



UACE Sub - ICT

Topic 5: Computer Hardware

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Presentation Outline

UACE Sub – ICT Topic 5:

Computer Hardware

- Sub Topic 1. Input Devices
- Sub Topic 2. Output Devices
- Sub Topic 3. Storage Devices
- Sub Topic 4. Processor Components

Learning Outcome: The learner should be able to use and describe the functions of common hardware devices.



Background

- A computer is made up of hardware and software. An analogy can be made to humans that the hardware is your body and the software is your mind. It is important to recognize that the way humanity is comprised of both the physical and mental, a computer is nothing without both hardware and software.
- **Hardware is any physical part of the computer that you can touch, see and pick up.** Some examples of hardware include the monitor, keyboard, mouse, disk drives, printer, scanner and speakers.

printer
(output device)

**portable
media player**
(output device)



system unit
(processor, memory,
and storage devices)



CD/DVD drive
(storage device)

hard disk drive
(storage device)

screen

Web cam
(input device)

monitor
(output device)

speakers
(output device)

microphone
(input device)

keyboard
(input device)

mouse
(input device)

digital camera
(input device)

scanner
(input device)

external hard disk
(storage device)

card reader/writer
(storage device)

USB flash drive
(storage device)

modem
(communications device)

memory cards

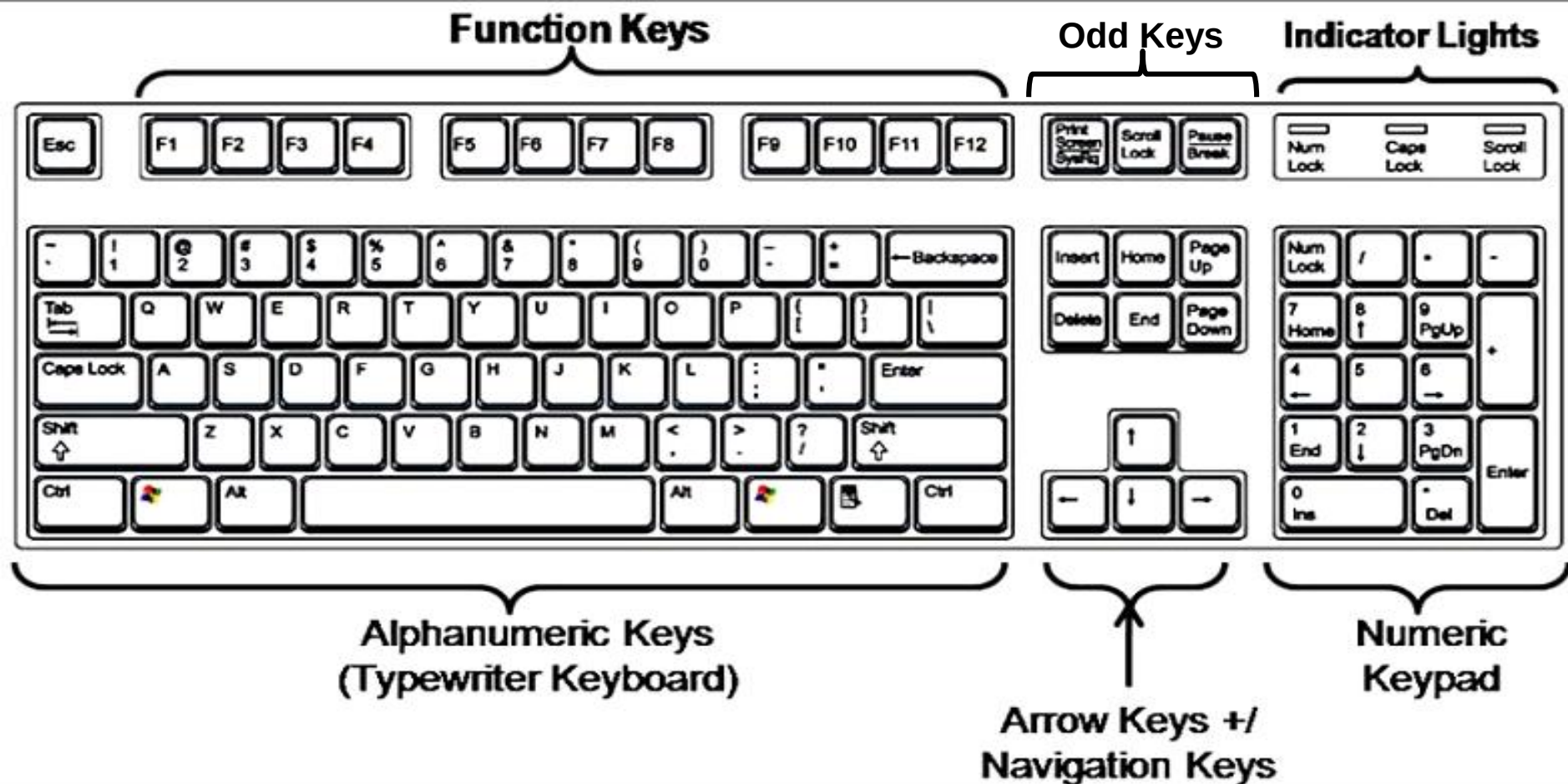


Sub Topic 1. Input Devices

Sub topic Objectives:

1. Identifying the basic input devices.
2. Distinguishing between input devices by their characteristics and functionality.

1. The Keyboard





1. The Keyboard

- **Input Device Category:** Text Input Devices
- A keyboard is an input device, consisting of a set of keys (buttons) used to operate a computer.
- The QWERTY is referred to as the "Universal" keyboard.
- The name "QWERTY" comes from the first six letters in the top alphabet row (the one just below the numbers).
- There are other setups also available such as Dvorak, ABCDE, GKOS, QWERTZ and AZERTY
- Keypads, Keyers and chorded keyboards have fewer keys, specially designed for devices such a pocket sized computers.

2. Barcode reader





2. Barcode reader

- **Input Device Category:** Text Input Devices
- *A bar code reader, is an optical* reader that uses laser beams to read bar codes that are printed on items usually in super markets.
- A bar code normally consists of a unique set of vertical lines and spaces of different widths which represent coded information about the item it represents.





3. Magnetic Strip Card Reader





3. Magnetic Strip Card Reader

- **Input Device Category:** Text Input Devices
- A magnetic stripe card reader reads the magnetic stripe on the back of credit cards, bank ATM cards, and other similar cards.
- Exposure to a magnet or magnetic field can erase the information and contents of a card's magnetic stripe.



4. The Mouse

- The mouse is a hand held pointing device. A **pointing device** is a spacial data input device, which allows users to move a pointer and make selections on the computer screen.
- A ball under the mouse senses movement while the buttons on top are used for left, right and double clicking and scrolling.
- An optical mouse uses a light-emitting diode and photodiodes to detect movement relative to the underlying surface.

4. The Mouse

Other pointing devices include:

- 5. Stylus pen & digitizing tablet
- 6. Cordless Mouse
- 7. Trackball
- 8. Touchpad
- 9. Touch Screen
- 10. A Track Point
- 11. Joystick





5. Stylus pen & digitizing tablet





5. Stylus pen & digitizing tablet

- **Stylus pen**- The pen lets you draw on what is called a **digitizing tablet** that mirrors the surface area of the computer screen.
- The pen can be used as a standard mouse (without wires connected to it) or also as a free flowing drawing device.
- The pen is useful for drawing since drawing graphics with a mouse tends to be inaccurate.



6. Cordless Mouse





6. Cordless Mouse

- A Cordless Mouse connects to the computer using wireless technology, giving flexibility to the user and to move the mouse over a wider working area.
- This mouse runs on a battery. When you move the mouse it sends an infrared beam to a sensor which interprets it causing the pointer to move.



7. Trackball

- The trackball uses the same principle as the mouse except that the rollers are reversed, the ball is on top
- It can remain stationary on your desk.





8. Touchpad

- The touchpad has sensors that sense a users touch and send a signal to the computer.
- Common on laptop computers.





9. Touch Screen





9. Touch Screen

- A touch screen is a touch-sensitive input and display device. Users can interact with these devices by touching areas of the screen.
- With some smart phones, portable media players, and other personal mobile devices, you can touch the screen to perform tasks such as dialing telephone numbers, entering text, and making on-screen selections.



10. Track Point





10. Track Point

- A Track Point, also called a pointing stick, is a pointing device located in the middle of the keyboard between the G, H, and B keys.
- The control buttons are located in front of the keyboard toward the user.
- The Track Point is operated by pushing in the general direction the user wants the cursor to move. Increasing pressure causes faster movement.



11. Joystick

- A Joystick consists 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, and usually have one or more push-buttons whose state can also be read by the computer.



12. Image scanner

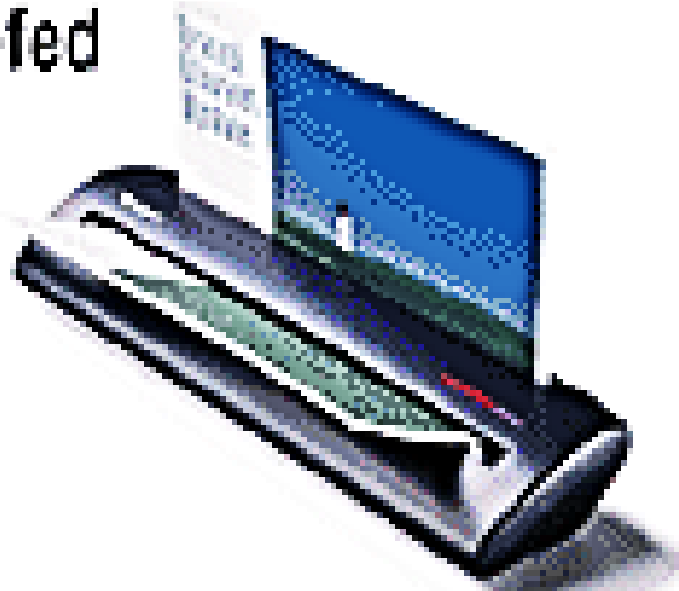
Flatbed



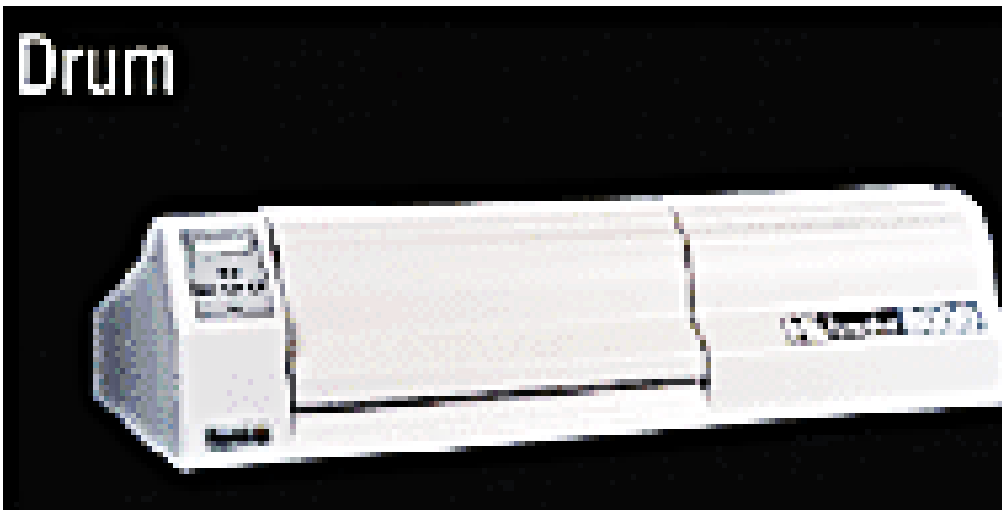
Pen or handheld



Sheet-fed



Drum





12. Image scanner

- A scanner converts hardcopy documents, drawings, or pictures to an electronic version (softcopy), which can then be stored on a disk.
- Some scanners include OCR software for analyzing what is read.
- ***Optical character recognition (OCR)*** is a technology that involves reading typewritten, computer-printed, or handwritten characters from ordinary documents and translating the images into a form that the computer can understand.

