

Introduction to Computers

Chapter No 2

I/O Devices and Peripherals



ITC - Chapter 2

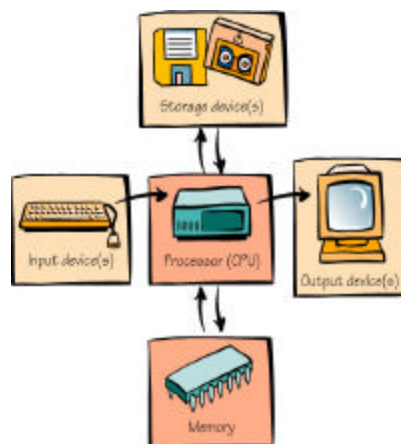
I/O Devices and Peripherals

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What Computers Do ?

Four basic functions of computers include:

- Receive input
- Process information
- Produce output
- Store information



Input and Output Hardware

✎ Input Hardware

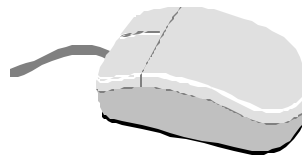
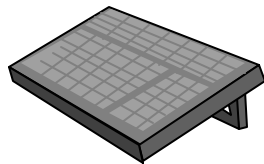
- ✎ Consists of devices that translate data into a form the computer can process.

✎ Output Hardware

- ✎ Consists of devices that translate information processed by the computer into the form that humans can understand

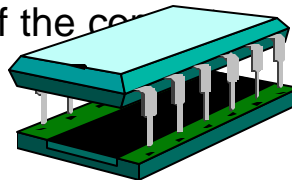
Input Devices

- Computers accept information from the outside world.
- The **keyboard** is the most common input device.
- **Pointing devices** like the mouse also provide input.



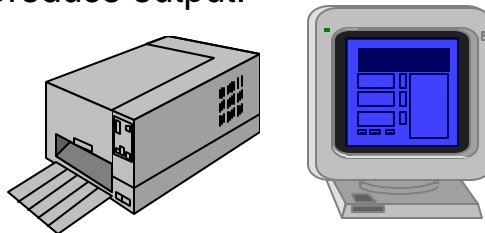
Process Information

- The processor, or **central processing unit** (CPU), processes information, and performs all the necessary arithmetic calculations.
- CPU is like the “**brain**” of the computer.



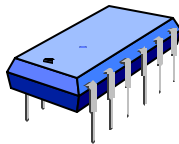
Output Devices

- Computers produce information and send it to the outside world.
- A **video monitor** is a common output device.
- **Printers** also produce output.



Store Information

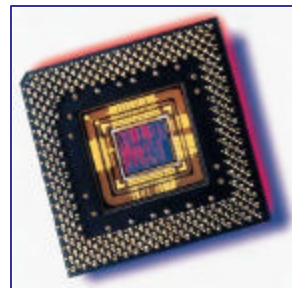
- Memory and storage devices are used to store information.
- **Primary storage** is the computer's main memory.
- **Secondary storage** uses disks or other media.



Primary storage Secondary storage

Computer's Core: The CPU and Memory

- The transformations are performed by the CPU - the ***central processing unit*** or processor.
- The microprocessor, which is a silicon chip, is located on the *motherboard*.



Computer's Core: The CPU and Memory

- When you purchase a computer, the selection of the CPU is a very important choice. There are two factors that are very important to computer users are:
 - Compatibility
 - Speed

Compatibility

- Not all software is compatible with any given CPU. Each computer has a unique **instruction set** - a vocabulary of instructions the processor can execute.
- New microprocessors can usually run older software, but new software is not usually compatible with old microprocessors.

Speed

- The computer's speed is measured by the speed of its internal clock - a device to synchronize the electric pulses.
- Speed is measured in units called megahertz (mHz).



Primary Storage: The Computer's Memory

RAM (Random Access Memory):

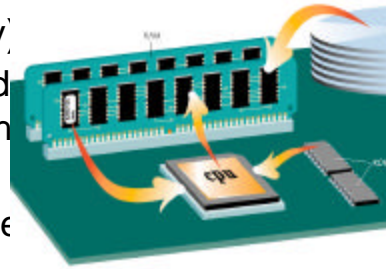
- RAM is the most common type of primary storage, or computer memory.
- used to store program instructions and data temporarily
- unique addresses and can store in any location
- can quickly retrieve information
- will not remain if power goes off (**volatile**).

Primary Storage: The Computer's Memory

- **ROM**

(Read-Only Memory)

- information is stored permanently on a chip
- contains startup instructions and other permanent data.



Buses, Ports, and Peripherals

- Information travels between components through groups of wires called **Buses**.



Buses, Ports, and Peripherals

- **Peripherals** are **external devices** for receiving input or producing output.
- Example (keyboard, monitor, and mouse).
- Communicate with other parts of the system.

Buses, Ports, and Peripherals

- Ports provide attachment and communication with external devices by means of:
 - **Slots** (For internal attachments)
 - **Ports** (For external attachments)

The Keyboard



- A standard computer keyboard has about 100 keys.
- Most keyboards use the **QWERTY** layout, named for the first six keys in the top row of letters.



