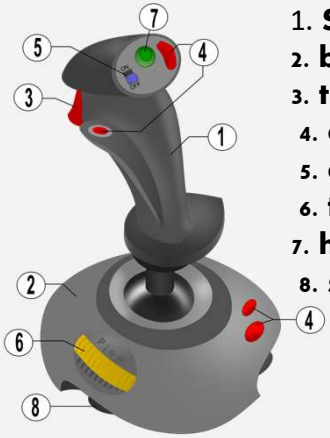
The disadvantages include:

- it takes up a lot of room to use

- It requires a flat surface next the PC
- Mechanical mice get clogged with dust and become inefficient.
- Excessive use can lead to repetitive strain injury

Joystick

- an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. Joysticks are often used to control video games



1. **Stick**,
2. **base**,
3. **trigger**,
4. **extra buttons**,
5. **autofire switch**,
6. **throttle**,
7. **hat switch (POV hat)**,
8. **suction cup**.

The Keyboard

- The keyboard is a device that has a set of keys used to enter commands and characters into the computer system.

The keys are arranged into sections:

- Alphabet keys
- Function keys
- Numeric keys
- arrow keys
- Command keys (insert, delete, home, end, page up/down)

Sections of alphanumeric keyboards

- Function keys- top row. Pressing these keys will instruct the operating system to perform a certain command.
- The main section of the keyboard is made up of five rows. The first row contains numbers and symbols, while the middle three rows are for the letters of the alphabet and punctuation marks and other symbols.

- The numeric keypad on the right side of the keyboard, activated by pressing the Numlock.
- The cursor control keys. These are the arrow keys on the keyboard that move the cursor in the desired direction.
- The bottom row has the spacebar and special keys.

Special keys

- Spacebar: Moves the insertion point one space at a time to the right.
- Backspace: Deletes the character immediately to the left of the insertion point/deletes one character at a time to the left. If placed at the beginning of a sentence, and pressed moves with the sentence to the upper line

- Delete key
- Clears a character at a time to the right. Also deletes a selected text or icon.

- Enter/return: Moves the start of the typing to the beginning of the next line/moves the insertion point to the next line.
- It confirms a command when pressed.

- Shift and Alt keys: used to change (alternate) the function of other keys.
- If pressed down together with other keys to give the given key's second-function command. Or entering a letter as upper case letters (when Caps Lock is off).

If the ALT key is pressed activates the keyboard to work in place of the mouse for the user navigate the menu bar and other commands eg by using the direction keys and the enter key, and other keys such as F for file, and N for insert etc.

Keyboard shortcuts

Keyboard shortcuts are combinations of two or more keys that, when pressed concurrently perform a task that would require a mouse or other pointing device.

General keyboard shortcuts

F1: Help	ALT+TAB: Switch between open programs
CTRL+ESC: Open Start menu	Windows Logo + L: Lock the computer (without using CTRL+ALT+DELETE)
CTRL+C: Copy	CTRL+X: Cut
CTRL+V: Paste	CTRL+B: Bold
CTRL+U: Underline	CTRL+I: Italic
ALT+F4: Closes the current window	Alt + F: File menu options in current program.
Alt + E: Edit options in current program	Ctrl + A: Select all text.
Ctrl + V: Paste	Ctrl + Home: Goes to beginning of document.
Ctrl + Z: Undo an action	Ctrl + Y: Redo an action
Alt + Tab: Switch between open items	Ctrl + enter: page break at the cursor position

SHIFT+right click: Displays a shortcut menu containing alternative commands	ALT+double click: Displays properties
SHIFT+double click: Runs the alternate default command (the second item on the menu)	SHIFT+DELETE: Deletes an item immediately without placing it in the Recycle Bin
Ctrl+Alt+Tab: Use the arrow keys to switch between open items	CtrL + Return = Page Break

Application of the Keyboard

- used to key in characters into the computer system.
- Used to enter commands into the computer using keyboard shortcuts
- Used to activate special commands for the operating system using the function keys
- Used for numeric entries and calculations using the numeric keypad.
- Used to edit documents using special keys like backspace and Del keys

Advantages of using the keyboard:

- It offers quick data entry for trained personnel
- Special keys are available for effective data entry
- Special keyboards are available to cater for varied needs

The disadvantages include:

- It is easy to make mistakes while typing
- Not suitable for drawing/creating diagrams
- Difficult to use by the dis abled people
- Excessive use can lead to health issues eg RSI

Types of keyboards

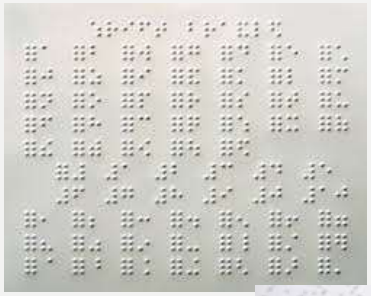
There are two types of keyboards: alphanumeric keyboards and special-function keyboards:

- ❑ The alphanumeric keyboard contains letters, numbers and symbols in particular layouts also known as QWERTY keyboard (based on the sequence of letters at the top left).

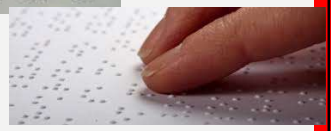
The Special-function keyboards are invented for a particular purpose. For example:

1) The Braille keyboard. This has its keys marked with raised dots to aid the blind.

Braille Keyboard



Braille



Braille Printers

2) The concept keyboard.

This is a flat board that contains a grid of buttons with pictures of items representing what they activate instead of the usual keyboard symbols and characters.

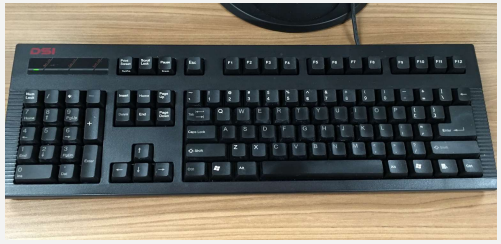
Concept Keyboards

Concept keys are commonly used:

- ❑among young children.
- ❑By people who would find using an ordinary keyboard difficult.
- ❑in locations where an ordinary keyboard might be damaged e.g. by spillage or dust.

- where there is a limited set of things to select and it needs to be done fast e.g. fast food store, pub, and other recreation events
- Where very little training is needed to operate them

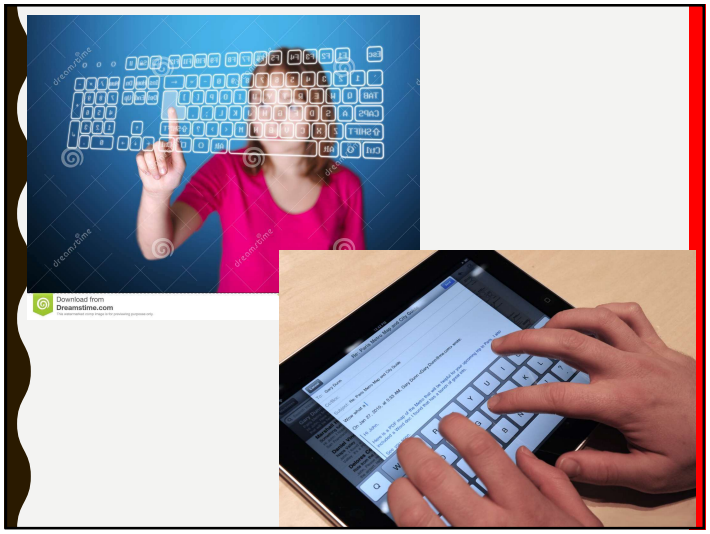
3) The left-handed keyboard. These are designed for the left-handed individual.