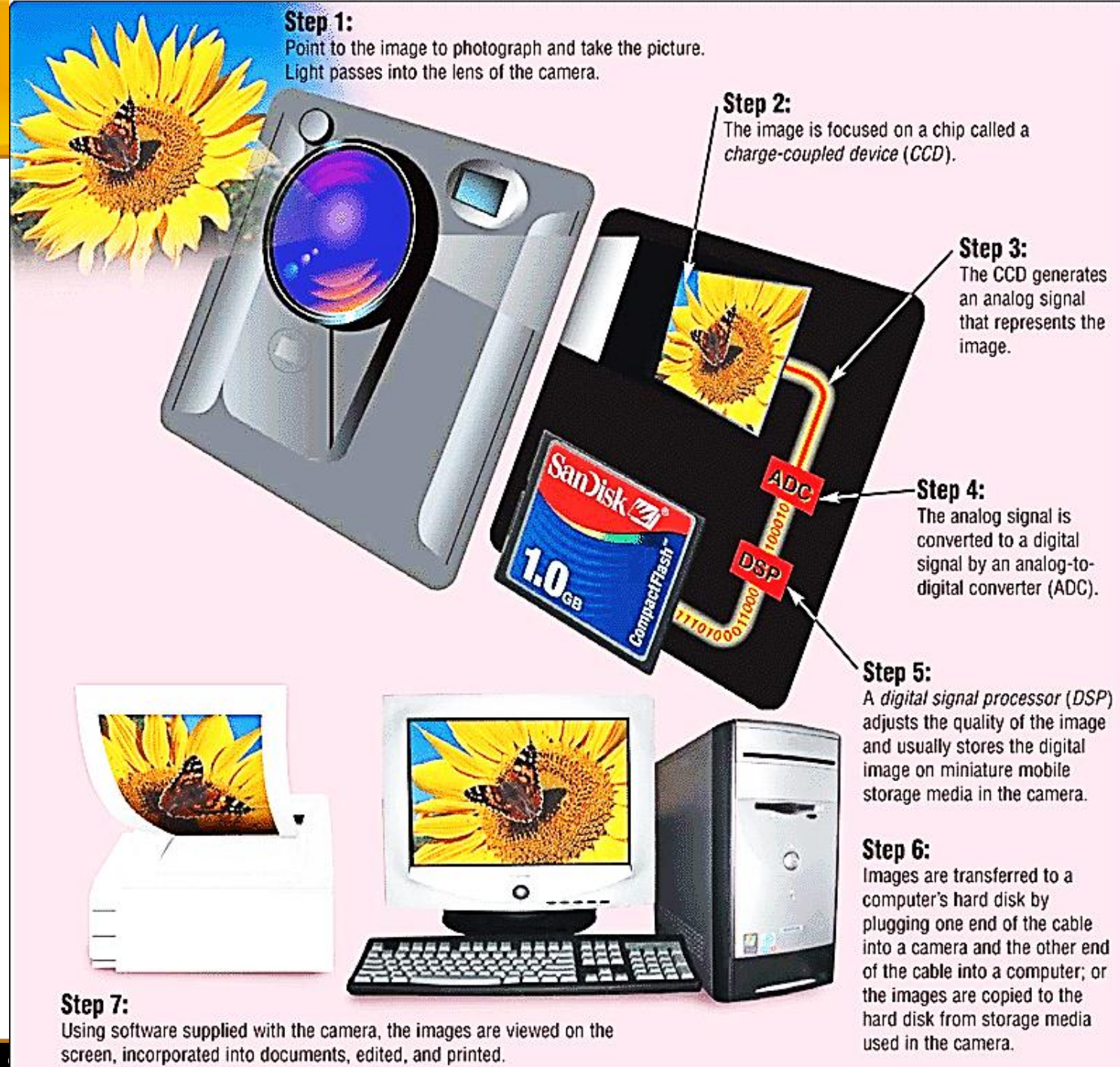


12. Image scanner

- A scanner is an imaging device.
- **Imaging Devices** are input devices that input images such as still photos, motion pictures, graphics, video etc.
- Other Imaging devices include: 13. Digital Camera, 14. Digital video (DV) camera, 15. Camcorder and 16. Web cam



13. Digital Camera





13. Digital Camera

- **A digital camera allows users to take pictures and store the photographed images digitally instead of storing on a traditional film.**
- **Users transfer a copy of the stored pictures to the computer or printer by connecting a cable between the digital camera and the computer.**



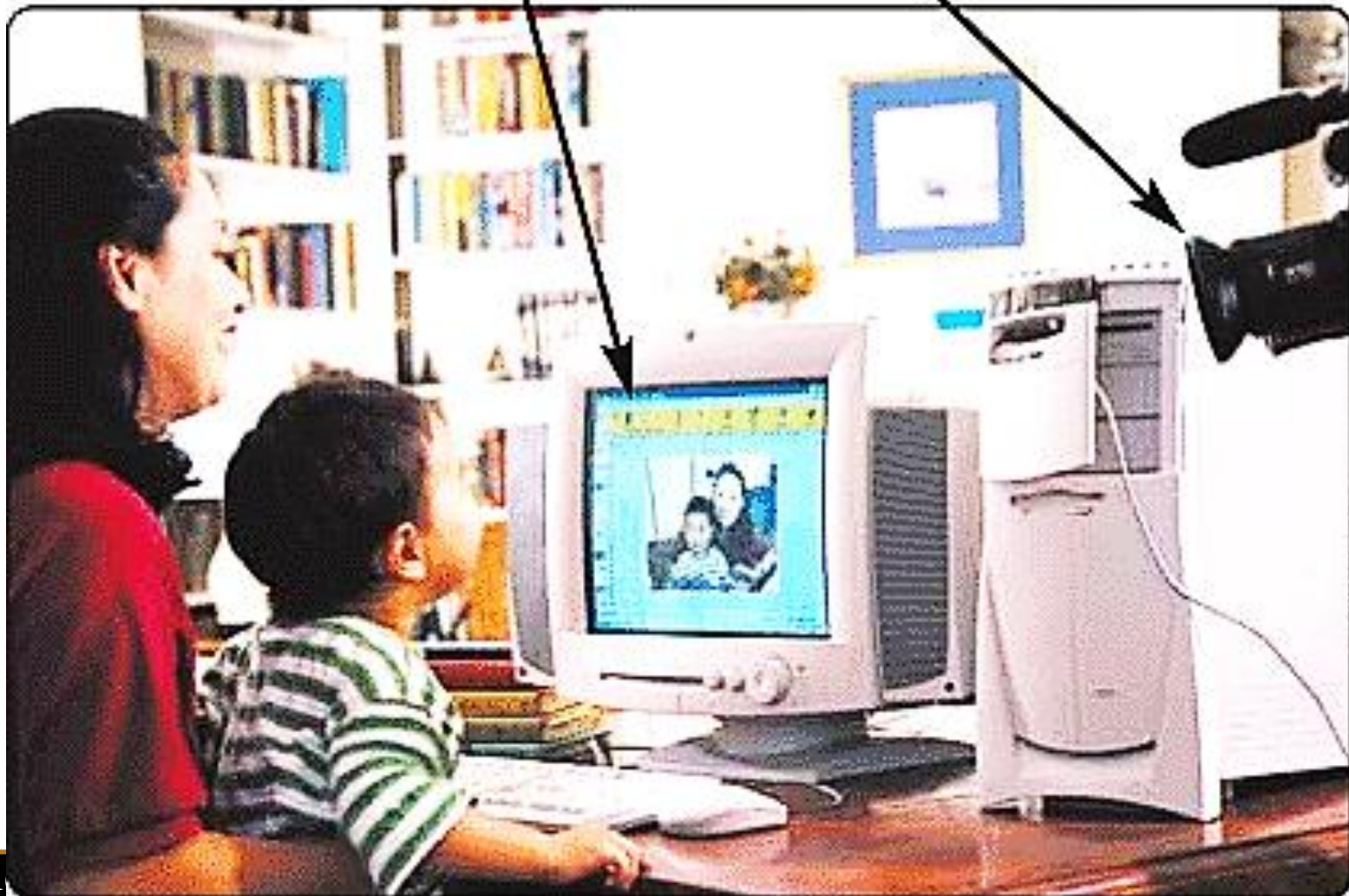
14. Digital video (DV) camera

- ***A digital video (DV) camera, by contrast, records video as digital signals instead of analog signals.***
- **After saving the video on a storage medium, users can play it or edit it and burn it to a DVD using software programs on the computer.**



video is displayed on
computer screen

video camera





15. Camcorder

- This is a light weight video camera that records data in digital form onto a storage device such as a videotape.



OPEN

CLOSED



16. Webcam

- ***A Web cam, also called a PC video camera, is a type of digital video camera that usually sits on top of the monitor. Some laptop computers have built-in Web cams.***
- **Webcams enable users to capture video and still images and make video telephone calls**





16. Webcam

- Web cams can be used for video conferencing





17. Gaming wheels

- A gaming wheel is a steering wheel-type gaming input device. Users turn the wheel to simulate driving a vehicle using programs on a computer.
- Most gaming wheels also include foot pedals for acceleration and braking actions.
- Gaming wheels include buttons, called triggers that you press to initiate certain events.



17. Gaming wheels





18. Game pad

- ***A gamepad controls the movement and actions of players or objects in video games or computer games.***
- ***On the gamepad, users press buttons in various directions to trigger events.***
- ***Gamepads communicate with a game console or a personal computer via wired or wireless technology.***



18. Game pad





19. Microphones

- A microphone is an instrument for converting sound waves into electrical energy variations, which may then input into the computer for processing, recording or audio playback.
- Microphones are connected to the **sound card** in the system unit.





20. Fingerprint scanner

- **A fingerprint scanner captures curves and indentations of a fingerprint.**
- **Some grocery and retail stores now use fingerprint readers as a means of payment, where the customer's fingerprint is linked to a an account or credit card.**



20. Fingerprint scanner





21. Iris Recognition systems

- These are devices that use *iris recognition technology* to read patterns in the iris of the eye.
- These patterns are as unique as a fingerprint.
- Iris recognition systems are used by government security organizations, the military, and financial institutions that deal with highly sensitive data.



21. Iris Recognition systems





Sub Topic 2. Output Devices

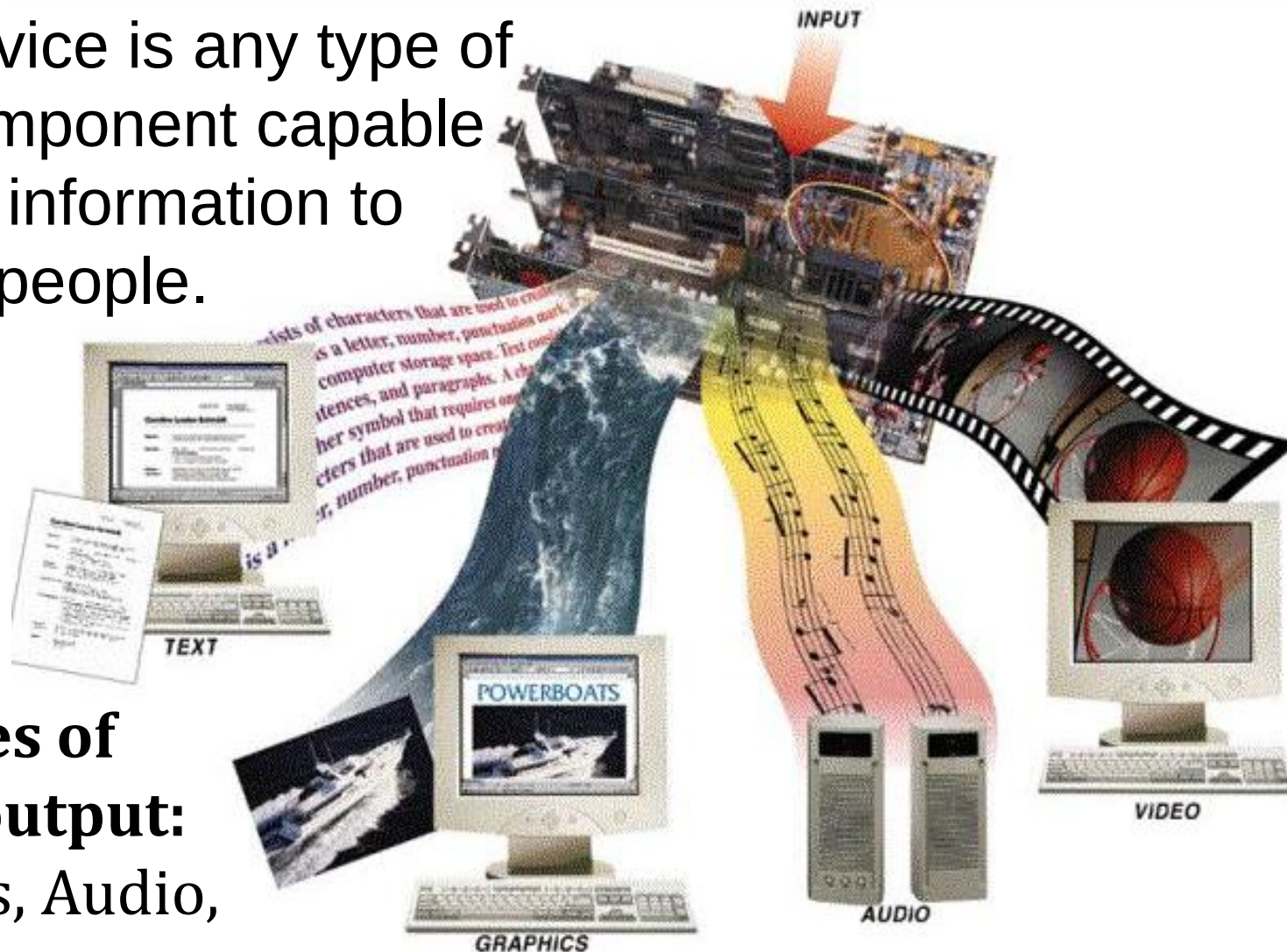
Sub topic Objectives:

1. Identifying the basic output devices.
2. Distinguishing between output devices by their characteristics and functionality.
3. Identifying the different peripheral device interfaces.



Sub Topic 2. Output Devices

An output device is any type of hardware component capable of conveying information to one or more people.



**Categories of
Computer output:**
Text, Graphics, Audio,
Video



1. CRT Monitors

- A CRT (cathode ray tube) monitor is a desktop screen that contains a large sealed glass cathode-ray tube.
- Inside the CRT, an electron beam moves back and forth across the back of the screen.
- This causes dots on the front of the screen to glow, producing an image on the screen.
- Each dot consists of a red, a green, and a blue phosphor, which combine to make up a pixel.
- A *pixel* is a single point in an electronic image.