The Omnipresent Keyboard

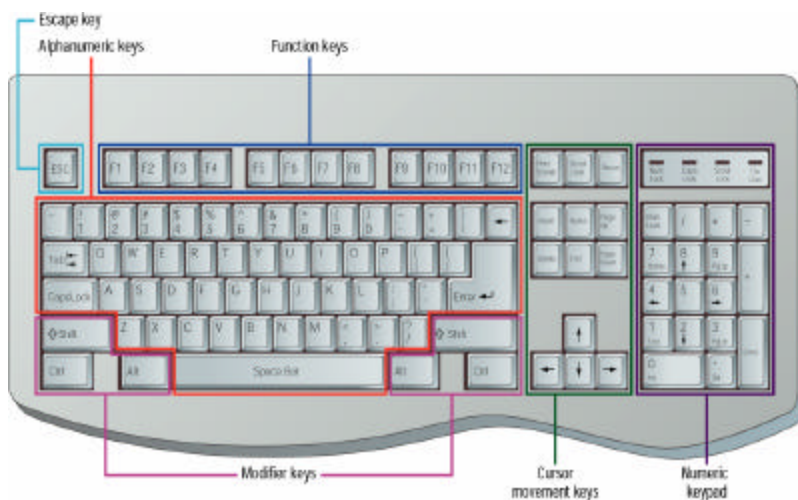
- ✍ Do you know where these keys are located on the keyboard and how to use them?
 - ✍ **Letters, Numbers, Cursor Keys, Delete Key, Enter (Return) Key, and Function Keys**



Standard Keyboard Layout

- Most keyboards have keys arranged in five groups:
 - Alphanumeric keys
 - Numeric keypad
 - Function keys
 - Modifier keys
 - Cursor-movement keys

Standard Keyboard Layout



Working of Keyboard

- 1 Key is pressed on the keyboard.



KEYBOARD
CONTROLLER

- 2 The keyboard controller sends the scan code for the key to the keyboard buffer.

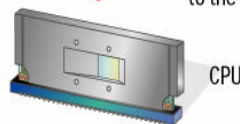
KEYBOARD
BUFFER

- 3 The keyboard controller sends an interrupt request to the system software.

- 4 The system software responds to the interrupt by reading the scan code from the keyboard buffer.

SYSTEM
SOFTWARE

- 5 The system software passes the scan code to the CPU.



CPU

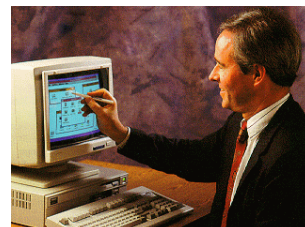
Pointing Devices



Mouse



Joystick



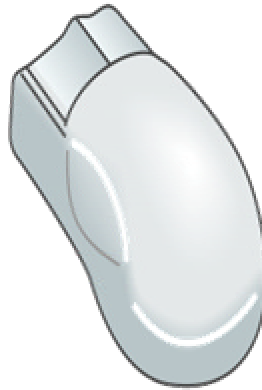
Touch Screen



Graphics Tablet

Mouse

- The mouse is a pointing device. You use it to move a graphical pointer on the screen.
- The mouse can be used to issue commands, draw, and perform other types of input tasks.



Mouse Techniques



- Using the mouse involves five techniques:
 - **Pointing;**
 - Move the mouse to move the on-screen pointer.
 - **Clicking**
 - Press and release the left mouse button once.
 - **Right-clicking**
 - Press and release the right mouse button.
 - **Double-clicking**
 - Press and release the left mouse button twice.
 - **Dragging**
 - Hold down the left mouse button as you move the pointer.

Other Pointing Devices

- **Trackballs:**

- A trackball is like a mouse turned upside-down. Use your thumb to move the exposed ball and your fingers to press the buttons.



Touchpads or Trackpads

- A touchpad is a touch-sensitive pad that provides the same functionality as a mouse.
 - To use a touchpad, you glide your finger across its surface.
 - Touchpads provide a set of buttons that function



Joystick

- It is also a pointing device.
- It consists of a vertical handle like a gearshift lever mounted on a base with one or two buttons.
- They are primarily used for playing games.
Joysticks are popular for flight simulator and driving games.



Alternative Input Devices

- Light Pens
- Pen-based Systems
- Touch Screens
- Digitizing Tablets

Pen-based System

- With a pen-based system, you use an electronic pen to write on the screen and choose commands.
- Pens are common input devices for handheld computers, like “personal digital assistants (PDAs).”
- Pens are handy for making notes or selecting commands, not for inputting a lot of text.

Pen-based System

- The user can point, tap, draw and write on the computer's screen with a pen



Touch Screens

- Touch-screen systems accept input directly through the monitor.
- Touch screens use sensors to detect the touch of a finger.
- They are useful where environmental conditions prohibit the use of a keyboard or mouse.
- Touch-screen systems are useful for selecting options from menus.