4)A virtual/projection keyboard.

This is a software component that allows a user to enter characters into the computer system.

Example: the touch-screen keyboard of the automatic teller machines (ATM), and mobile devices like smartphones. etc.



Pen input devices

a) A digital pen

This is an input device which captures the handwriting or brush strokes of a user, and converts handwritten analogue information created into digital format. E.g. the one used with a digitiser

b) Stylus (or stylus pen). This is a small pen-like shape that is used to input commands to a computer screen that is used instead of a finger to touch.

c) Light pen. This is in a form of a light-sensitive wand used in conjunction with a computer's screen. Allowing the user to point to displayed objects or draw on the screen.

Source data automation (Direct data entry methods)

The use of special equipment like scanners and digital cameras to collect data at the source, generated and send directly to the computer system for processing.

Benefits of source data automation:

- It increases speed of data input process
- it reduces cost of data entry
- it reduces possibility of human errors.

Scanning devices

These are devices that optically scan printed text, handwriting, or an object (3D) to digital format in order to input them into the compute

Types of scanning devices

1)Flatbed scanner: it scans a document, image or object placed on a glass window for scanning.

Flatbed scanner

2) Drum scanner: This is one where Photographs and transparencies are stuck into a clear cylinder (drum) that is spun at very high speed during the scanning operation to produce a very clear image.

Drum scanner

3) Sheet-fed scanner: This allows only paper to be scanned rather than books or other thick objects.

4) Magnetic Ink Character Recognition (MICR). This is an input device that identifies special ink and characters in a document by magnetising the ink and then translates the information into readable characters.

MICR is mainly used in banks to read cheques. Bank cheques have the following information encoded in magnetic ink:

- The cheque number
- The bank branch number
- and The customer's account number

- 5) Hand-held scanners, where the device is moved by hand.

Magnetic Stripe Reader

6) Card reader. This is a data input device that reads data from a card-shaped storage medium.

Examples of card readers include:

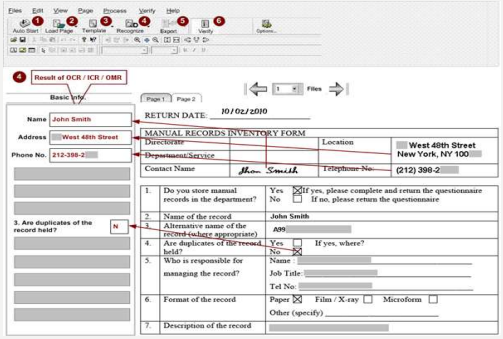
- Memory card readers
- Smart card readers
- Magnetic card readers
- Business card readers

Smart card readers

7) Optical Mark Readers (OMR).

This is a technology that scans a printed form and reads predefined positions and records where marks are made on the fill-in form such as registration forms.

Survey form where OCR is applied



8) Barcode reader (or barcode scanner)

This is an electronic device that uses a laser beam to scan and read printed barcodes.

The information received by the scanner is sent to a computer for processing.

Barcode reader

Barcodes (optical codes)

- A barcodes are optical machine readable bars representing data relating to the object to which the codes are attached

Barcode types

QR codes (Quick Response Code)

UPC (Universal Product Code) codes

42000 06200

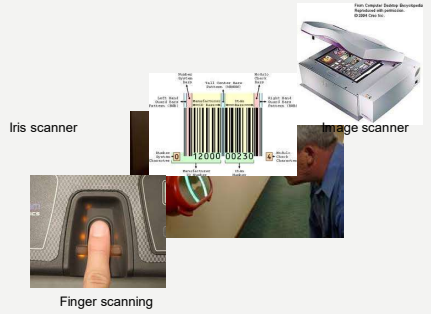
9) Biometric scanner. This a device used to identify physical characteristics of parts of the body that uniquely identify an individual (biometrics).

- Examples of parts of the body to be scanned include the eye retina, facial features, and figure prints.

- The system links the scanned image to the computer database to identify the individual being scanned.
- Biometrics are used where proof of identity is required. e.g. to give users access to an account.
- Also used to enhance security e.g. in addition to, or instead of identity cards or passports etc.

Finger print reader

- This scans the pattern of ridges on the finger and compares them to a set of fingerprint patterns stored in computer memory.

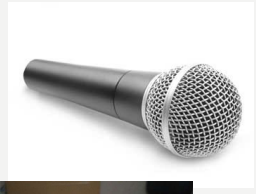


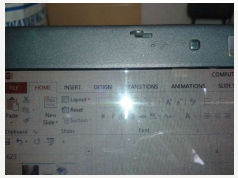
The Audio and Video input devices

i) Microphones

- These are used to input/capture sound into the computer system.
- They can be used with voice recognition software and a word processing application to enter text.

- Microphones may be supplied as independent devices or may be embedded in other systems. e.g. Webcams, laptops, smartphones, cellphones and headsets have built-in microphones.

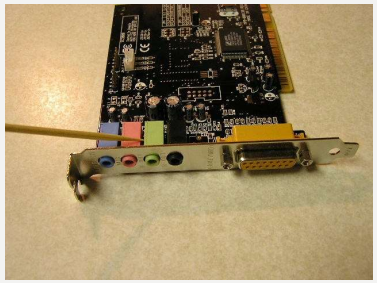




Sound cards

- This is required in a computer system for recording voice or music.
- It digitises the information into a form that the computer can understand.

Sound card/sound adaptor



- The sound card enables input and output of audio signals to and from a computer system under control of computer programs.

MIDI (Musical Instrument Digital Interface)instruments

- Electronic musical instruments have a Musical Instrument Digital Interface (MIDI) port for music input into the computer. The sounds are digitised and stored as a file, can be displayed on screen, edited and played back, using appropriate software.

MIDI interface

USB MIDI Cable Interface Adapter for Music Electronic Keyboard Piano

A MIDI port on your Music keyboard, computer,

USB cable-like MIDI interface

Graphics tablet/Digitiser

- This is a computer input device that enables a user to use a free hand to draw images, signatures and graphics on the surface of the digitiser and be translated into digital format into the computer system.

- It consists of a flat surface upon which the user may "draw" or trace an image using an attached stylus, a pen-like drawing apparatus. The image does not appear on the tablet itself, but is displayed on the computer monitor.

Digital cameras

These are devices that capture images and store them as a digital file in memory within the camera and can be transferred to a computer system for editing.