1. CRT Monitors

- It is advisable to always sit 1 meter away from CRT monitors because they produce electromagnetic radiation, posing a health risk.*





2. Flat-Panel Displays

- A flat-panel display is a lightweight display device with a shallow depth and flat screen that typically uses LCD (**liquid crystal display**) or **gas plasma technology**.
- Examples of flat -panel displays include LCD monitors, and plasma monitors.
- Many are widescreen, ie much wider than they are tall.
- Screens are measured diagonally from one corner to the other. Common sizes are 17", 19", 20", 22", 24" and 27", 45" and 65 inch screens



2. Flat-Panel Displays



gas plasma technology
and liquid crystal display



3. Projectors

- A data projector takes the image that displays on a computer screen and projects it onto a large screen or wall so that an audience of people can see the image clearly.
- For example, many classrooms use data projectors so that all students easily can see an instructor's presentation on the screen.
- Presence of excess light affects data projectors and so they perform well in dark rooms.



3. Projectors





4. Interactive whiteboard (IWB)

- An interactive whiteboard is a touch-sensitive device, resembling a dry-erase board, that displays the image on a connected computer screen.
- The presenter can use bare hands, a special tablet, or remote control to interact with the device.
- Notes written on the interactive whiteboard can be saved directly on the computer.



4. Inter

Interactive whiteboards are used frequently in classrooms as a teaching tool.





5. Head mounted display (HMD) / headgear

- A headgear is made up of two tiny display and sound systems that channel images and sound from the source to the eyes and ears, thus presenting a stereo three dimensional sound effect in the virtual world.
- The wearer may also put on a body suit that senses the body movement and relays the data into the virtual reality system which in turn adjusts the position of the user in the system.



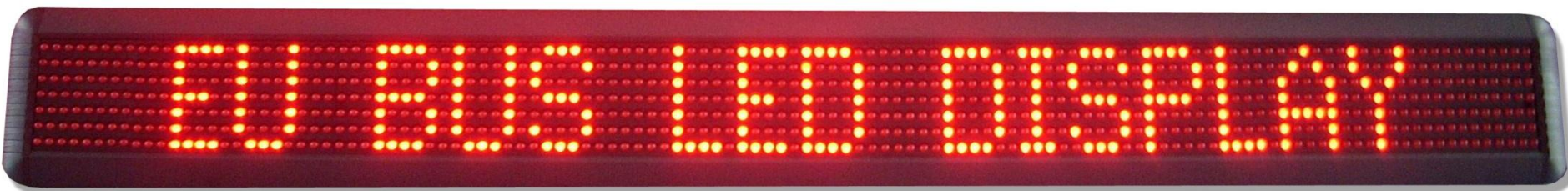
5. Head mounted display (HMD) / headgear





6. LED displays

- A LED display is a flat panel display, which uses light-emitting diodes as a video display.
- A LED panel may be a small display, or a component of a larger display.
- They are typically used outdoors in store signs and billboards.





7. Printers

- A printer is a device that produces a hard copy output such as text and graphics on a physical material like paper.
- Printed information (hard copy) exists physically and in a more permanent form than a soft copy on a display device.
- Printers with different speeds, features, quality, and capabilities are available in a range of prices.
- Printers can be grouped into two categories: **impact** and **nonimpact** printers.



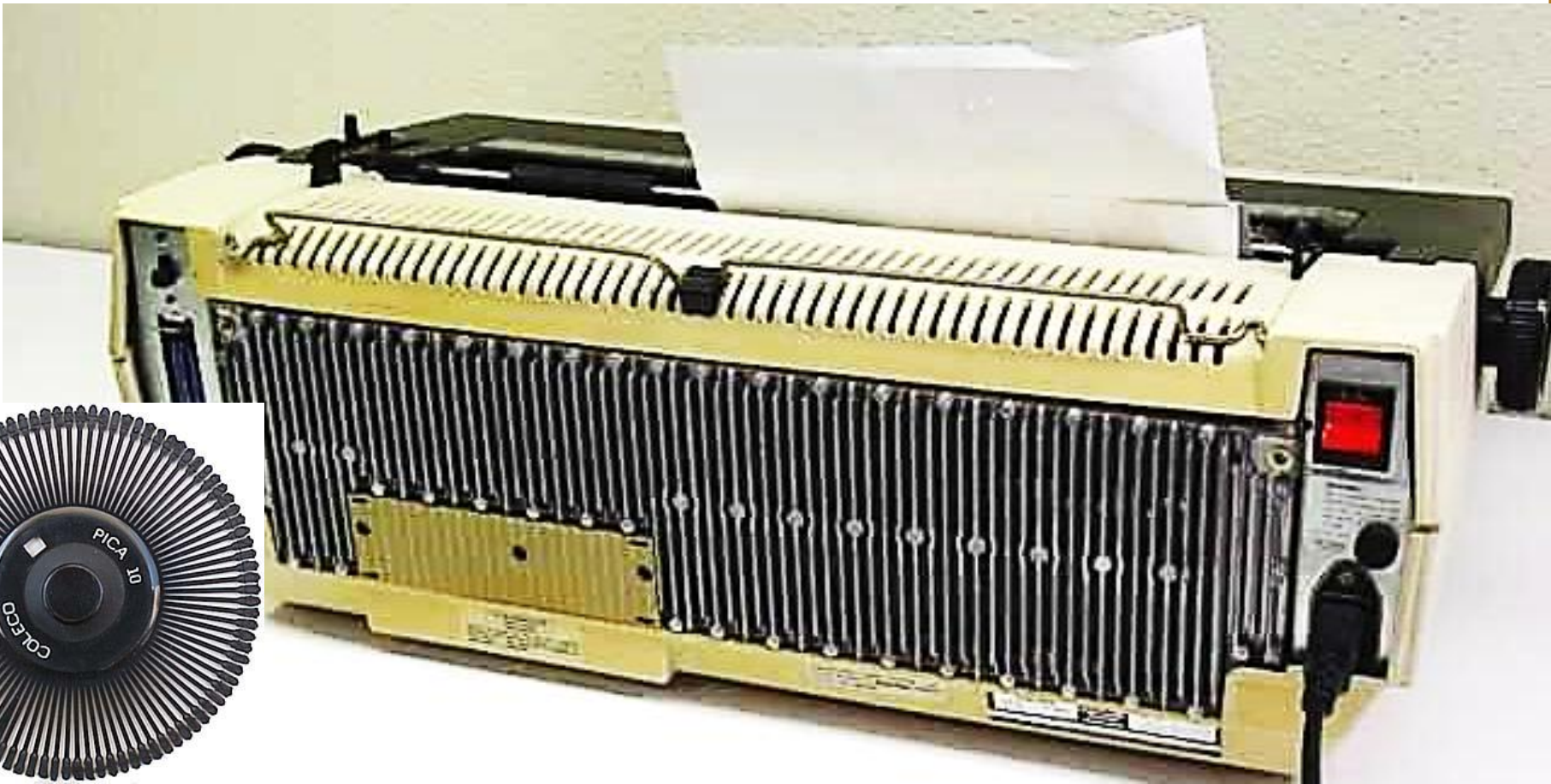
7. Printers

- An **impact printer** forms characters and graphics on a piece of paper by a striking mechanism against an ink ribbon that physically contacts the paper.
- Commonly used types of impact printers include **Daisy wheel**, **dot-matrix**, **Braille** and **line** printers.



7. Printers

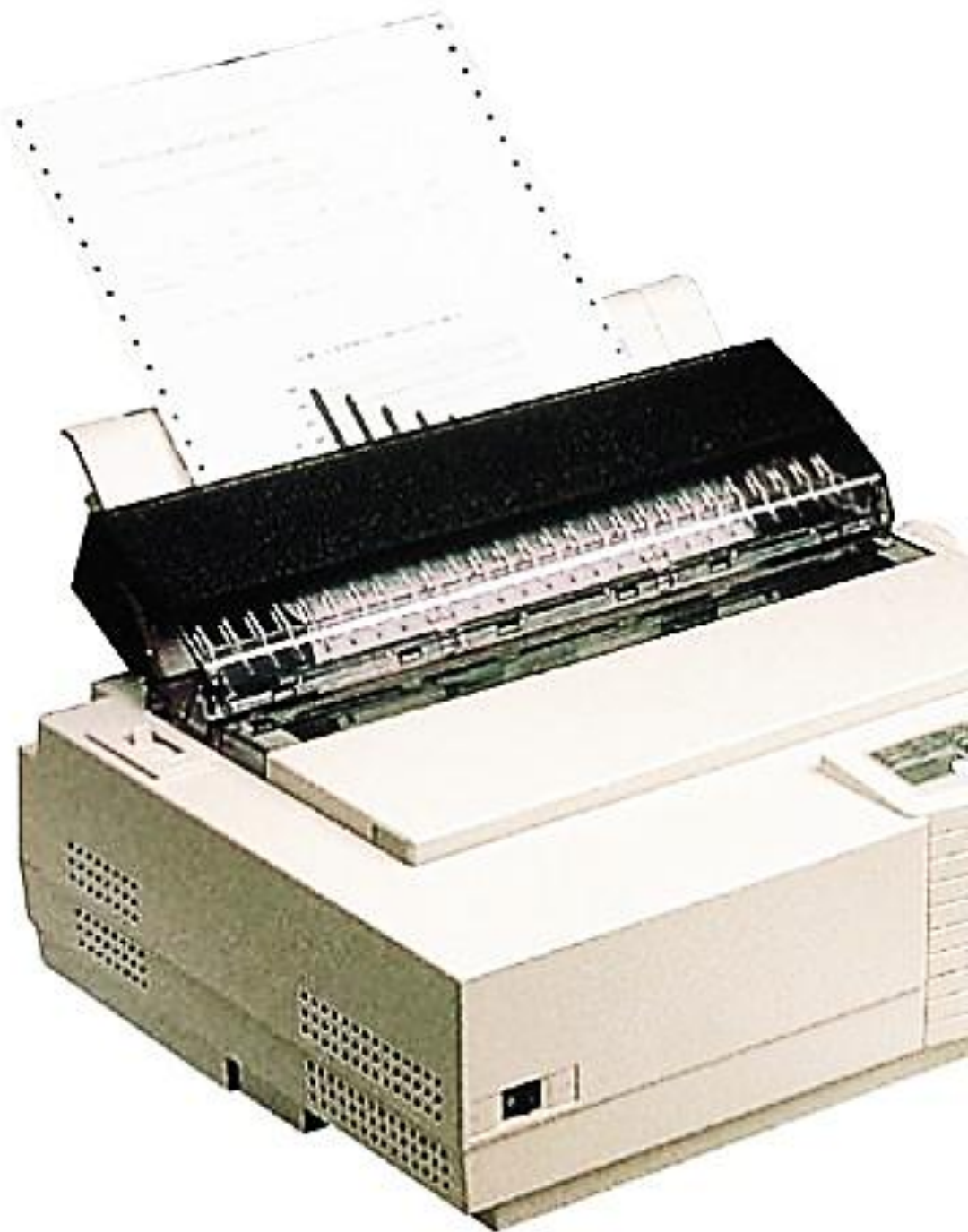
- Daisy Wheel Printer with characters arranged on the ends of the spokes of a wheel





7. Printers

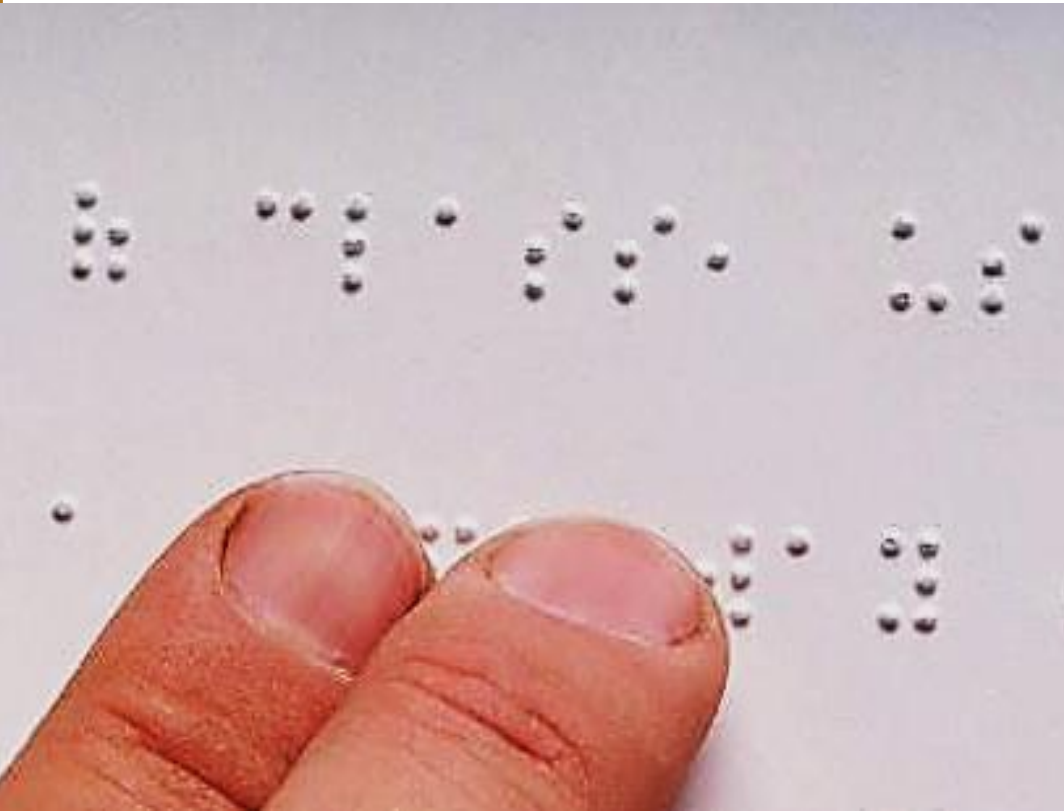
- Most dot-matrix printers use continuous-form paper, in which thousands of sheets of paper are connected together end to end. The papers have holes along the sides to help feed the paper through the printer.