Touch Screens



Digitizing Tablets

- An input device that enables you to enter drawings and sketches into a computer.
- A digitizing tablet consists of an electronic tablet and a *cursor* or pen.
- A cursor (also called a *puck*) is similar to a mouse, except that it has a window with cross hairs for pinpoint placement, and it can have as many as 16 buttons.
- A pen (also called a *stylus*) looks like a simple ballpoint pen but uses an electronic head instead of ink.

Source-Data Entry

- Does not require keystrokes
- Direct entry into computer often is more accurate
- Main devices
 - Bar-code readers
 - Mark and character recognition devices
 - FAX machines
 - Imaging systems

Bar-Code

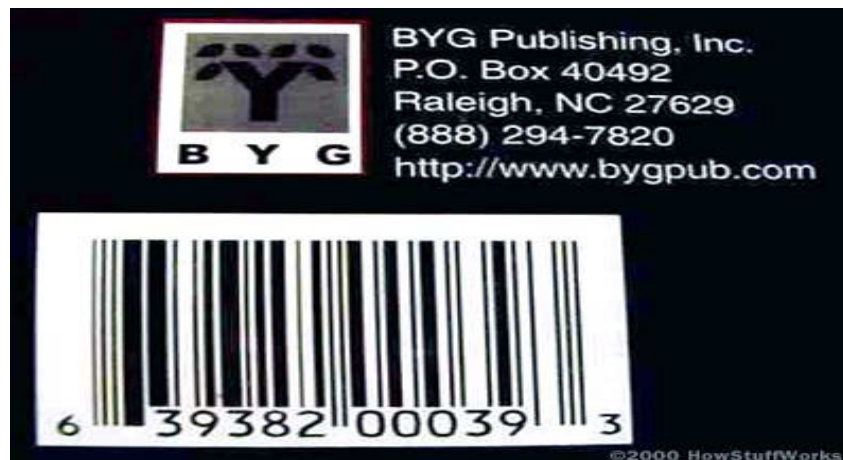
- Vertical striped marks on most manufactured products
- Often seen is a Universal Product Code, as seen in North America and Australia
- Photoelectric scanners that translate code symbols into digital code
- The reader emits light, which reflects off the bar code and into a detector in the reader. The detector translates the code into numbers.
- Flatbed bar code readers are commonly found in supermarkets. Courier services often use handheld readers.



**Bar code readers
commonly track
sales in retail
stores**

Bar-Code

- "UPC" stands for **Universal Product Code**. UPC bar codes were originally created to help grocery stores speed up the checkout process and keep better track of inventory, but the system quickly spread to all other retail products because it was so successful. UPCs originate with a company called the Uniform Code Council (UCC). A manufacturer applies to the UCC for permission to enter the UPC system. The manufacturer pays an annual fee for the privilege. In return, the UCC issues the manufacturer a six-digit **manufacturer identification number** and provides guidelines on how to use it.



You can see that the UPC symbol printed on a package has two parts:
The machine-readable bar code
The human-readable 12-digit UPC number

Bar-Code: UPC

- Manufacturer identification number is the first six digits of the UPC number -- 639382. The next five digits -- 00039 -- are the **item number**. A person employed by the manufacturer, called the **UPC coordinator**, is responsible for assigning item numbers to products, making sure the same code is not used on more than one product, retiring codes as products are removed from the product line, etc. In general, every item the manufacturer sells, as well as every size package and every repackaging of the item, needs a different item code. So a 12-ounce can of Coke needs a different item number than a 16-ounce bottle of Coke, as does a 6-pack of 12-ounce cans, a 12-pack, a 24-can case, and so on. It is the job of the UPC coordinator to keep all of these numbers straight!
- The last digit of the UPC code is called a **check digit**. This digit lets the scanner determine if it scanned the number correctly or not.