- The resolution of the camera is measured in pixels.
- A Pixel is the smallest discrete component of an image or picture on a computer screen.
- The larger the number of pixels the camera has, the clearer the image and the greater the detail captured.

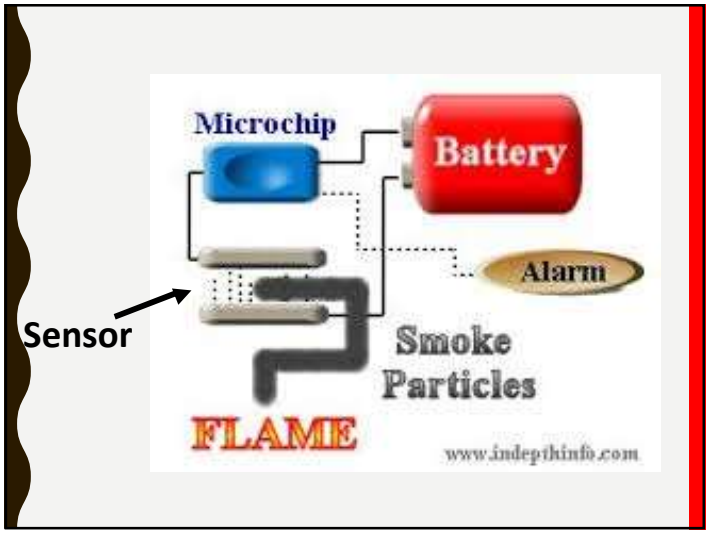
Remote control

It inputs commands to an electronic system by emitting a beam of infra-red data signals that is converted into an electronic signal on being received by the electronic device. Commonly used for input to televisions, stereo systems, VCRs and DVD players, etc.

- Infra red remotes work within a relatively small distance of about 10 metres.
- It requires a line of sight to work.

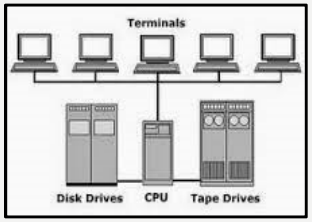
Sensors

These are devices used to detect events or changes in the physical environment such as light, heat, chemical and motion, and convert the information to electrical signals before passing it to a computer system that analyses, stores and manipulates it using a control program.



Data input using Terminals

- A terminal is a device or set of devices used to input data to, or retrieve information from a remotely located computer system.
- Terminals can be dumb, smart/intelligent.



- A dumb terminal is one that cannot carry out any processing activity, but it entirely dependent for all its capabilities on the computer system on which it is remotely connected.
- Usually made up of devices like the keyboard and mouse for data entry and a monitor to display output only.
- smart terminals are those that may have sufficient processing capabilities of their own.

Examples of computer terminals include:

1) Desktop terminals- these are more than one terminal that fit and used at the users' desktop remotely connecting to a central computer,

2) The point of sale terminal – This is used at the point of sale e.g. at a supermarket to capture sales and inventory data and send it to the central computer for processing.

It constitutes:

i) display devices that show the price, the product number, and description.

ii) a cash drawer to keep money

iii) a printer to print receipts.

- Input devices including a keyboard, barcode reader, and card reader.

3) Financial transaction terminals – used to store and retrieve data from a central computer to perform banking related functions. e.g. Those used by bank tellers within banking halls and ATMs.

4) Portable data terminals (PDT) – these can be carried around by users but remotely connect to a central computer via a wireless transmission facility used to effect payment of bills to service providers and other electronic fund transfers.

The computer System Unit

This is a collection of many electronic components that collectively process data. The system unit is normally housed in a rectangular box (chassis)

The chassis that houses the System unit components

Uses of the Chassis (system casing)

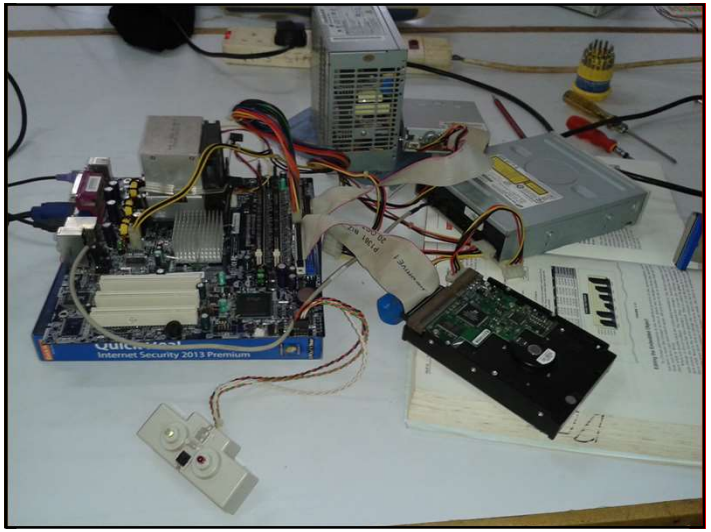
- It protects the internal parts of the system unit against direct dust, water, and other falling objects.
- It provides attachments for holding different units together,
- It houses the different components as a single component.

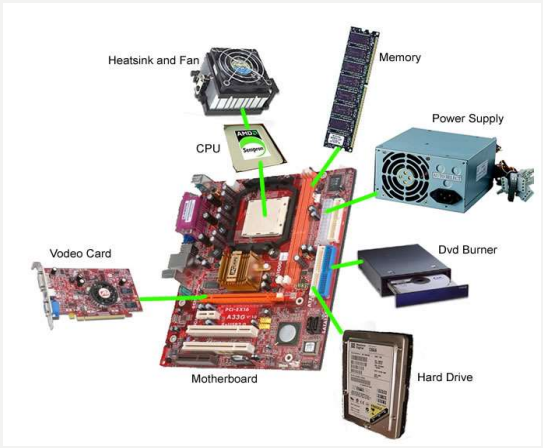
- It facilitates easy movement of the system unit.
- It provides protection for the user against electrical signals.

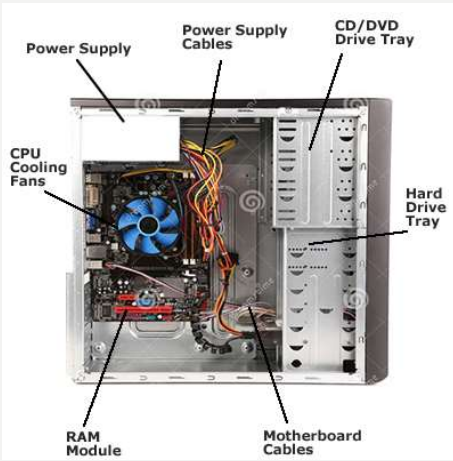
Components of the system unit

- The motherboard
- Central processing unit (CPU), or microprocessor
- Upgrade sockets, and expansion slots
- Random access memory chips (RAM), connectors
- Drives, e.g. floppy, CD/DVD, and Hard disk drives
- The power supply Unit
- Sound adaptor

- Ports through which peripheral devices are connected.