7. Printers

- A Braille printer, commonly known as a Braille embosser, is an impact printer, that renders text as tangible dot cells which are felt and read by the blind.





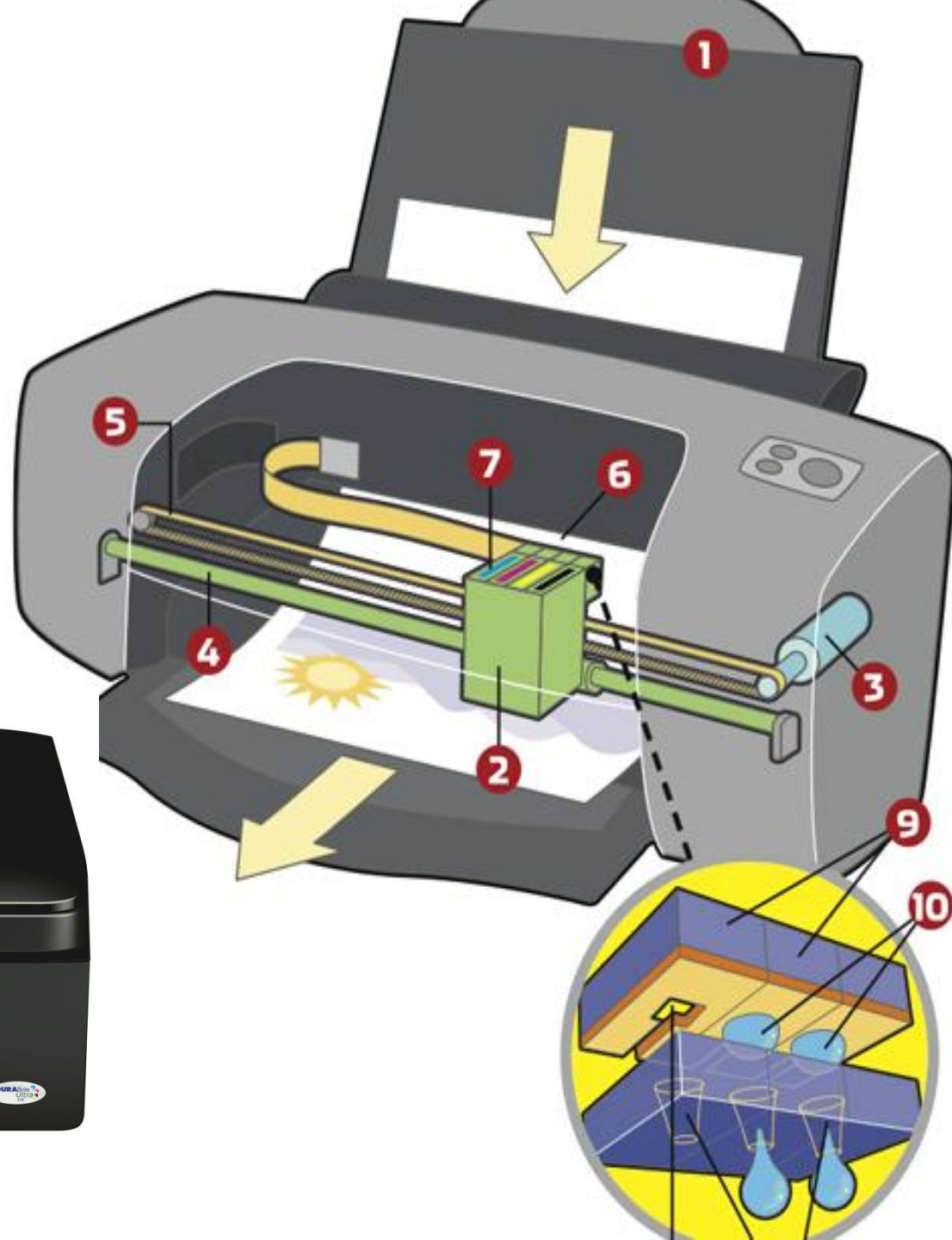
7. Printers

- A **nonimpact printer** forms characters and graphics on a piece of paper without actually striking the paper. Some spray ink, while others use heat or pressure to create images.
- Commonly used nonimpact printers are **ink-jet** printers, **laser** printers, **thermal** printers, **plotters**, and **mobile** printers.



7. Printers

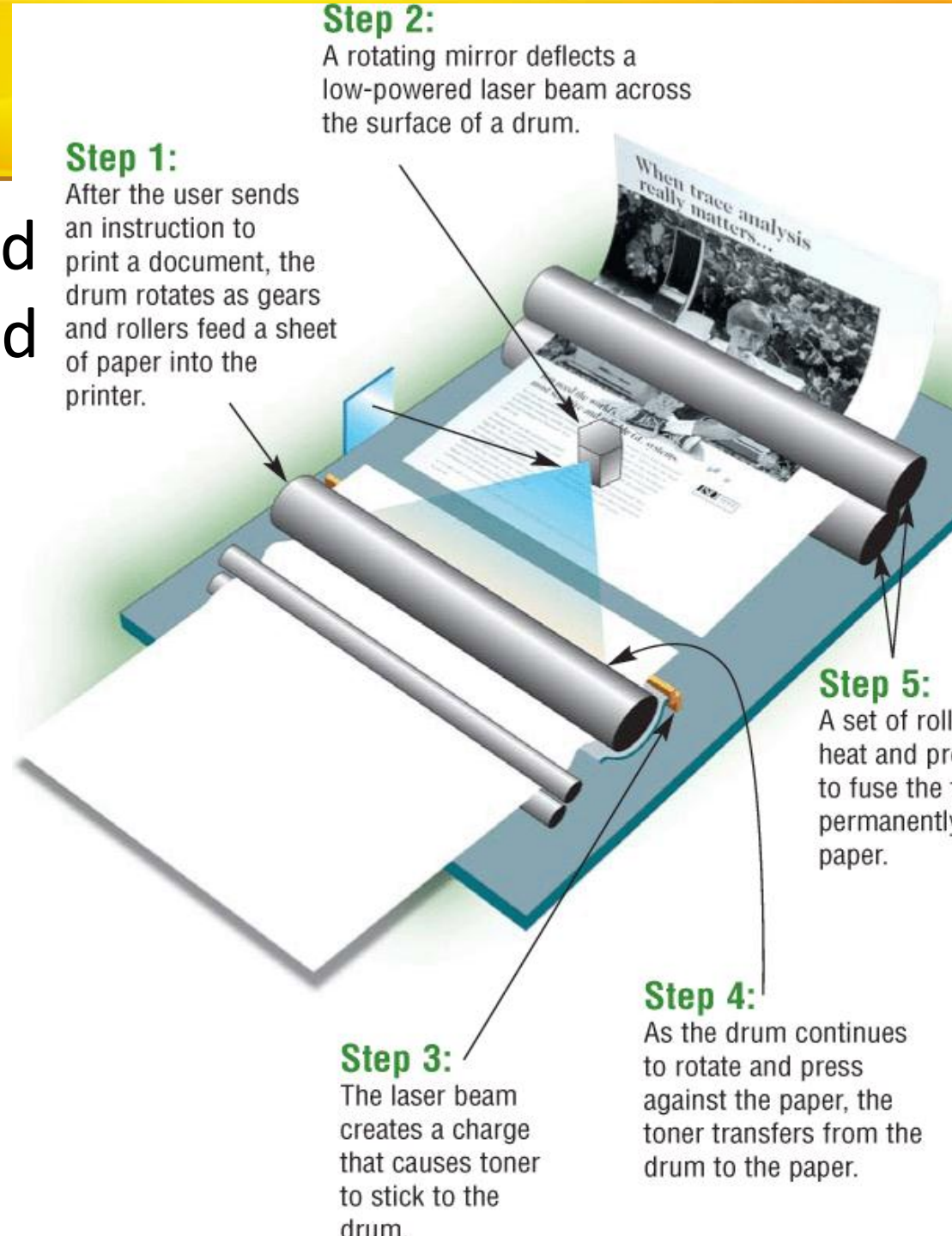
- The print head mechanism in an ink-jet printer contains ink-filled **print cartridges**.





7. Printers

- A laser printer instead uses a laser beam and powdered ink, called **toner**, packaged in a **cartridge**.





7. Printers

A thermal printer generates images by pushing heated pins against a coated heat-sensitive paper, ideal for use in small devices e.g. ATM receipt printers.



A mobile printer is a small, lightweight, battery powered printer that fit easily in a briefcase alongside a notebook computer.





7. Printers

- **Plotters** are printers used to produce large, high-quality, vector graphic drawings such as blueprints, maps, posters, and signs.
- They use ink-jet printer technology, on a much larger scale, to print professional quality displays.





Factors to consider when purchasing a printer

- **Print quality:** dot matrix printers are good for bulk printing or low quality documents, laser printer is good for printing higher quality documents.
- **Initial cost:** Laser and thermal printers are still expensive compared to inkjet printers.
- **Running cost:** The cost of maintaining an inkjet printer is higher than that of maintaining laser printers.
- **Speed:** the speed of a printer is measured in pages per minute.
- **Colour printing:** some printers support black and colour printing while others don't.



8. Computer Speakers

- Audio output devices like Computer Speakers are the components of the computer system that produce music, speech, or other sounds, such as beeps
- Some Computer Speakers use Wireless technology.
- Most personal computers have a small **internal speakers** that basically output beeps and low-quality sound.





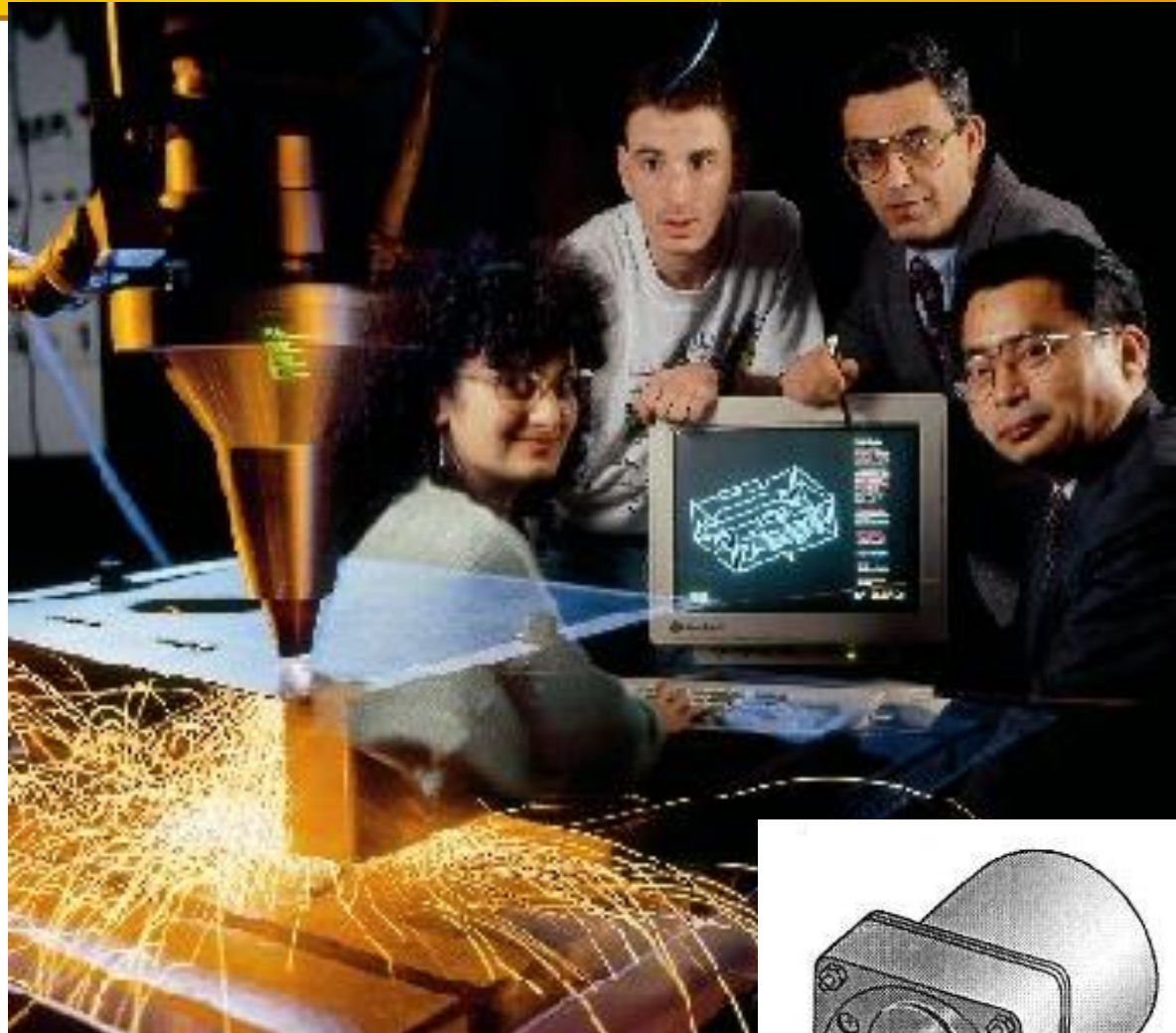
9. Headphones and Earphones

- In a crowded computer laboratory environment, speakers might not be applicable.
- Instead, users can plug head-phones or earphones in a port on the sound card, in a speaker, or on the front of the system unit.