Bar-Code: Calculation

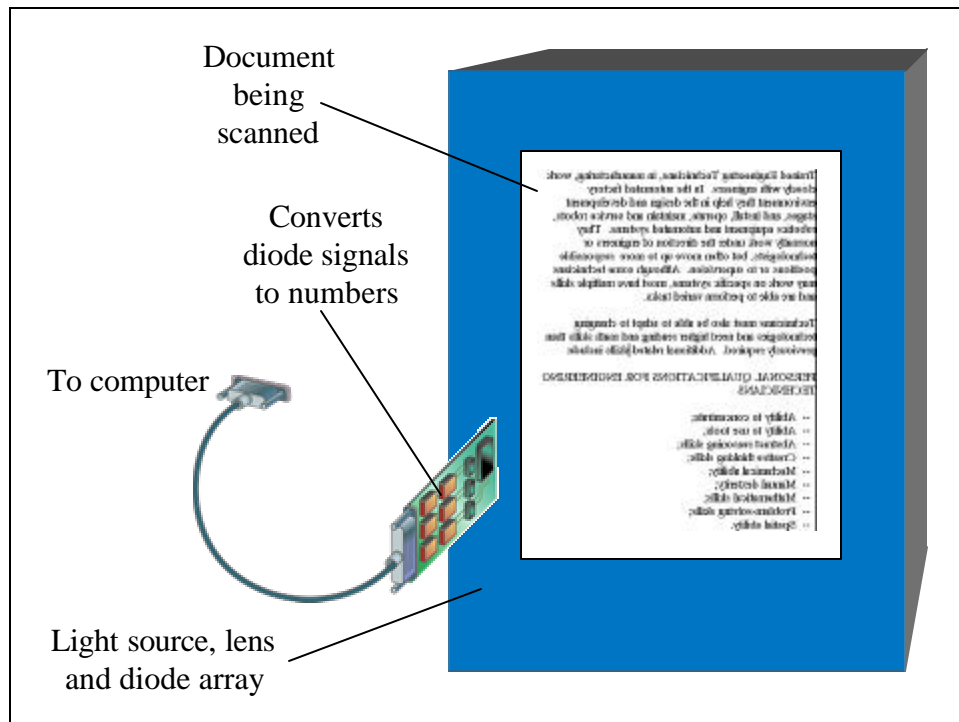
- Add together the value of all of the digits in odd positions (digits 1, 3, 5, 7, 9 and 11).
 $6 + 9 + 8 + 0 + 0 + 9 = 32$
- Multiply that number by 3.
 $32 * 3 = 96$
- Add together the value of all of the digits in even positions (digits 2, 4, 6, 8 and 10).
 $3 + 3 + 2 + 0 + 3 = 11$
- Add this sum to the value in step 2.
 $96 + 11 = 107$
- Take the number in Step 4. To create the check digit, determine the number that, when added to the number in step 4, is a multiple of 10.
 $107 + 3 = 110$
- The check digit is therefore **3**.

How is the Price Determined?

- As you can see, there is no price information encoded in a bar code. When the scanner at the checkout line scans a product, the cash register sends the UPC number to the store's central **POS** (point of sale) computer to look up the UPC number. The central computer sends back the actual price of the item at that moment.
- This approach allows the store to change the price whenever it wants, for example to reflect sale prices. If the price were encoded in the bar code, prices could never change. On the other hand, not encoding a fixed price gives the store an easy way to rip off customers. When you hear about "**scanner fraud**" in the news, that is what the newsperson is talking about. It is incredibly easy for a store to mistakenly or purposefully overprice an item.

Mark and Character Recognition

- MICR
 - Magnetic-ink character recognition numbers such as on checks
- OMR
 - Optical mark recognition reads marks and converts them into usable form
 - can now include black pen as well as pencil, depending upon the reader
- OCR
 - Optical character recognition uses specific character sets, converting them into machine-readable form



FAX machines

- Facsimile transmission machine scans an image, then sends those electronic images over telephone lines



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FAX machines

- At the sending end, there is some sort of **sensor** to read the paper. Usually, a modern fax machine also has a paper-feed mechanism so that it is easy to send multi-page faxes.
- There is some standard way to **encode** the white and black spots that the fax machine sees on the paper so that they can travel through a phone line.
- At the receiving end, there is a mechanism that **marks** the paper with black dots.

FAX machines

- The fax machine typically has a CCD or photo-diode sensing array. It contains 1,728 sensors (203 pixels per inch), so it can scan an entire line of the document at one time. The paper is lit by a small fluorescent tube so that the sensor has a clear view.

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vera3.htm">CCD or photo-diode
~~contains 1,728 sensors (283 pixels per~~
n an entire line of the document at on
er is lit by a small fluorescent tube li
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The scanning process: The scanner in a fax machine looks at one line of the sheet of paper. The scan line is shown here in red. It sees a group of black and white spots, shown blown up in the red rectangle at the bottom of the figure. It encodes the pattern of spots and sends them through the phone line.

FAX machines

- The image sensor looks for black or white. Therefore, a single line of the document can be represented in 1,728 bits. In standard mode, there are 1,145 lines to the document. The total document size is:
- **1,728 pixels per line * 1,145 lines = approximately 2,000,000 bits of information**

Imaging systems

- Image or graphic scanners convert text, drawings, photographs into digital form which can then be transmitted elsewhere
- Used in
- Desktop Publishing
- Multimedia Development
- Include scanners
 - External: flatbed, drum, or handheld
 - Internal: slide and photo

Scanners

- The core component of the scanner is the **CCD array**. CCD is the most common technology for image capture in scanners. CCD is a collection of tiny light-sensitive diodes, which convert photons (light) into electrons (electrical charge). These diodes are called **photosites**. In a nutshell, each photosite is sensitive to light -- the brighter the light that hits a single photosite, the greater the electrical charge that will accumulate at that site.

Scanners

- The document is placed on the **glass plate** and the **cover** is closed. The inside of the cover in most scanners is flat white, although a few are black. The cover provides a uniform background that the scanner software can use as a reference point for determining the size of the document being scanned. Most flatbed scanners allow the cover to be removed for scanning a bulky object, such as a page in a thick book.
- A **lamp** is used to illuminate the document. The lamp in newer scanners is either a cold cathode fluorescent lamp (CCFL) or a xenon lamp, while older scanners may have a standard fluorescent lamp.
- The entire mechanism (mirrors, lens, filter and CCD array) make up the **scan head**. The scan head is moved slowly across the document by a **belt** that is attached to a stepper motor. The scan head is attached to a **stabilizer bar** to ensure that there is no wobble or deviation in the **pass**. Pass means that the scan head has completed a single complete scan of the document.