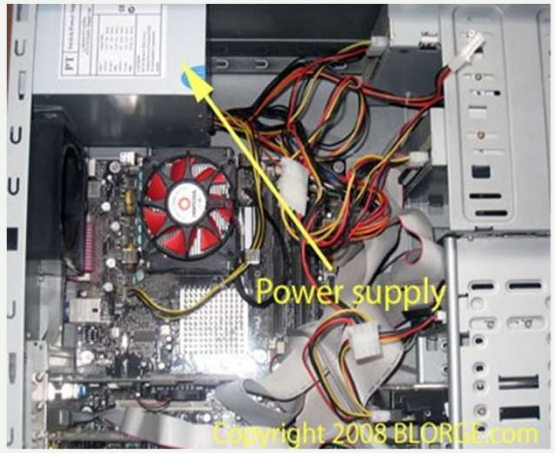






Power supply unit (PSU)

This is the shielded metal box fixed within the computer chassis that receives power from the AC mains and transforms it to DC power used by the components of the system unit.



The Uses of the power supply unit

- It coverts AC from the mains to DC used by the system.
- It receives and distributes power to the different system parts in the required voltage.
- It can be used to alternate electricity according to the regional voltage settings i.e. between 110 and 240 volts.
- Some have a fuse for protecting the system.

Computer Disk Drives

These are hardware used to read and write information on a storage Disk.

Examples of disk Drives include:

- Optical disk drives including CD/DVD drives
- Hard disk drives
- Floppy disk drives
- Zip drives, Flash Disk Drives

CD/DVD DRIVE

FLOPPY DRIVE

HARD DISK DRIVE

Disk drive access time

This is the time the device takes to locate a single piece of information on a disk and makes it available to the CPU for processing.

Bays

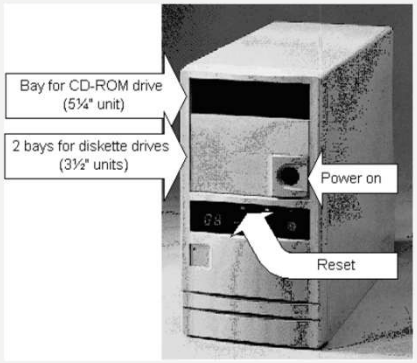
These are open areas inside the system unit casing set a side to firmly hold additional equipment installed inside it.

e.g.

CD/DVD bays,

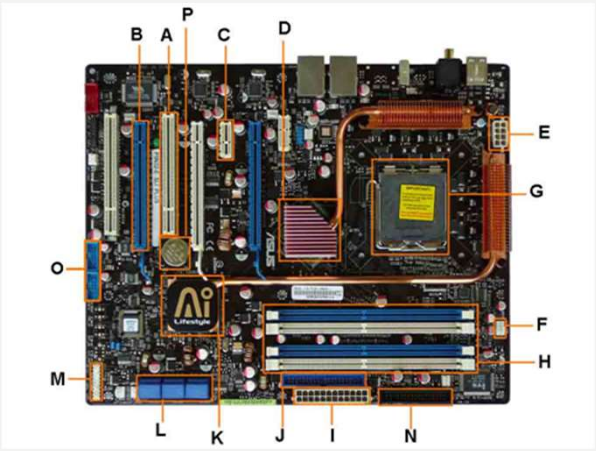
Floppy disk bay,

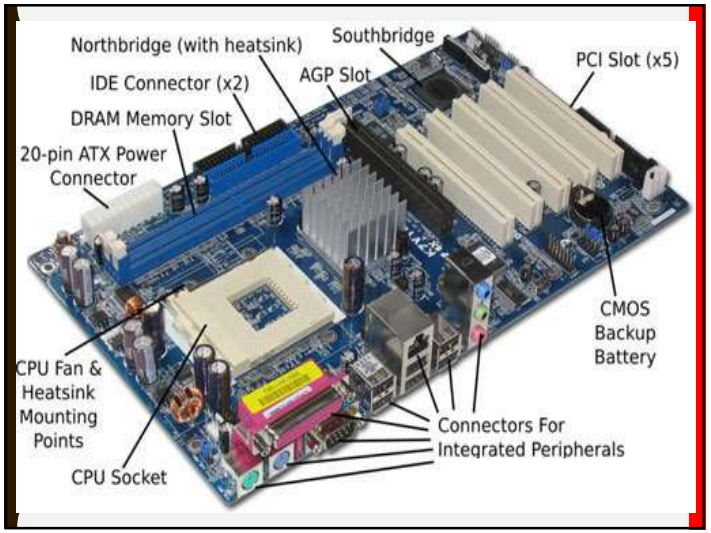
and hard disk bay.

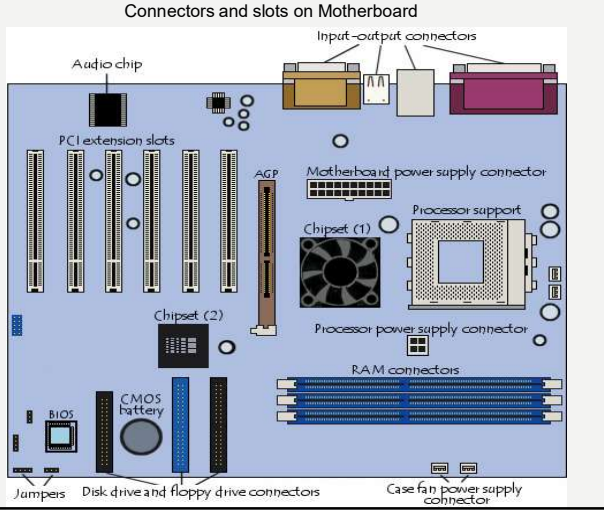


The Motherboard (main board or system board)

This is the main circuit board of a computer on which metallic circuits are printed, with sockets, slots and ports that hold all other system unit components together for the computer to work as a single unit to process data.







Functions of a motherboard

- It is an integration of circuits that enables flow of data from one component to another.
- It has expansion slots that enable installation of adaptors to increase the usability of the computer.
- It has ports that provide the interface to connect peripherals to the system.
- It has sockets on which other devices like the CPU are connected

Computer Bus

A bus is a set of signal pathways that allow information to travel between components inside or outside of a computer.

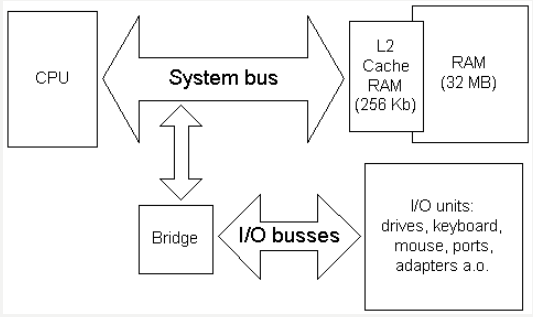
Functions of Buses in Computers

- Data sharing - transfer of data.
- Addressing - A bus has address lines, which match those of the processor. This allows data to be sent to or from specific memory locations.
- A bus supplies power to various peripherals that are connected to it.
- Timing - The bus provides a system clock signal to synchronise the peripherals attached to it with the rest of the system.