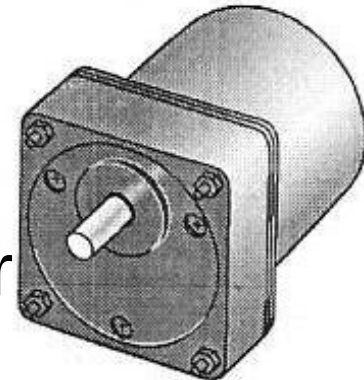


10. Machine Tools

- Through Computer-aided manufacturing (CAM) computers are used to control the output of machine tools and like **motors** (inset) in the manufacturing process.



Inset: A motor





Sub Topic 3. Storage Devices

Sub topic Objectives:

1. Differentiating Primary and Secondary Storage
2. Categorizing secondary storage devices, listing various examples per category.



Differentiating Primary and Secondary Storage

- (i) **PRIMARY MEMORY** such as random access memory (RAM) provides a small amount of temporary storage area for the data and instructions required by the CPU during processing.
- (ii) **SECONDARY Storage** is used by Computer systems to store larger amounts of data, and information more permanently than allowed with primary memory.
 - When a user issues a command to start an application program, the operating system locates the program in secondary storage, and loads it into primary memory.
 - In this sub topic, we shall focus on secondary storage.



Categories of Secondary Storage Media

- There is a wide variety of storage devices in the following categories.
 - (A) Magnetic media,
 - (B) Optical media
 - (C) Solid-state media and
- Other Types of Storage Media such as
- Photographic film
 - Microfilm and Microfiche



(A) Magnetic media

- Magnetic storage media represent data as magnetic spots on the tape or disk, with a magnetized spot representing a 1 bit and the absence of such a spot representing a 0 bit.
- Common examples of magnetic media include:
 - i. Magnetic tape
 - ii. Floppy disk,
 - iii. Hard disks

(i) Magnetic tape

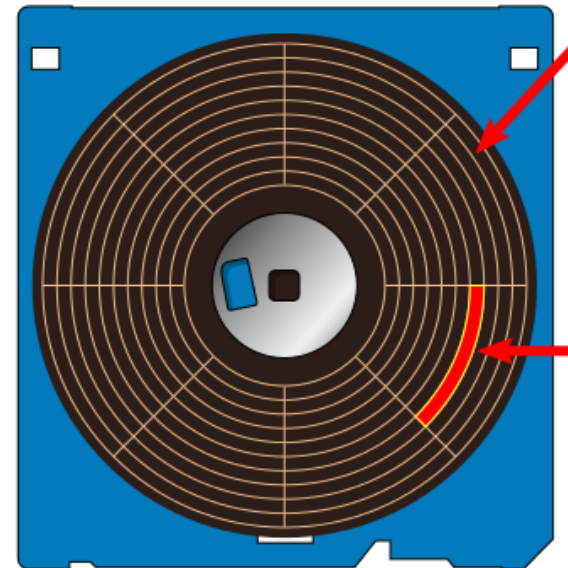
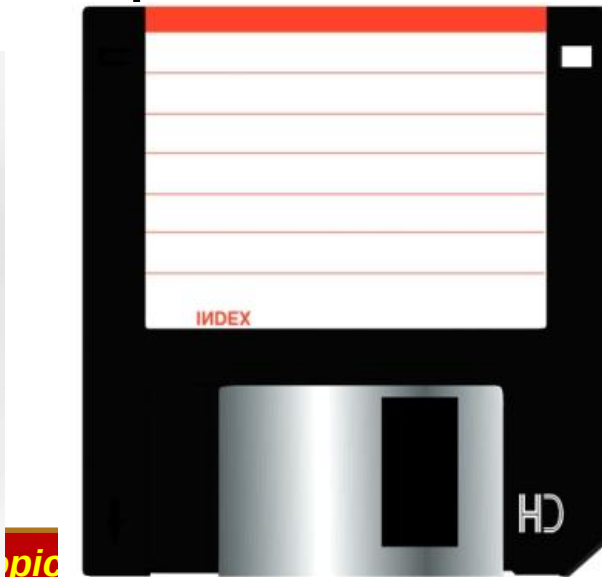
- Magnetic tape is a magnetically coated ribbon of plastic capable of storing large amounts of data and information at a low cost.
- Tape storage requires sequential access, i.e. data must be accessed in the order in which it is stored.





(ii) Floppy disk (diskette)

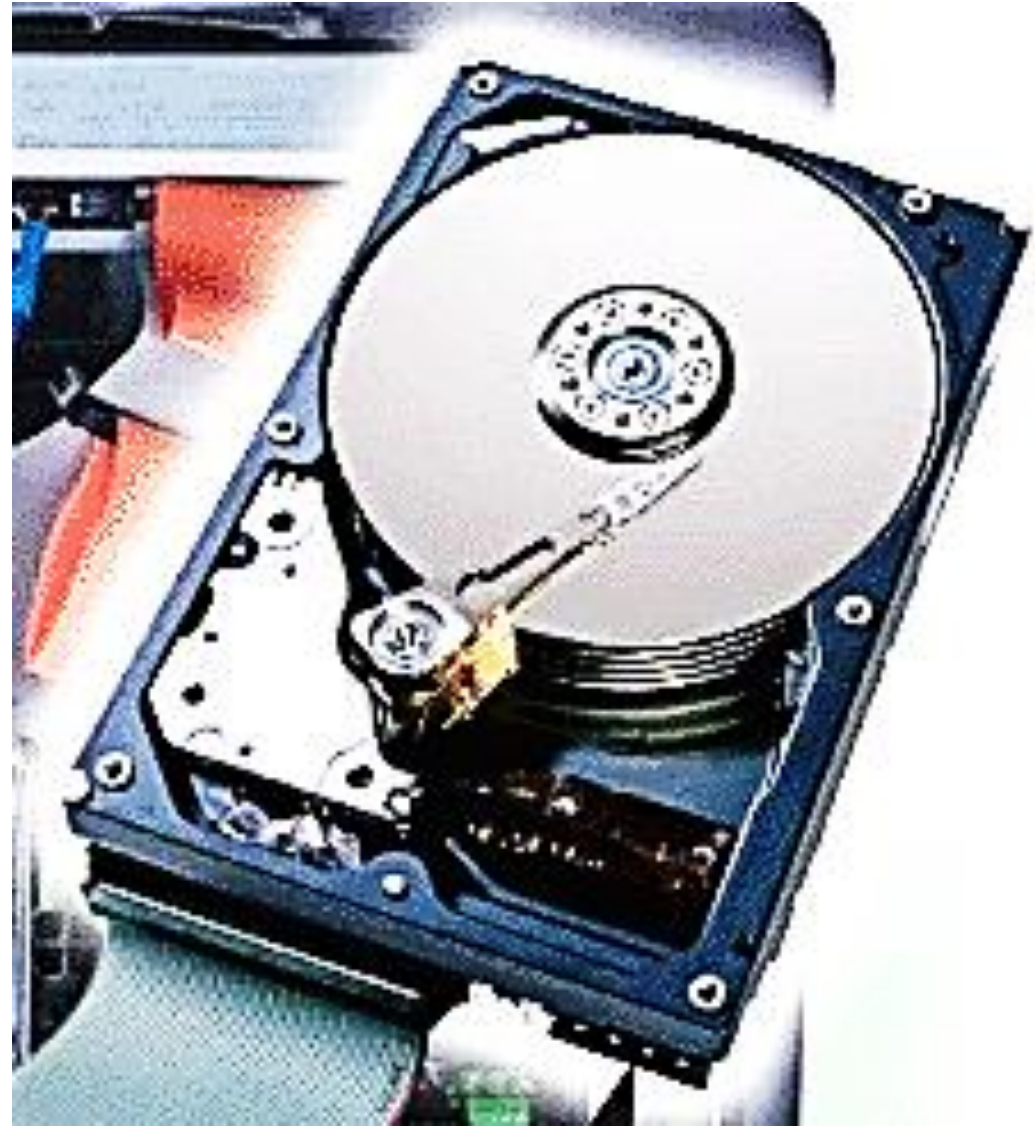
- A *floppy disk, or diskette*, is a portable, inexpensive storage medium that consists of a thin circular, flexible plastic disk with a magnetic coating enclosed in a square-shaped plastic shell.
- A standard floppy disk is 3.5-inches wide and has storage capacities up to 1.44 MB.





(iii) Hard disks

- A hard disk, also called hard drive, usually consists of several inflexible, circular metal platters coated with magnetic oxide that can be magnetized to represent data.





(iii) Hard disks

- *A read/write head is the mechanism that reads items and writes items in the drive as it barely touches the disk's recording surface.*
- When a read/write head does accidentally touch the platter surface, it is called a *head crash* and *all data is destroyed*. Thus, it is crucial that you back up your hard disk regularly.
- A **backup** is a duplicate of a file, program, or disk placed on a separate storage medium that you can use in case the original is lost, damaged, or destroyed.



Hard disk interfaces

- The hard disk interface defines the physical means by which the hard disk connects to the rest of the computer.
- There are many disk interfaces:
 - External hard disk interfaces include:
 - USB
 - FireWire
 - Internal hard disk interfaces Include:
 - SATA, (*Serial Advanced Technology Attachment*)
 - EIDE, (*Enhanced Integrated Drive Electronics*)
 - SCSI, (*Small Computer System Interface*) and
 - SAS (*Serial-attached SCSI*)