Scanners

- The image of the document is reflected by an angled **mirror** to another mirror. In some scanners, there are only two mirrors while others use a three mirror approach. Each mirror is slightly curved to focus the image it reflects onto a smaller surface.
- The last mirror reflects the image onto a **lens**. The lens focuses the image through a **filter** on the CCD array.



Audio-Visual (Multimedia) Input Devices

- **Microphones and Speech Recognition**
- **Video Input**

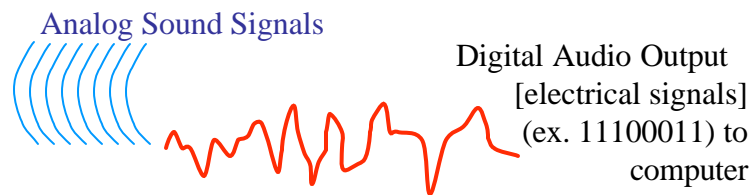
Voice Recognition

- Using as microphone or telephone
- Converts to digital code
- Saves typing input
- Current technology up to 98%



Voice Recognition

- **Microphones can accept auditory input. A microphone requires a sound card in the PC.**
- **A sound card can digitize analog sound signals, and convert digital sound signals to analog form.**
- **With speech recognition software, you can use your microphone to dictate text, navigate programs, and choose commands.**



Voice Recognition

- Keys after signal processing:
 - Phonetic models
 - Dictionary
 - Grammar
 - Search
 - Output

Audio Input Devices

- Records or plays analog sound
- Translates for digital storage and processing



Audio Boards

- Also called sound cards
- Some motherboards have built-in audio boards
- Three major standards
 - SoundBlaster
 - Ad Lib
 - Windows

MIDI Boards

- Most support MIDI
 - musical instrument digital interface
- MIDI boards
 - used for multimedia applications

Video and Photographic Support

- Most are analog
 - frame-grabber video card
 - full-motion video card
- Digital video growing rapidly
- Advent of USB ports
 - rapid increase in digital cameras
- All-in-one cards
 - provide sound and video

Video Input

- Digital video
 - can be limited to the speed of the computer and its ability to provide a consistent and high enough frames-per-second
 - minimum to provide full-motion is 24 frames per second



Digital Cameras

- Use charge-coupled device (CCD)
 - light-sensitive photo cells
- Smallest 1/8th size of a 35 mm frame
- Up to 35 mm frame size
- Approaching image quality of 35mm



Sensors

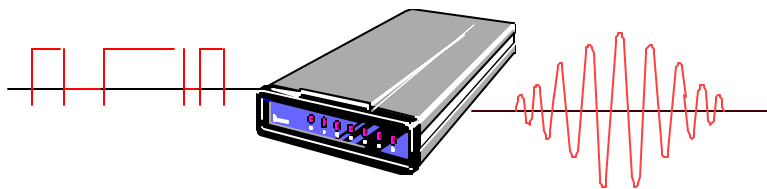
- Collect specific kinds of data directly from the environment
- Transmit data to a computer for processing and consolidation
- Under highways for traffic control
- Within buildings for temperature control

Input Controls

- Garbage in, garbage out
- Manual and computer-based controls
- Software often uses internal software tables to validate data input
- Reasonableness tests coded
- Care should be taken to ensure system is not too restrictive

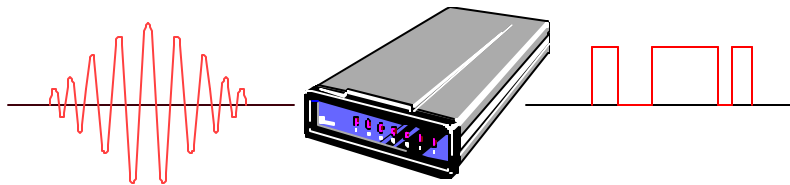
Communication Modem

- A modem:
 - Converts the digital stream of information from a computer to an analog stream in order to send a message on the telephone network



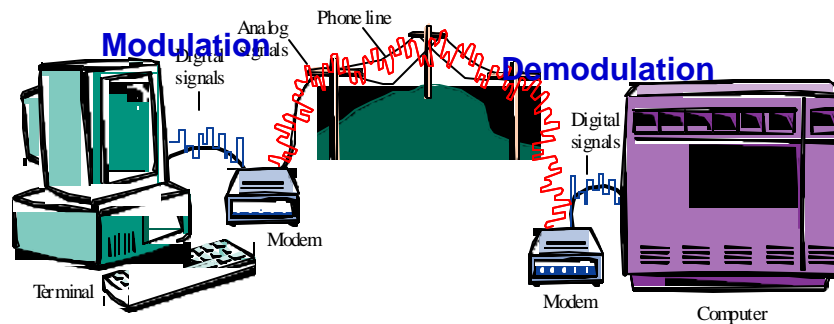
Communication Modem

- A modem:
 - Converts the analog stream of information received over the telephone network into the digital form that the computer understands