Types of Bus

Broadly, there are two types of computer bus:

1. System bus (also called local bus)
2. I/O bus (also called expansion or external buses)

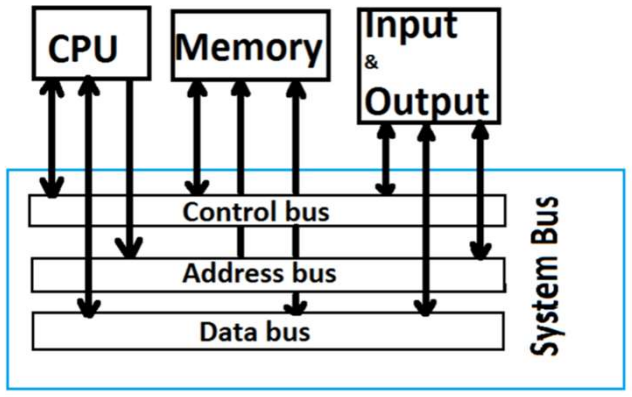


The system bus

- This is an internal path between the computer's Central Processing Unit (CPU) and main memory, Its speed and width depends on the type of CPU installed on the system board

The system bus, is a combination of three separate kinds of buses: the data bus, the address bus, and the control bus.

Control bus + Address bus + Data bus = System Bus



The Data bus

This carries the data to and from memory and between the microprocessor(CPU) and input/output controllers.

I/O controller is an interface that manages data entering and leaving the CPU to and from I/O

- The size of the data bus determines the amount of data that can be transmitted simultaneously. The wider the data bus the more the amount of data it transmits.

The address bus

This is used by the CPU to transmit data to or from internal memory locations.

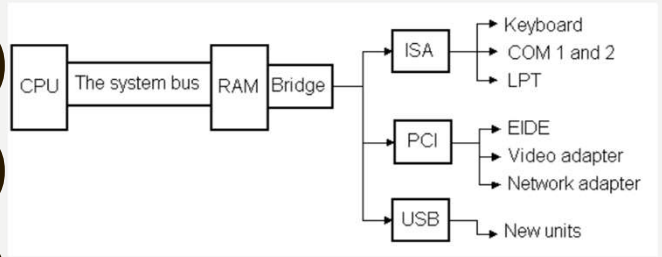
Each line carries one bit so the number of lines (wires) in the address bus determines the amount of primary memory that can be directly addressed

The control bus

- This is the pathway for control signals generated by the control unit of the CPU to the appropriate computer system components e.g. From the CPU to hard disk.

External bus

- External bus (or Expansion bus (I/O buses) allows the CPU to indirectly communicate with other devices of the computer system via the I/O controller.



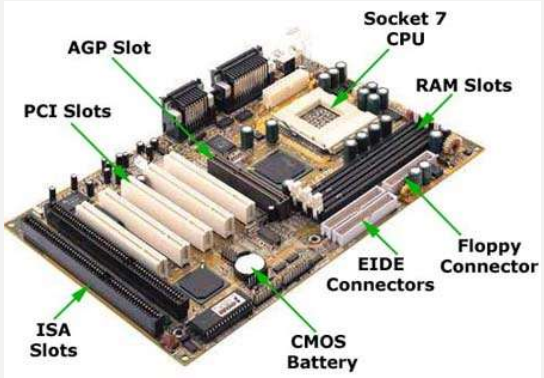
I/O busses connect the CPU to all other components, except RAM. Data is moved on the busses between components, and from components to the CPU.

Types of Expansion Buses (I/O buses)

They are categorised by make, connector size and word size (data width), and bus speed.

Common expansion buses

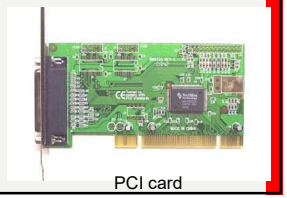
- ISA - Industry Standard Architecture
- EISA - Extended Industry Standard Architecture
- MCA - Micro Channel Architecture
- VESA - Video Electronics Standards Association
- PCI - Peripheral Component Interconnect
- PCMCIA - Personal Computer Memory Card Industry Association (Also called PC bus)
- AGP - Accelerated Graphics Port
- SCSI - Small Computer Systems Interface



1. PCI:

- Introduced by Intel in 1992, it is a 32-bit or 64-bit expansion bus.

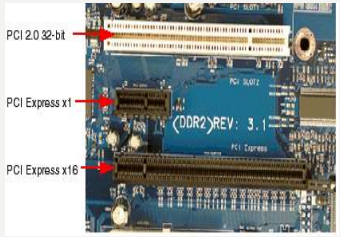
PCI slot



PCI card

2. PCI Express. A high speed serial I/O interconnect standard being used for high speed connection.

PCI-e Card



3. AGP:

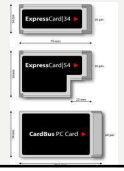
This is a 32-bit bus or 64-bit bus used only for video or graphics environment with a direct line to the computers memory to hold 3-D images.

AGP slot

AGP CARD

4. PCMCIA or PC Card

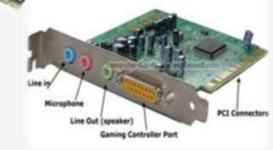
(Personal Computer memory card international association) is a type of bus use for laptops. These cards are slid in the in a PC ca laptop.



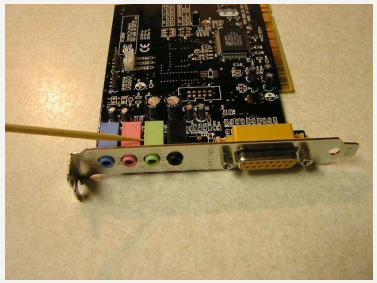
Expansion cards(adapter cards)

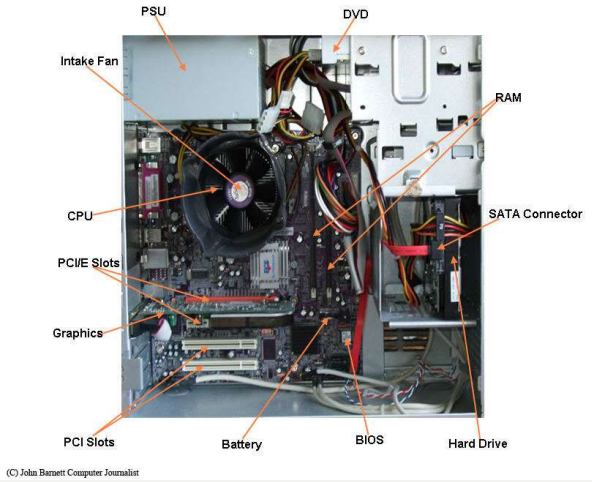
- These are printed circuit boards that can be inserted into an expansion slot of a computer motherboard to add functionality to the computer system via the expansion bus.
- Examples of cards:
- Network
- Video
- TV
- Sound