Hard d

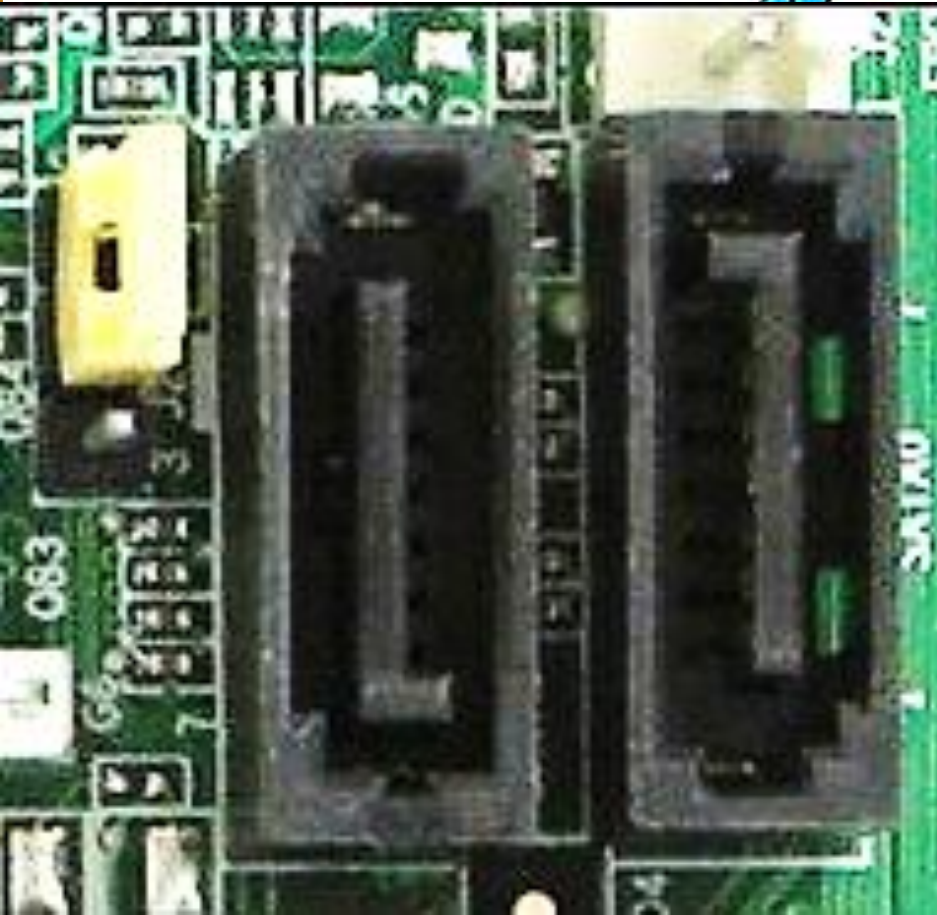
- FireWire Interface



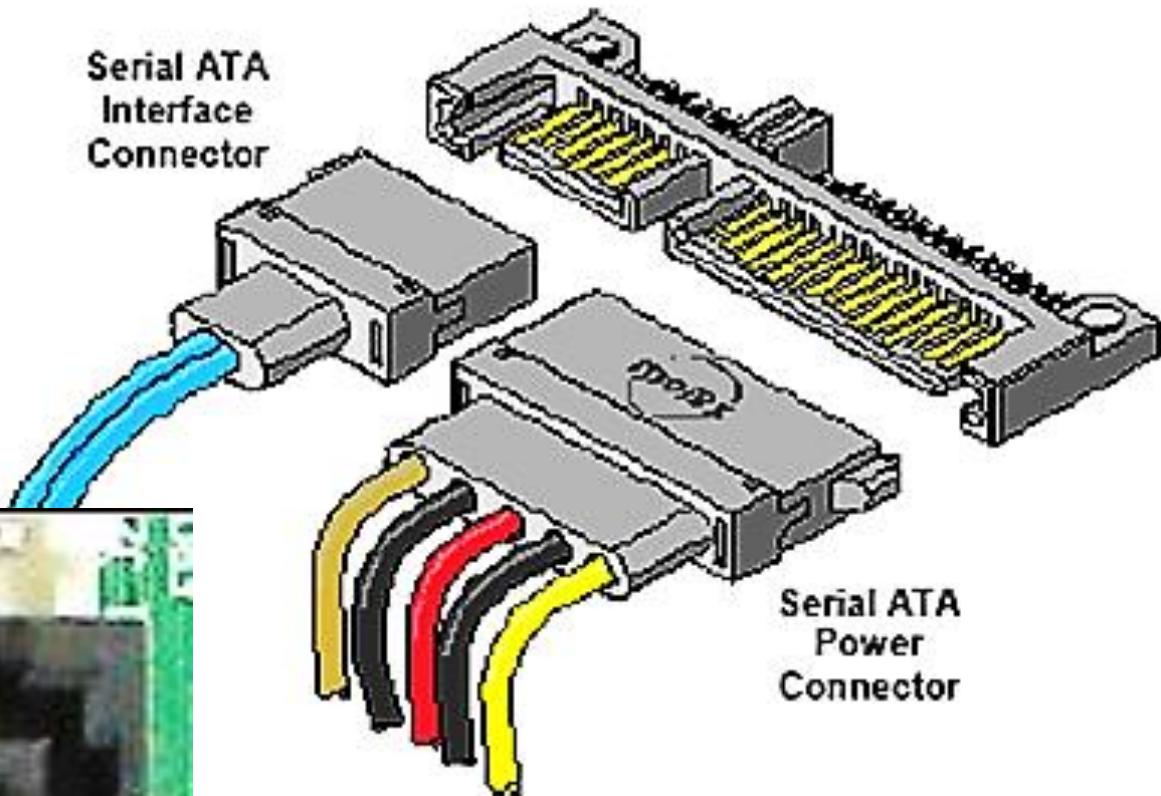


Hard disk

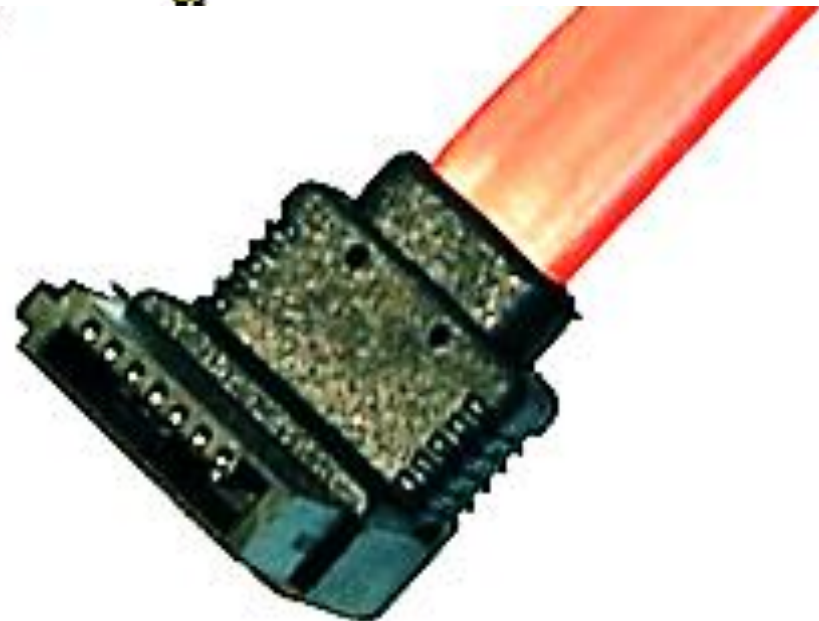
- SATA Interface



Serial ATA
Interface
Connector



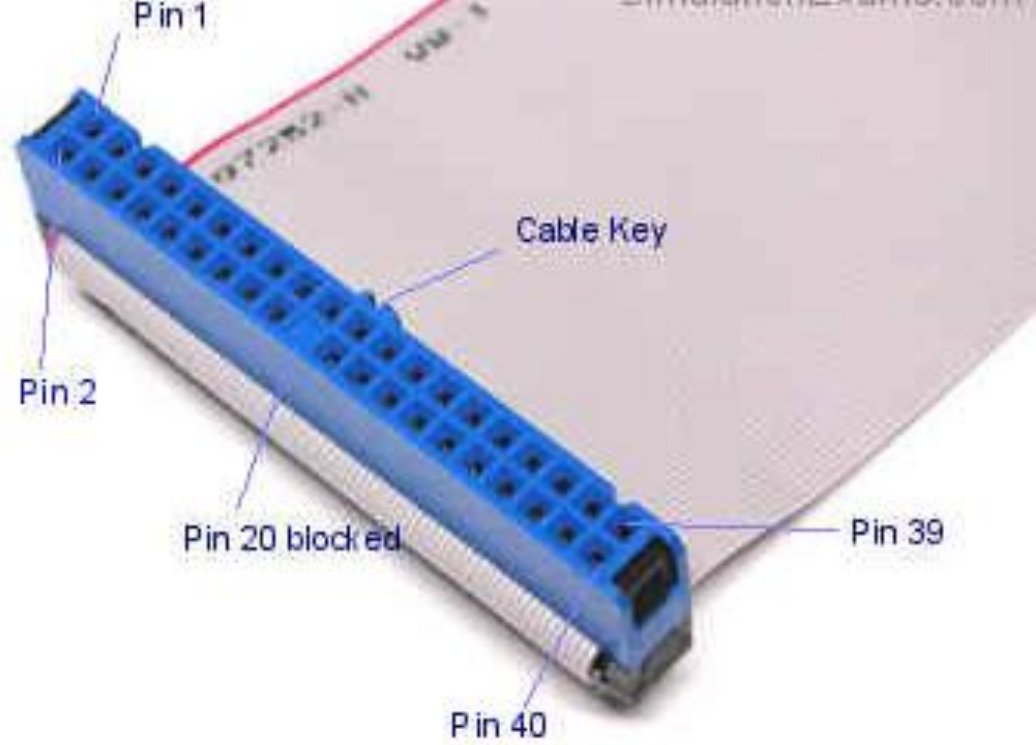
Serial ATA
Power
Connector





Hard disk in

- EIDE Interface





Hard disk interfaces

- SCSI Interface





Types of Hard disks

- An **Internal hard disk** is fixed in the system unit and usually stores the operating system required for the computer to work.
- An ***external hard disk*** is a separate free-standing hard disk that connects with a cable to a USB port or FireWire port.
- A ***removable hard disk*** is a hard disk that you insert and remove from either a dock or a drive.
- An ***Internet hard drive***, also called *online storage*, is a service on the Web that provides storage to computer users, usually for a minimal monthly fee.



(B) Optical Media

- *An optical disc is a flat, round, portable storage medium made of metal, plastic, and lacquer that is written and read by a beam of laser light.*
- The reflected light is converted into a series of bits that the computer can process.
- Optical discs used in personal computers are 4.75 inches in diameter. Smaller computers and devices use mini discs that have a diameter of 3 inches or less.



Care for Optical Disks



Do store the disc in a jewel box when not in use.



Do hold a disc by its edges.



Categories of Optical Disks

- Two general categories are CDs and DVDs, with DVDs having a much greater storage capacity than CDs.
- Examples of Optical Disks include:
- *CD-ROM (compact disc read-only memory)*: These are written by the manufacturer and can not be modified. A typical CD-ROM can hold from 650 MB to 1GB of data, but most hold 700MB.
- *CD-R (compact disc-recordable)* is a technology that allows you to write on a compact disc using your own computer's CD-R drive.



Categories of Optical Disks

- A CD-RW (compact disc-rewritable) is an erasable multisession disc that you can write on multiple times.
- *DVD-ROM (digital video disc-ROM). A DVD-ROM is an extremely high capacity compact disc capable of storing from 4.7 GB to 17GB.*
- DVDs are also available in a variety of recordable and rewritable versions and formats such as DVD-R and DVD+R *DVD+RW, DVD+RE, and DVD+RAM.*
- *A Blu-ray Discs-ROM (BD-ROM) has storage capacities of up to 100 GB.*



(C) Solid-state media

- Solid-state media consist entirely of electronic components and contain no moving parts.
- Solid state is a non-volatile storage that employs integrated circuits rather than mechanical, magnetic or optical technology.

Examples include:

- Flash Memory Cards
- USB Flash Disks



Flash memory cards

- Common types of flash memory cards include Memory Stick, CompactFlash (CF), SmartMedia, microSD, miniSD, xD, Picture Card, etc.
- They are commonly used in electronic devices such as digital cameras and mobile phones. They are tiny, re-recordable, and able to retain data without power.





USB flash drive

- A USB flash drive is a small and lightweight removable storage device that plugs in a USB port on a computer.
- USB flash drives have become the mobile user's primary portable storage device, making the floppy disks outdated.





Other Types of Storage Media

- **Photographic film** is a sheet of plastic such as polyester coated with a light sensitive emulsion, that is used to record and store photographs.
- Chemical processes can then be applied to the film to create a visible image, in a process called film developing.





Other Types of Storage Media

- **Microfilm and Microfiche** are media used to store microscopic images of documents on roll or sheet film. They have the longest life of any storage medium. Libraries use these media to store back issues of newspapers, magazines, and genealogy records.





Sub Topic 4. Processor Components

Sub topic Objectives:

1. Describing the types of processors in computers and other electronic devices.
2. Appreciating the parts of the Central Processing Unit (CPU) and their functions.

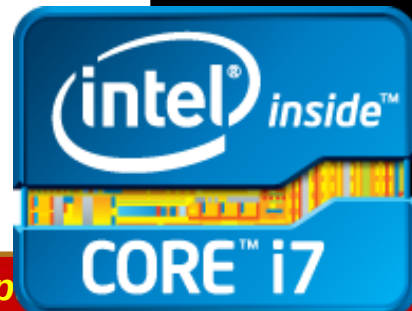


Types of processors

- Microprocessors are VLSI devices. Very-Large-Scale Integration (VLSI) is the process of creating integrated circuits by combining thousands of transistors into a single chip
- The most common types of processors are:-

- 80286,
- 80386,
- Pentium I,
- Pentium II,
- Pentium III,
- Pentium IV,
- Pentium Duo core,

- Celeron,
- Xeon,
- Opteron,
- Athlon,
- Itanium
- Core 2 Quad,
- Intel CORE i3
- Intel CORE i5
- Intel CORE i7 etc



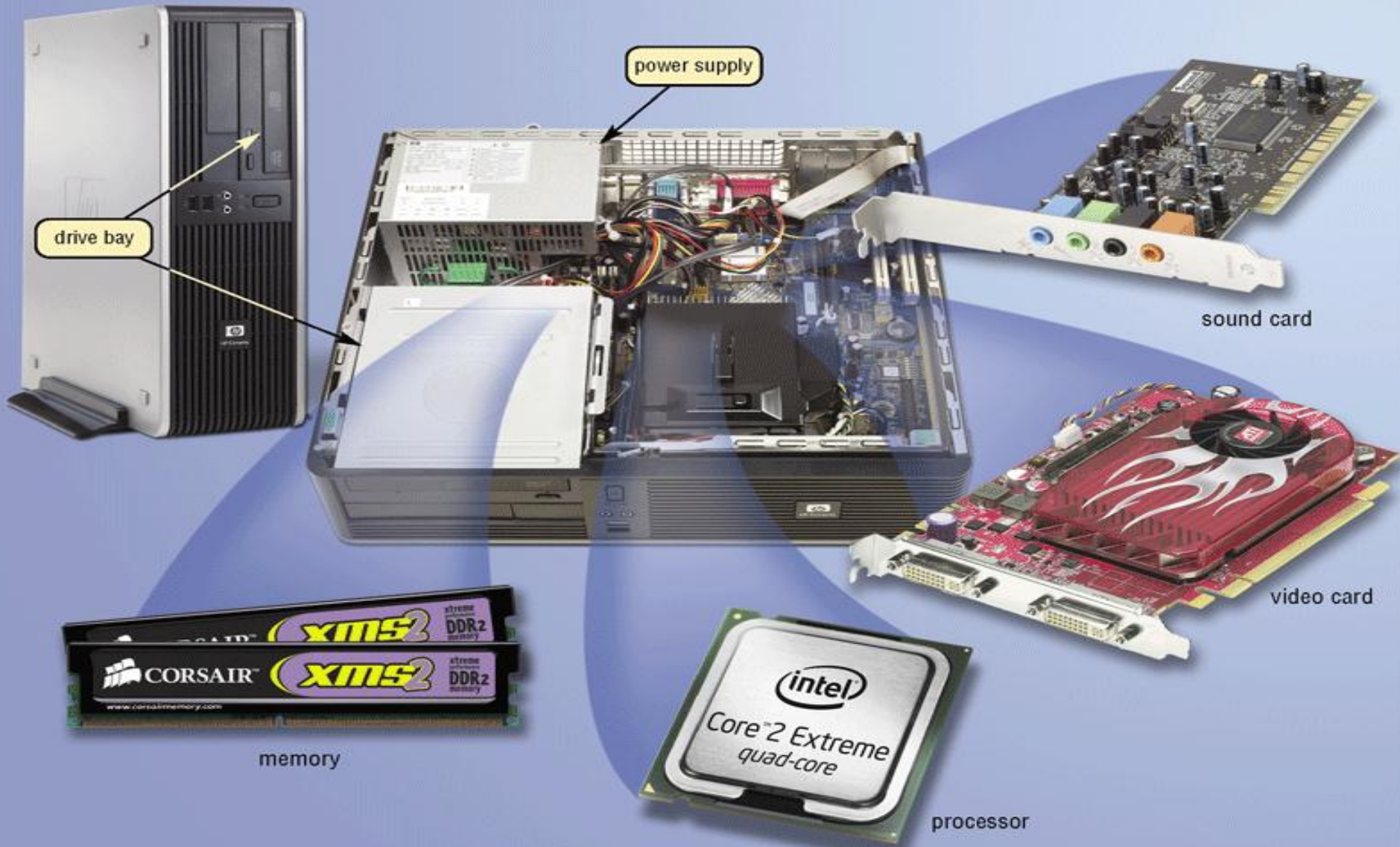


Processor Components

- Processing devices are the computer electronic components and chips housed in 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.*
- The components in the system unit are connected to the *motherboard.*
- *Two major components on the motherboard are the CPU and internal memory.*
- A drive bay is a rectangular opening inside the system unit that typically holds disk drives.