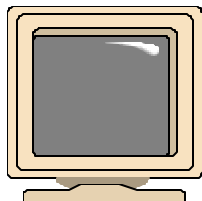
How a Modem Works

- ✍ The word modem comes from the terms **mod**ulation and **demod**ulation



Screen Output

- Video Monitor
 - Also called Video Display Terminal (VDT)
 - Image exists in video memory—VRAM
 - Monitor size is measured diagonally across the screen

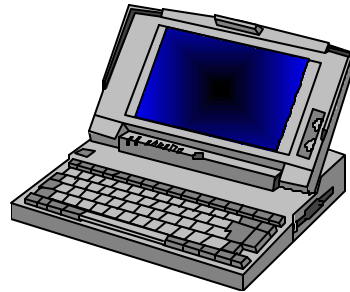
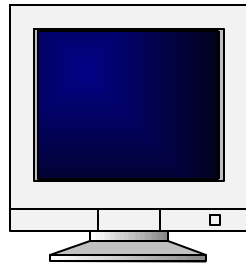


Pixels

- Images are made up of dots called **Pixels** for picture elements
 - The number of pixels affects the resolution of the monitor
 - The higher the resolution, the better the image quality



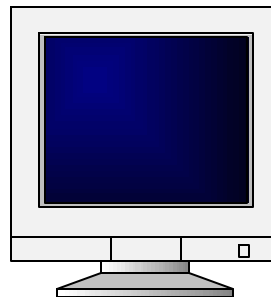
Classes of Monitors



CRT (Cathode Ray Tube) **LCD** (Liquid Crystal Display)

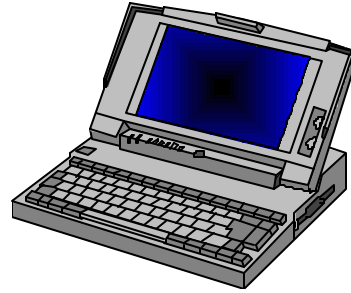
CRT (Cathode Ray Tube)

- A CRT is a television-style monitor
- Its features include:
 - Clear image
 - Quick response time
 - Low cost
 - Very popular



LCD (Liquid Crystal Display)

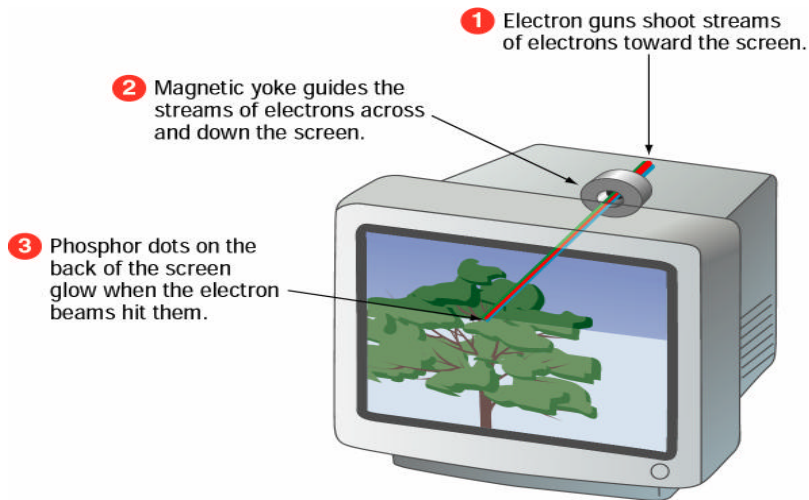
- LCDs comprise flat-panel monitors
- Features of flat-panel monitors include:
 - Lighter weight
 - More compact
 - More expensive
 - Dominate the portable computer market



CRT Monitors

- In CRT monitors, electrons are fired at phosphor dots on the screen.
- The dots are grouped into pixels, which glow when struck by electrons.
- In color CRTs, each pixel contains a red, green, and blue dot. These glow at varying intensities to produce color images.

CRT Monitors



Flat-Panel Displays Monitors

- Most flat-panel monitors use liquid crystal display (LCD) technology or Electro-luminescent (EL).
- Passive matrix LCD uses a transistor for each row and column of pixels.
- Active matrix LCD uses a transistor for each pixel on the screen.
- Thin-film transistor displays use multiple transistors for each pixel.

Factors affecting Screen Clarity

- Resolution
- Refresh rate
- Dot pitch

Resolution

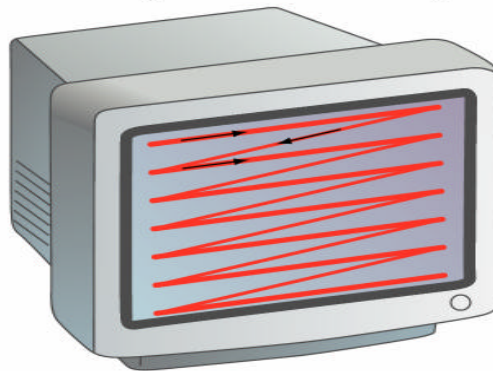
- **Resolution** is the number of pixels on the screen, expressed as a matrix. Example such as 600x800.
- A 17" monitor offers resolutions from 640x480 up to 1280x1024.
- The **Video Graphics Array (VGA)** standard is 640x480. Super VGA (SVGA) monitors provide resolutions of 800x600, 1024x768 or higher.
- **Resolution (image sharpness) is important.**

Refresh Rate

- **Refresh rate** is the number of times each second that the electron guns scan the screen's pixels.
- Refresh rate is measured in Hertz (Hz), or cycles per second.
- Look for a refresh rate of 72 Hz or higher. A slower rate may cause eyestrain.