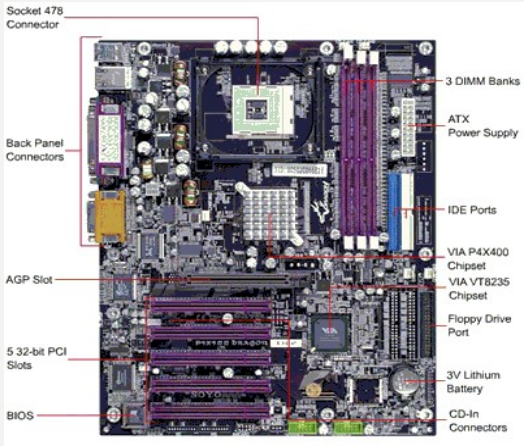
Cards(adaptors)



Sound Card







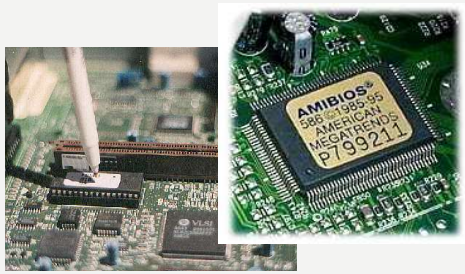
Memory chip

This holds programs and data either temporarily or permanently.

BIOS chip (ROM BIOS)

- BIOS stands for Basic Input/output System.
- It houses the built-in non-volatile BIOS software. This ensures that the BIOS will always be available and will not be disk failures.

ROMBIOS chip



- BIOS software has the computer start-up information which is the first code run by a PC when powered on (boot firmware).
- When the PC starts up, BIOS does the power-on self-test.

Flash BIOS chips

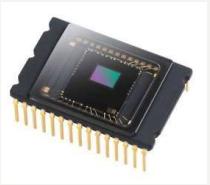
- BIOS that have been recorded on a flash memory chip, which can be updated enabling BIOS upgrade if necessary.

CMOS memory chip

- CMOS stands for Complementary Metal Oxide Semiconductor.
- It is a small amount of memory on a CMOS chip on the computer motherboard that stores the computer configuration settings of a computer, e.g. Language, date and time, boot sequence, and installed storage devices.
-

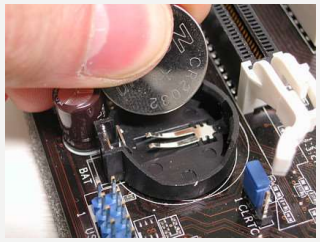
- All PCs have a CMOS chip, which is used to save the hardware settings while the computer is switched off.

CMOS CHIP



CMOS battery

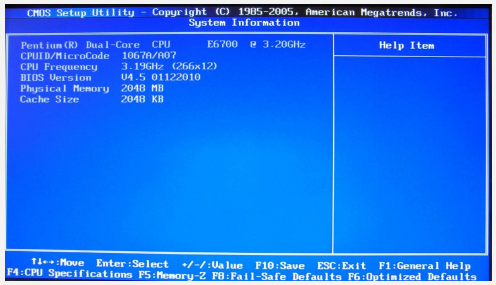
- The CMOS chip is supported by a CMOS battery, allowing it to store these settings without main power.



CMOS Configuration

- CMOS settings are configured through the computer's hardware set-up utility known as CMOS set-up that resides in the ROMBIOS chip.

System information

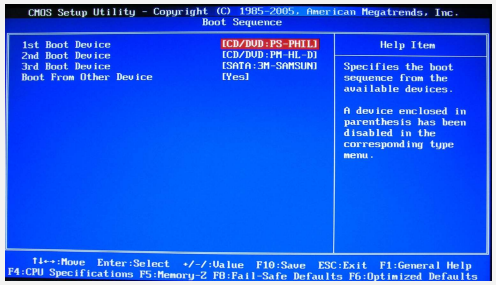


- The CMOS setup utility is composed of five major sections that are accessed using menus often organized as follows:
- Standard CMOS Setup: In this menu, you can set system time, date, hard disk drive type, video settings (such as EGA, VGA, and so on).

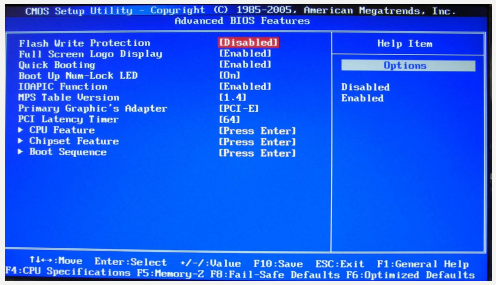
CMOS setup utility interface

- Power Management: You change power saver settings in this menu. These settings may be particularly important if the PC is a laptop to control battery consumption.
- Boot Options: used to set up the desired boot sequence.

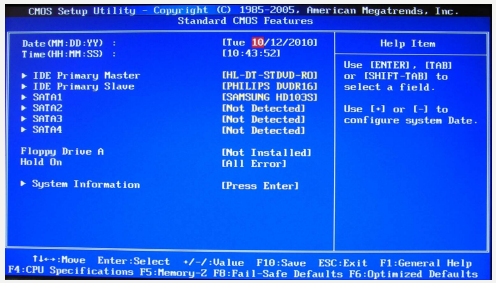
Boot sequence



Advanced BIOS features



Standard CMOS features



PROCESSING DEVICES
The CPU Chip

This is a device on a computer system that does all the processing of data into information.

It is commonly referred to as the "Brain" of the computer because it does all the processing activity in the computer system that involves receiving, and decodes (interpreting) instructions from memory and executes them by performing the basic arithmetic and logic operations.

- The CPU is housed in a single silicon chip called a microprocessor.
- The Intel 4004 was the first microprocessor(1971)

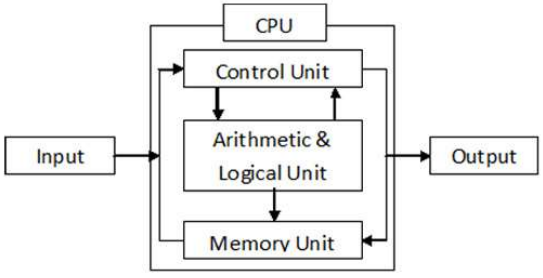


Fig. Block Diagram of Computer

CPU manufacturers

The major CPU manufacturers are:

Intel Corporation, Advanced Micro Devices (AMD), ARM, Motorola Corporation and IBM.

CPU types and generations

- CPU type is described based on some of the following: manufacturer, family name, code name and processor generation.

Older CPUs	System bus width	System Bus speed
8088	8 bit	4.77 MHz
8086	16 Bit	8 MHz
80286 – 12	16 Bit	12 MHz
80386S X – 16	16 Bit	16 MHz
80386DX – 25	32 Bit	25 MHz

- Intel 4004

-Intel 8085, 8086

-Intel Pentium I, II, III, and 4. (Double layer)

-Intel Celeron – Single layer, Heats up very fast, and they are cheaper if compared to double layer processor chips.