Processor Components

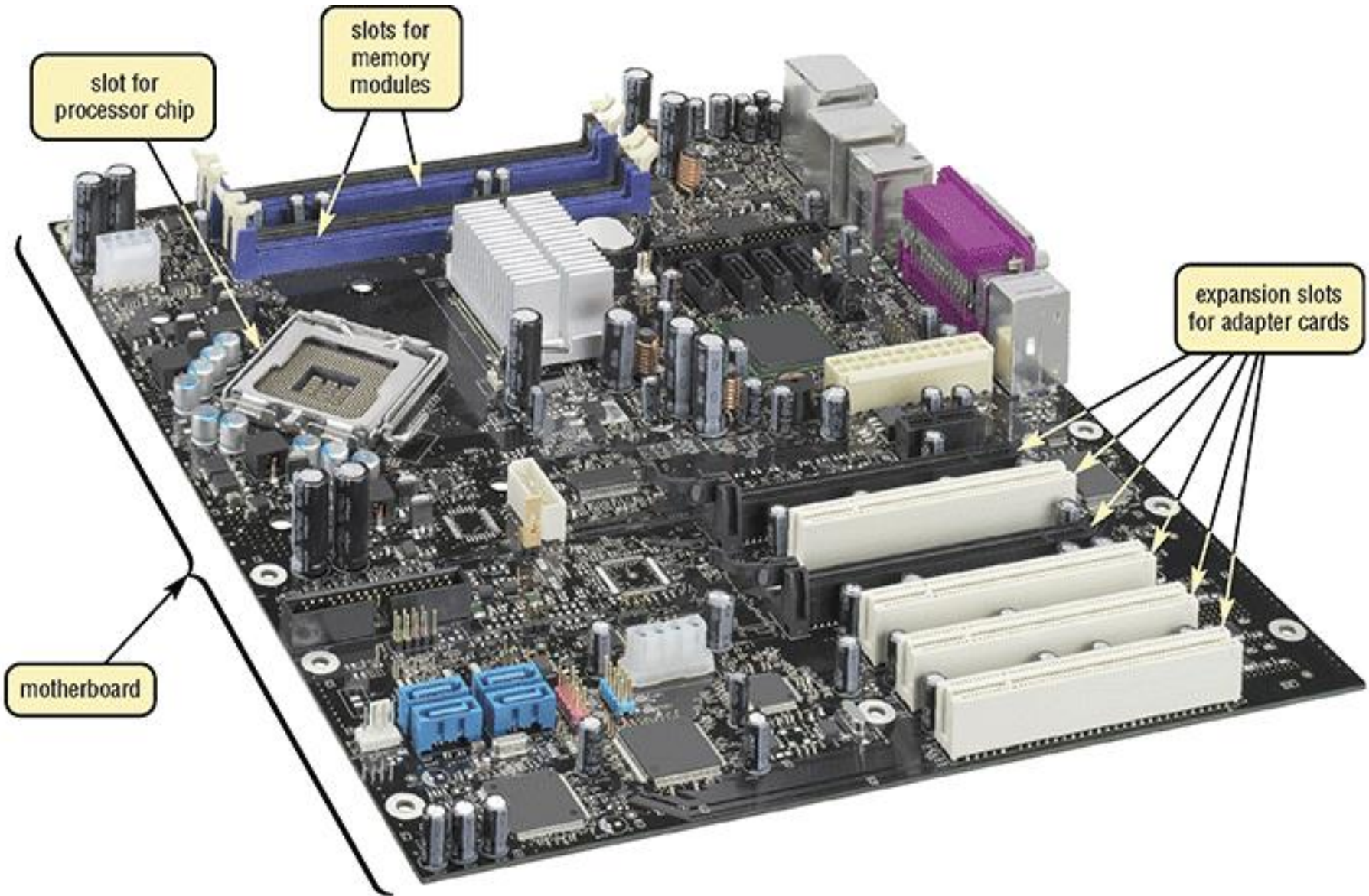




The Motherboard

- 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, memory chips, support electronic circuitry, buses, and Expansion Slots for Adapter Cards.

The Motherboard





Commonly used adapter cards and their functions

Adapter Card	Purpose
Disk controller	Connects disk drives
FireWire	Connects to FireWire devices
HDTV tuner	Allows viewing of HDTV broadcasts on the monitor
MIDI	Connects musical instruments
Modem	Connects other computers through telephone or cable television lines
Network	Connects other computers and peripherals
PC-to-TV converter	Connects a television
Sound	Connects speakers or a microphone
TV tuner	Allows viewing of television channels on the monitor
USB 2.0	Connects to USB 2.0 devices
Video	Connects a monitor
Video capture	Connects a video camera



The Motherboard

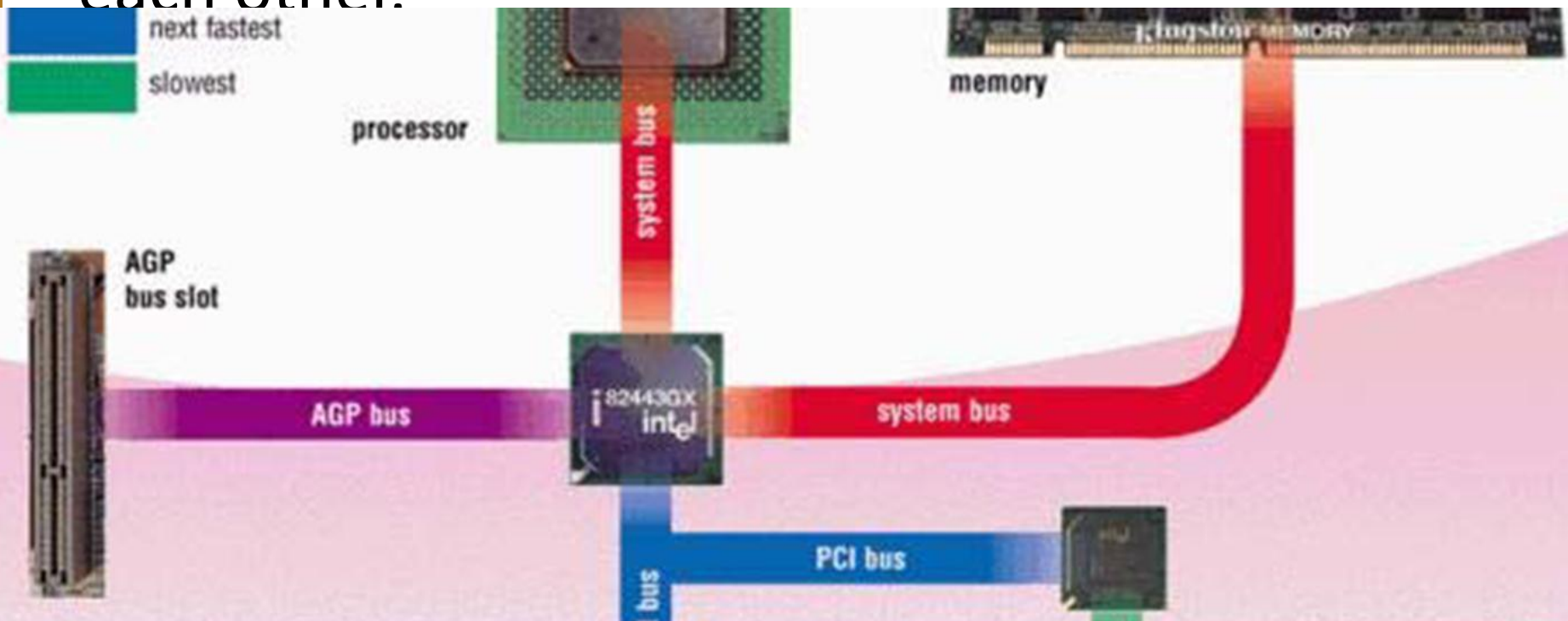
- Adapter cards are used for many supplemental capabilities, such as more memory, higher-quality sound devices, a modem, extra ports, or graphics capabilities.
- Some motherboards include all necessary capabilities and do not require cards.





Buses

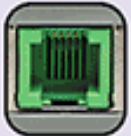
- The **bus** is a common electrical path, *that enables data flow between the various system components.*
- *A bus, allows the various devices inside and attached to the system unit to communicate with each other.*





Peripheral Device Interfaces (Ports)

- A port is the point at which a peripheral attaches the system unit. Common interfaces include Video Graphics Array (VGA) interface, Parallel, Serial , Personal system 2(PS/2) , Infrared and Bluetooth and power interface, etc.

Type	Picture	Type	Picture	HDMI port		Speaker	
Audio in		Monitor		Headphones		S-video	
Cable TV		Mouse		Keyboard		Telephone line in	
Center Surround Sound/Subwoofer		Network		Microphone		USB	



Peripheral Device Interfaces (Ports)

- **Parallel Interfaces** transmit information simultaneously using a set of many conductors (wires), commonly used to connect printers.
- **Serial Interfaces** also known as COM or RS232 ports, support transmission of data one bit at a time, hence it is slower than the parallel ports but more reliable because they can support data transmission to devices connected 15m away. Serial cables are generally used to connect devices such as the mouse.
- **Universal serial bus** is a new standard serial interface that provides high-speed and quality data transmission and is replacing the conventional parallel and serial cables and ports.



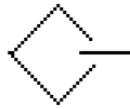
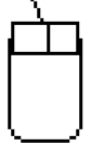
Peripheral Device Interfaces (Ports)

- **Personal system 2 (PS/2)** interface is a small 6-pin mini-DIN interface common on desktop computers in pairs, one for mouse and the other for the keyboard.
Two small, circular connectors side-by-side. The left one is purple and the right one is green, representing the PS/2 mouse and keyboard ports respectively.
- **Video graphics array (VGA)** is used to connect a monitor or a data projector. It is shaped like a letter D with 15 pins.
- **Audio interface** is used to connect speakers and microphone.
- **Fire wire** or IEEE 1394 has the same features as the USB but transmits data faster than USB. It is mostly used for streaming video from a digital video camera.
- **Infrared**, also referred to as infrared Data Association (IrDA) is a wireless interface that uses infrared to connect to infrared-enabled devices.
- **Bluetooth** is also wireless interface that uses short range radio broadcast to connect to any Bluetooth- enabled device.



Peripheral Device Interfaces (Ports)

- Table showing summary of standard symbols used to denote common interfaces.*

Symbol	Port
	Parallel
	Serial
	USB
	SCSI
	PS/2 for mouse
	PS/2 for Keyboard



Power Supply and Cooling Technology

- The power supply is the component of the system unit that converts the wall outlet AC power of 110 to 240 volts into DC power of 0.5 to 12 volts
- 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.



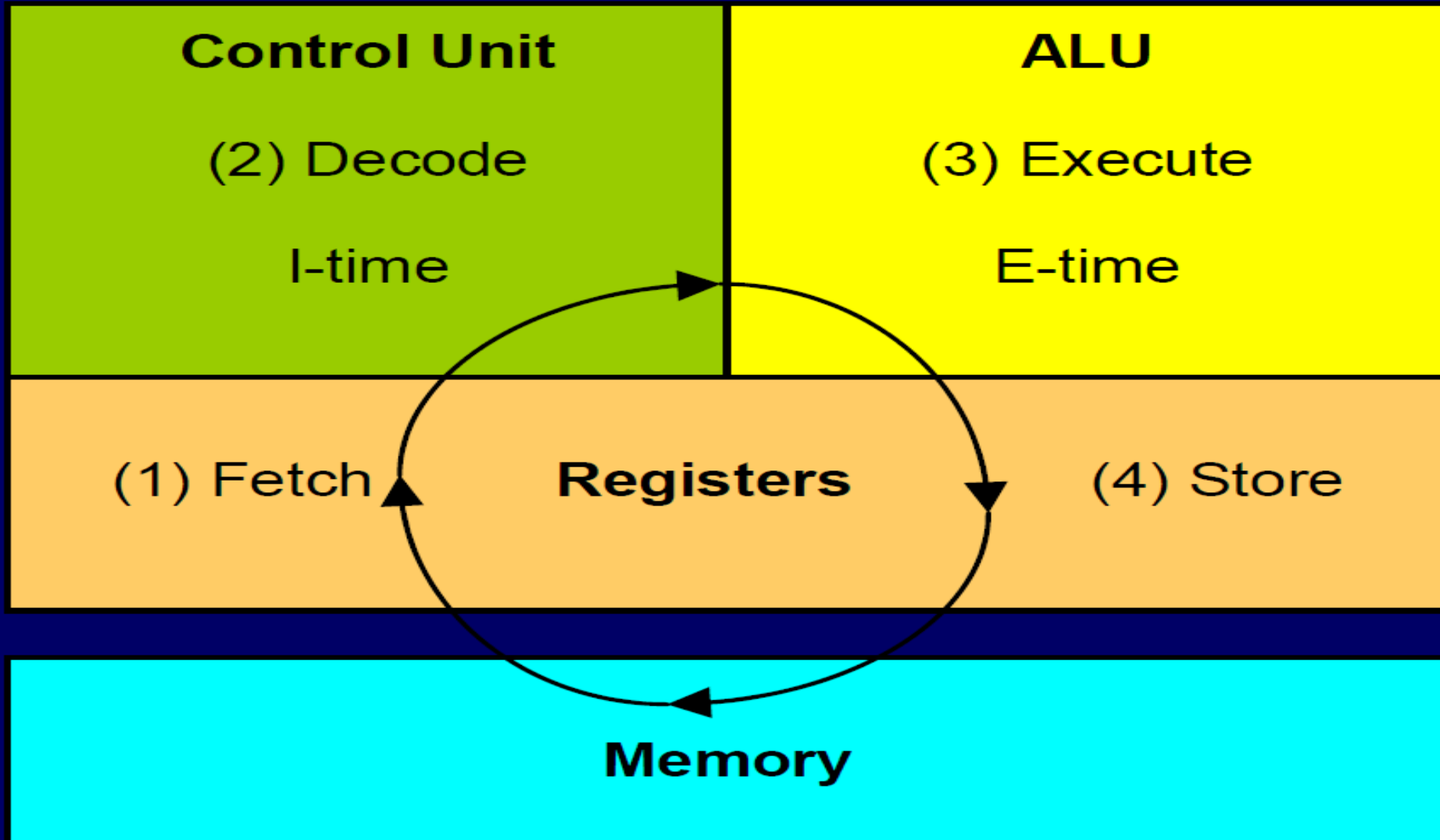


The CPU

- The *central processing unit (CPU)*, is a chip that interprets, carries out the basic instructions and manages most of a computer's operations.
- It is at times referred to as the 'brain' of the computer.
- It has two basic sections: the control unit (CU) and the arithmetic/logic unit (ALU), which work together to perform the processing operations.
- *Other CPU components are the Registers and the System Clock.*