Refresh Rate

1 The electron gun scans from left to right,



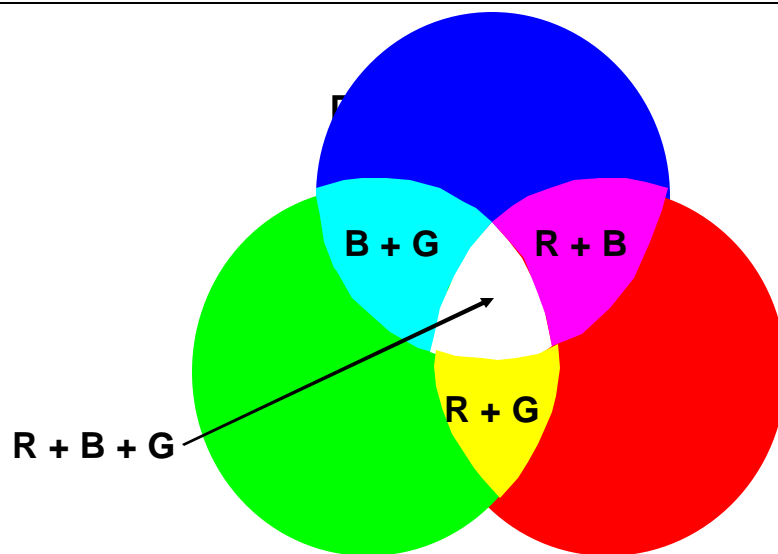
2 and from top to bottom,

3 refreshing every phosphor dot in a zig-zag pattern.

Fast scanning = Quick refresh (less flicker)

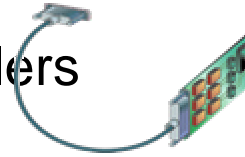
Dot Pitch

- **Dot pitch** is the distance between the phosphor dots that make up a single pixel.
- In color monitors, three dots (red, green, and blue) comprise each pixel.
- Look for a dot pitch no greater than .31 millimeter.



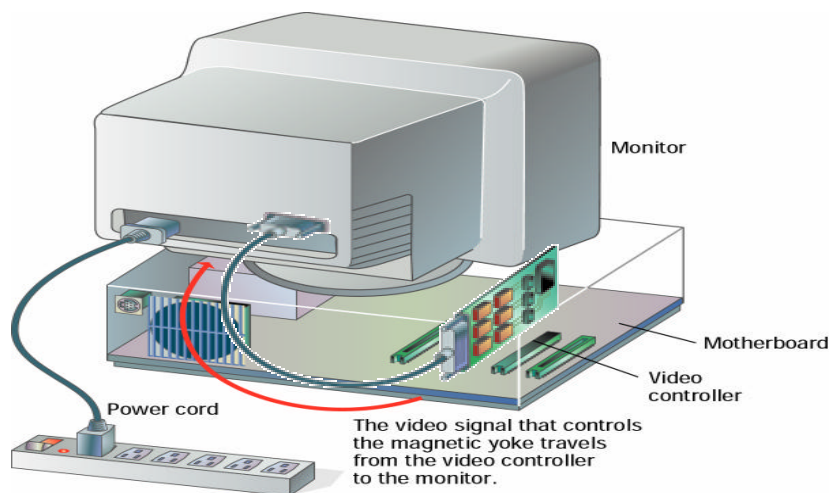
Phosphor Dot Color Mixing

Video Controllers



- The video controller is an interface between the monitor and the CPU.
- The video controller determines many aspects of a monitor's performance, such as resolution or the number of colors displayed.
- The video controller contains its own on-board processor and memory, called video RAM (VRAM).
- Graphic intensive applications such as games require plenty of VRAM.

Video Controllers

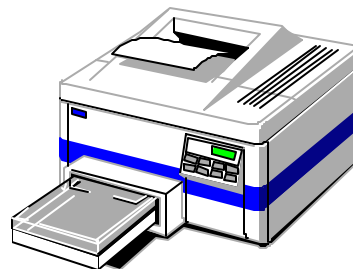


Standards of Monitors

- **VGA: Video Graphic Array-**
 - Supports 16 x 256 colors depending on the resolution
 - At 320 x 200 pixels: 256 colors
 - At 640 x 480 pixels: 16 colors
- **SVGA: Super VGA-**
 - 800 x 600 pixels and 1024 x 768 pixels – 256 colors
- **XGA: Extended Graphic Array-**
 - 16.7 million colors at 1024 x 768 pixels

Paper Output

- In computer, paper output is sometimes called **Hard Copy**.
- Hard copy can come from one of two kinds of printers:
 - Impact Printers
 - Non-Impact Printers



Printer Categories

Printers fall into two categories:

- **Impact printers** use a device to strike an inked ribbon, pressing ink from the ribbon onto the paper.
- **Non-impact printers** use different methods to place ink (or another substance) on the page.