-Pentium Dual-Core

I core

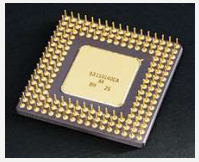
-Cyrix

-Motorola 68040, 68030

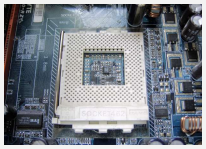
A computer can have more than one CPU, this is what is known as Multi-processing

Some circuits can contain more than one CPU, this is what is known as Multi-core processor such as Dual core, Intel core i3, i5, i7

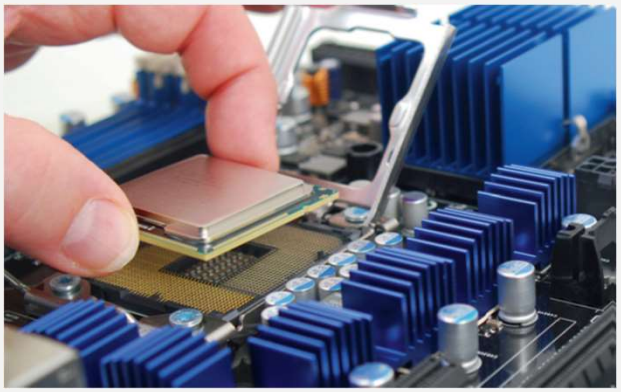
An Intel 80486DX2 from below



An Intel 80486DX2 CPU from above



CPU Socket



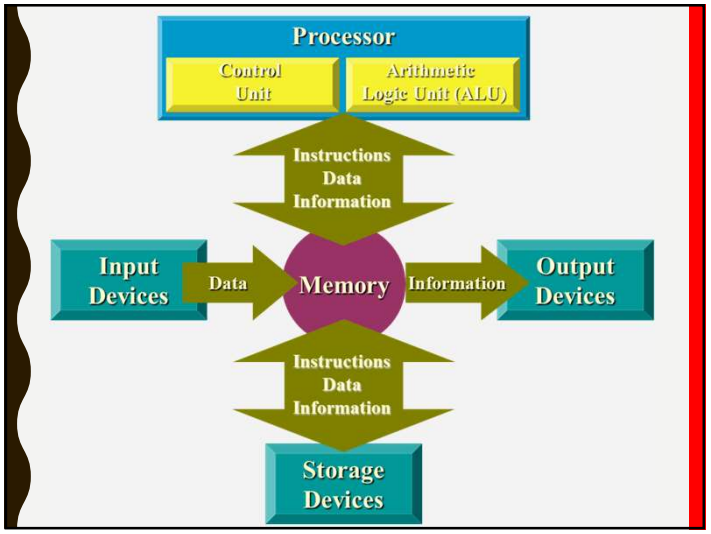
The key parts of the CPU

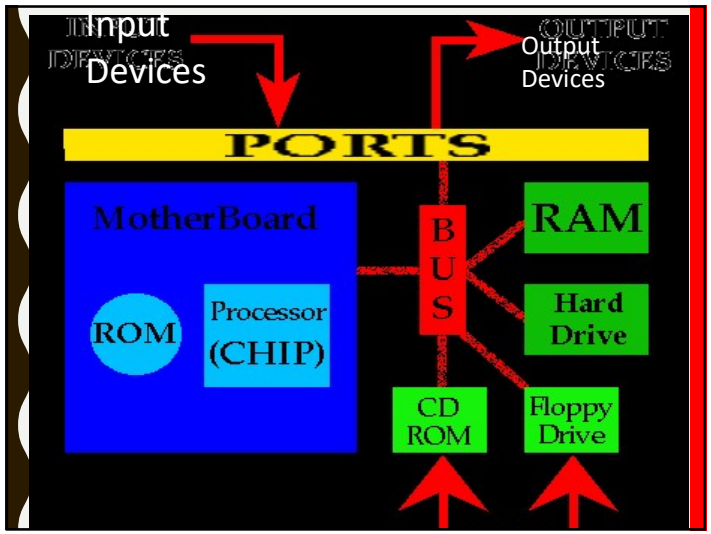
- These include:

1) The control Unit
2) The Arithmetic Logic Unit
3) The Registers

The control unit:

1. Controls all activities within the CPU
2. It controls the flow of data within and outside the CPU.
3. It fetches data from memory
4. It interprets the commands given by users.





The ALU (Arithmetic logic Unit)

- This is does the actual processing of data takes place.
- The ALU has two parts:

1. Arithmetic unit: where arithmetic calculations take place
2. Logic unit: this makes decisions

Registers

1. The registers. This is the immediate access store that holds data and programs needed by the CPU during processing to avoid wasting time fetching the data from RAM

- Registers have a specific storage capacity based on computer bus size, for example, a 32- bit computer has a register of 32 bits in length.

Types of Registers

The number and type of registers in a CPU vary according to the CPU design The most commonly used registers are:

(1) Program counter (PC). This stores the memory location of the next instruction that will be needed by the CPU.

(2) Instruction registers or current instruction register (CIR). This stores the instruction currently being executed by the CPU which are being executed.

(3) The memory data register (MDR).

This holds data that has just been read from or about to be written to main memory.

(4) Memory buffer registers (MBR). The data read from the memory location is stored in these registers.

CPU Cache

- A CPU cache is a smaller, fast memory which stores copies of the data frequently used from main memory locations to save time the CPU would take to access data from the main memory.

- This **memory** is integrated directly with the CPU chip or placed on a separate chip that has a separate bus interconnect with the CPU.

- This enables the CPU to bypass the system bus during data transfer so as to increase the CPU's overall access speed. The CPU can access cache much more quickly than RAM.

System clock

This is the internal clock that generates a signal to match and set the speed of all operations of the CPU and the movement of data around the other components of the computer.

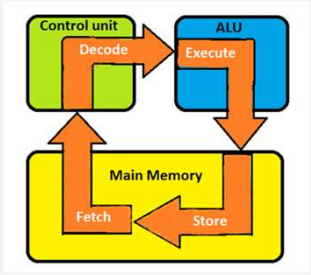
Each phase in the processing cycle takes one pulse of the clock to be executed.

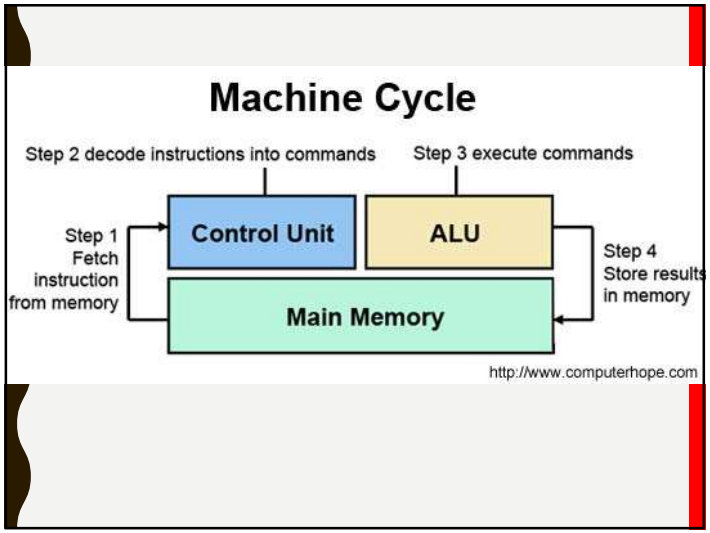
- The unit of measure of the clock speed (clock rate) is hertz. E.g. megahertz (MHz, millions of cycles per second) or gigahertz (GHz, 1000 million cycles per second).