Components of a CPU





The control unit (CU)

- The *control unit is the component of the processor that directs and* coordinates most of the operations in the computer.
- It interprets each instruction issued by program and then initiates the appropriate action to carry out the instruction.
- For every instruction, the control unit repeats a set of four basic steps called the machine cycle steps:

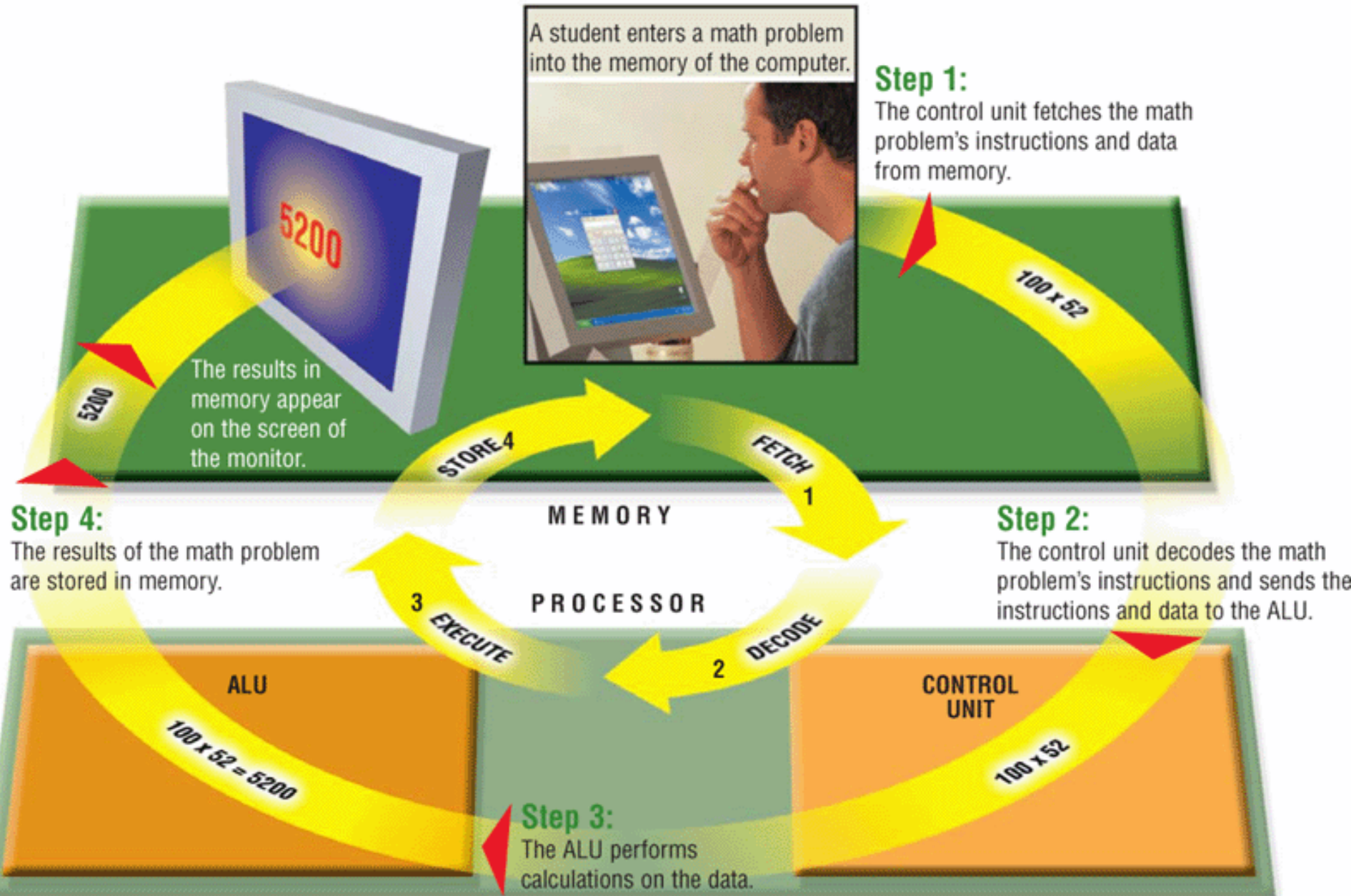


The control unit (CU)

- **Step 1: Fetching the instruction.** The instruction to be executed is obtained from memory.
- **Step 2: Decoding the instruction.** The instruction is translated into commands the computer understand and sent to the ALU.
- **Step 3: Executing the instruction.** The commands are carried out.
- **Step 4: Storing results.** The results are stored in registers or memory.



An example of a machine cycle





Arithmetic/logic unit (ALU)

- The ALU performs the arithmetic, comparison, and logical operations in a computer.
- It performs the execution step of a machine cycle.
- *Arithmetic operations include addition, subtraction, multiplication, and division.*
- *Logical operations work* with conditions and logical operators such as AND, OR, and NOT.
- For example, if you wanted to search a student database for Candidates of Computer students, you would search for any students classified as 'Computer students AND listed under Candidates.



Registers

- Registers are high-speed working storage areas *that temporarily hold instructions and data **within** the CPU.*
- Registers work under the direction of the control unit to accept, hold, and transfer instruction or data and comparisons at high speed.
- Registers hold data *immediately related to the operation being executed. Memory is used to store data that will be used in the near future.* Secondary storage holds data that may be needed *later (in future).*



The *system clock*

- The *system clock* is a small chip that is used by the CPU to synchronize the timing of all computer operations.
- The system clock generates electronic pulse or ticks at a fixed rate, which set the operating pace of components in the system unit.
- Each tick is called a *clock cycle*, which affects machine cycle time.
- The faster the clock, the more instructions the CPU can execute per second.
- Clock speed is measured in **hertz**.



Internal Memory

- A computer's memory in the system unit consists of one or more chips physically close to the CPU to decrease access time.
- The system unit contains two types of memory: **volatile** and **nonvolatile**.
- Examples of volatile memory include **RAM** and **Cache**.
- Examples of nonvolatile memory include **ROM** and **CMOS**.



Random Access Memory (RAM)

- When the computer is powered on, certain operating system files are loaded from a storage device such as a hard disk into RAM.
- These files remain in RAM as long as the computer is running. As additional programs and data are requested, they are read from storage into RAM. The processor acts upon the data while it is in RAM.





Read-only memory (ROM)

- *Read-only memory (ROM) refers to memory chips storing permanent data and instructions.*
- The data, or *firmware* stored on ROM chips is often recorded when the chip is manufactured.
- ROM is usually nonvolatile, and its contents are not lost if the power is switched off.



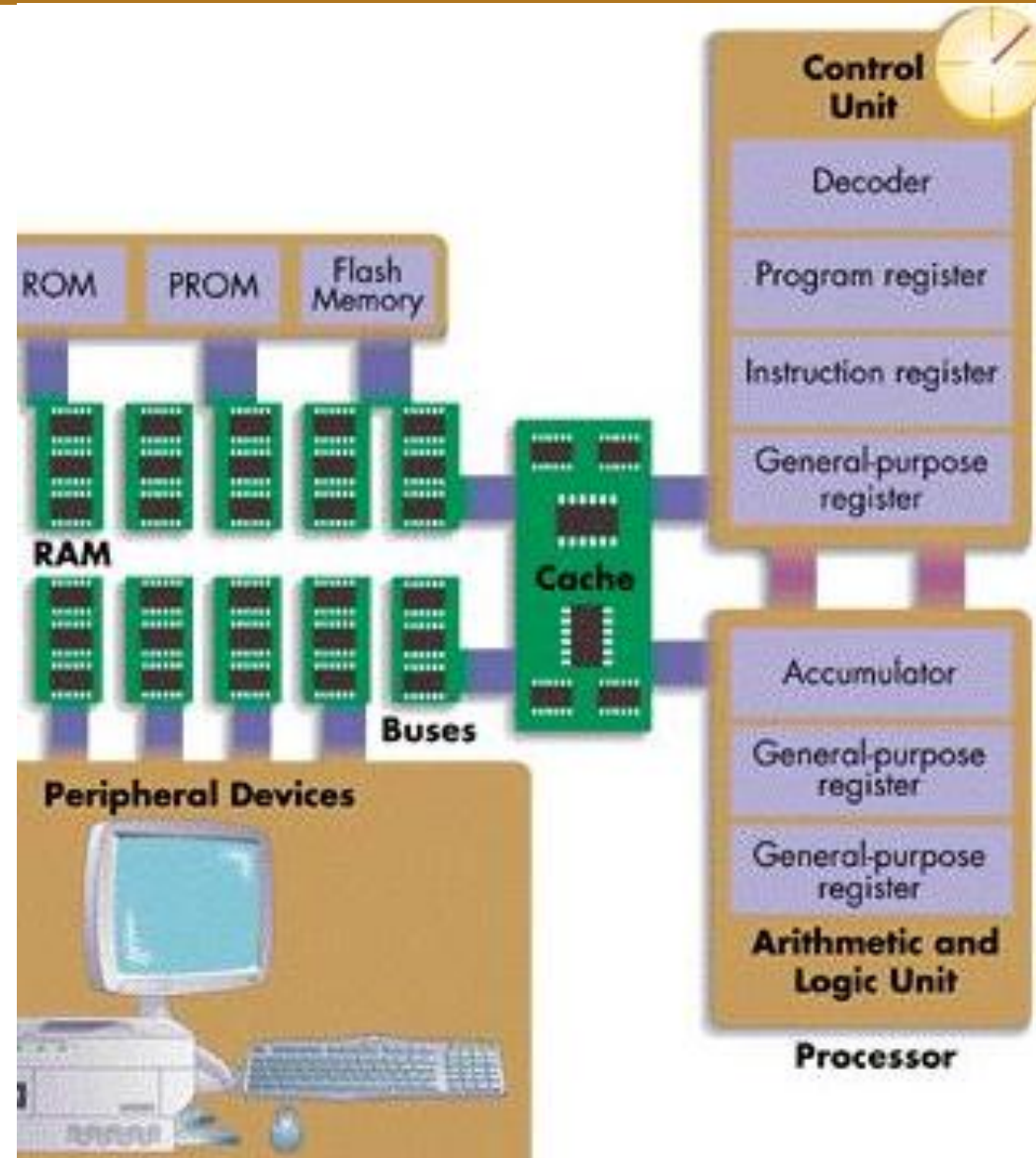
Differences Between RAM and ROM

RAM	ROM
1. Volatile, temporally	1. Non Volatile, permanent
2. Contents lost when power goes off	2. Contents remain when power goes off
3. Read and Write	3. Read Only
4. Can be increased	4. Cant be Increased
5. Data Not recorded at Factory	5. Firmware Recorded at Factory



Memory cache

- A cache is a small block of very fast memory that is faster than conventional RAM, speeding up processing time by storing frequently used instructions and data.
- The processor first checks cache, then RAM for needed data and instructions.





Memory cache

- There are three types of cache memory namely:
- **Level 1 (L1)-Primary cache**; located inside microprocessor
- **Level 2(L2)-External cache**; that may be inside microprocessor or mounted on the motherboard;
- **Level 3(L3)-cache**; works with L2 to optimize system performance.



Buffers

- Buffers are special memories that are found in input/output devices. Input data is held / accumulated in input buffer while processed output is held in output buffer.
- For example, computer printers have buffers where they can store massive documents sent by the CPU for printing hence freeing the CPU to perform other urgent tasks as the printer continues to print in the background.



CMOS

- Complementary Metal-Oxide Semiconductor (CMOS) technology provides high speeds and consumes little power.
- CMOS technology uses battery power to retain information even when the power to the computer is off.
- Battery-backed CMOS memory chips, for example, can keep the calendar, date, and time current even when the computer is off.



Units of Measuring Computer Memory

- The smallest unit of measuring Computer Memory is a Bit (Binary digit)
- Binary digits are the numbers 1 and 0 which can be represented in a computer by switching voltage on and off.
- Eight little bits make one BYTE.
- The storage capacity of computers (RAM and ROM) and that of secondary storage devices like disks are generally given in bytes.
- One BYTE stores approximately one character.
- Other units include Kilobyte, Megabyte, Gigabyte, Terabyte approximately equal to 10^3 , 10^6 , 10^9 , 10^{12} etc.



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End of Topic 5:

Computer Hardware

Next Topic 6: Computer Software