The machine cycle

- The machine cycle is the four stage sequence of Fetch, decode, Execute and store carried out by the CPU by which it retrieves a program instruction from memory, determines what actions the instruction requires, and carrying out those actions and storing the results.

The machine cycle





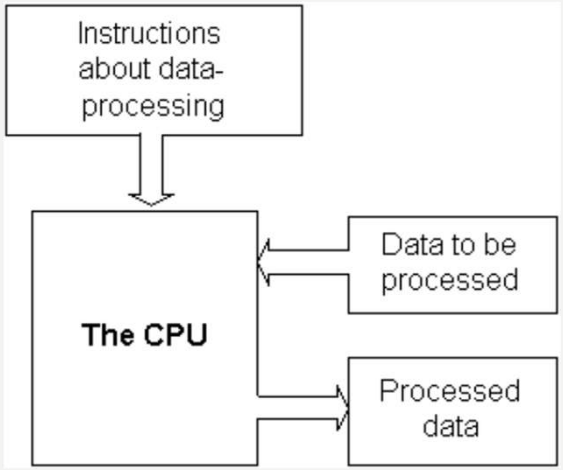
Fetch

- Fetch is the process done by the Control unit of obtaining the next program instruction from memory.
- Before the CPU can execute an instruction, the control unit must retrieve (fetch) a command or data from the computer's memory.

Two types of Data

- The CPU receives at least two types of data:

1. The Instructions on how to handle the other data (e.g. to save or to print).
2. Data, which must handled according to the instructions (e.g. a document for printing or to save or format).



Decode

- Decode means translating the program instructions into commands that the computer can process.
- The Control Unit of CPU then passes the decoded instructions to the ALU to perform mathematical or logic functions on them.

Execute

- This is the stage where the CPU carries out arithmetic, comparison and logical operations. Execute is the actual processing of the computer commands.

Store/Writeback

- Storing/write back to memory is writing data to memory such as the internal CPU register for quick access by subsequent instructions.

The factors that influence the processing speed of a CPU

1. RAM size
2. Cache memory size(high-speed memory that holds the most recent data and instructions that have been loaded by the CPU).
3. The number of CPU cores on the processor. the more the number, the more powerful because the computer can execute more instructions at a time.

5. Clock rate (clock cycles or clock speed).

This is the frequency at which the processor executes instructions or processes data(completes a processing cycle).

6. Word size/Bus capacity.

The word size is the number of bits that the CPU can process at a time measured in bits; e.g, 32-bit or 64-bit word sizes. A CPU with 32-bit word size can manipulate 32 bits at a time. The higher the word size, the more data a computer can process at a given time.

- 7. The size and number of registers. The larger the register, the greater the processing power

Cooling the Processor

- Due to its processing activity, The processor produces heat, and, if it gets overheated, it can become damaged and unstable.
- Devices that are used to keep a system cool include CPU fans, case fans, coolers, heat sinks,liquid cooling systems, and dust-preventing tools.

- The Heat sink is made of aluminum or copper which are good conductors of heat sits on top of the processor to suck heat away from the processor, while a fan on top of the heat sink sits on top of the processor blows the heat away.

Types of computer processing

Computer system collect and process data in a number of ways including batch, online, multiprocessing and other processing systems

Multiprocessing/parallel processing

Multiprocessing is the simultaneous execution of data using two or more central processing units (CPUs) within a single computer system.

MotherboardThis motherboard for a server has two processor sockets, which allow for a multiprocessor platform

Pipelining (pipeline processing)

- This is a computer processing technique where the CPU is able to execute more than one instruction at a time by beginning to execute another instruction before the first/preceding instruction has been completed. This increases processing speed

Real time/reactive processing

This is where there is no delay between the input and output operations. Data processing appears to take place, or actually takes place immediately upon data entry or receipt of a command.

The user and data must be handled online.

- There is no processing lags caused by the system
- The system is immediately updated
- Usually expensive to acquire and maintain.

- Examples of real-time processing systems include those in anti-missile defense systems, electronic fund transfer systems, ATM transactions, Traffic control, Heart rate monitoring, Computer games, Controlling Robots etc.

Batch processing

This is where data are collected in a bunch and accumulated before processing it all at once at a later time when it is necessary or efficient to do so.

Once a batch job starts, it continues until it is done or until an error occurs. There is no interaction with the user while the program is being run.

batch processing is usually done where:

i) There is large amount of data to be processed.
ii) The output is not urgently needed.
iii) Where there is no need of human interruptions during processing.
iv) Where processing is periodical or repetitive. e.g. salaries or monthly bills.

Advantages of batch processing over real-time processing

- It is usually done during less busy times, when computer resources are less needed.
- Jobs are queued in order to share computer resources fairly.
- Repetitive jobs are done quickly due to absence of interruptions once batch processing starts.

- There is no need of special hardware to support data input.
- Batch processing can take place off-line which reduces cost.
- Can easily and quickly handle large amount of data processing at lower processing cost.

- It is not possible to correct errors during the processing.
- Sorting data is time consuming.

Multitasking/Multiprogramming

The apparent simultaneous performance of two or more tasks by a computer's central processing unit.

A multi-tasking system handles a number of different jobs at the same time.

- An example of multi-tasking is typing in a word processor while at the same time listening to music played from a CD-ROM.
- Both batch and interactive jobs may be run in a multi-tasking environment.

Multitasking

Time-sharing processing (multi-user processing)

This is the processing method where users share time on the same computer. the CPU allocates slices of time to the different users on the computer system, who independently run different or the same programs.

- It provides many users the opportunity to use the system.
- All users get the equal amount of processing time.
- It is possible to interact with the running program.

Interactive processing

- Interactive processing is one that involves a two-way communication between the user and computer system, involving continual exchange of responses between the computer and the user during processing.
- Examples include electronic fund transfer systems, tickets reservation systems, and point-of-sales systems.

On-line transaction processing (OLTP)

On-line processing uses a terminal (input) that is remote from the CPU. The user is linked directly to a computer for the purpose of data input or receiving output.

Centralised processing

This is where all data processing operations are executed by the central computer and the access to the central computer is via dumb terminals from which the user sends input and receives output

Distributed processing

This is processing of data carried out by more than one computer where the system consists of independent computers installed at different sites, and inter-connected by transmission facilities (network), each of the computers performing independent data processing.

Computer Cables and Connectors

- A cable is one or more wires covered in a plastic covering that connects a computer to a power source or to another device.
- There are two main types of computer cables: a data cable and a power cable.