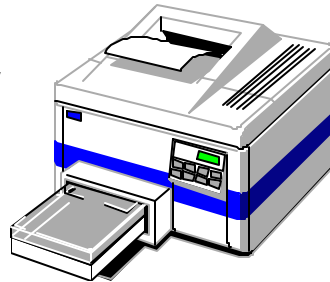
Impact Printers

- **Line Printers**
 - Used by mainframes for massive jobs
 - Limited characters available
- **Dot-Matrix Printers**
 - Image formed from dots printed on paper
 - Good for text and graphics
 - Inexpensive

Non-Impact Printers

- **Laser Printers**

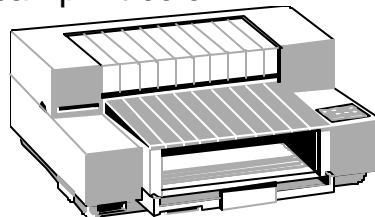
- Image transferred to paper with laser beam
- Faster and more expensive than dot-matrix
- High-resolution hard copy



Other Non-Impact Printers

- **Ink-Jet Printers**

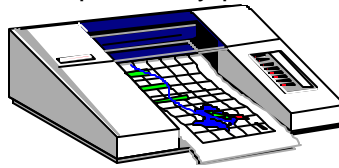
- Dots of ink are sprayed onto the paper to form the image
- High-resolution hard copy
- Some models print can print color photographs



Other Non-Impact Printers

- **Plotters**

- Image transferred to paper with ink pens
- Very high resolution
- Excellent for scientific and engineering applications
- They are mostly used for print-outs that are too large to be printed by printers.



Printer Quality

When evaluating printers, consider four criteria:

- **Image quality**– Measured in dots per inch (dpi). Most printers produce 300 – 600 dpi.
- **Speed**– Measured in pages per minute (ppm) or characters per second (cps).
- **Initial cost**– Consumer printers cost \$250 or less, but professional printers can cost thousands of dollars.
- **Cost of operation**– This refers to the cost of supplies used by the printer.

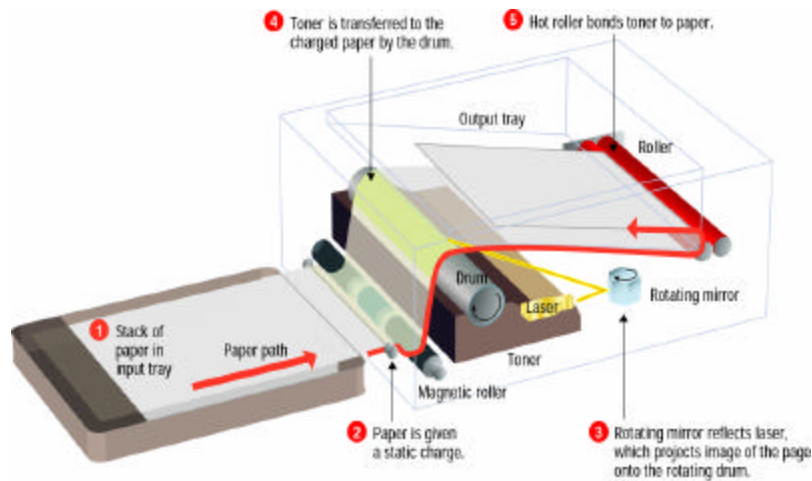
Ink-jet Printers

- Ink jet printers are an example of non-impact printers.
- The printer sprays tiny droplets of ink onto the paper.
- Ink jet printers are available for color and black-and-white printing.
- Ink jet printers offer speeds of (2 – 4 pages per minute ppm) and resolution (300 – 600 dots per inch dpi), comparable to low-end laser printers.

Laser Printer

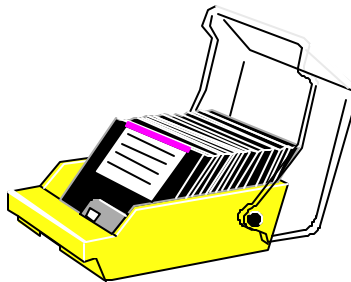
- Laser printers are non-impact printers.
- They use heat and pressure to bond particles of toner to paper.
- Laser printers provide resolutions from 300 – 1200 dpi and higher.
- Black-and-white laser printers usually produce 4 – 16 ppm.
- Laser printers produce higher-quality print than ink jet printers, but are more costly

Laser Printer Working



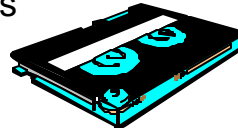
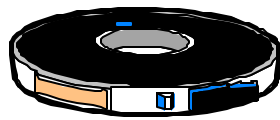
Secondary Storage: Input and Output

- Peripherals with both input and output functions.
- This form of storage is semi-permanent
- Examples include:
 - Magnetic tape
 - Magnetic disks
 - Optical disks



Magnetic Tape

- Magnetic tape is a common form of storage for mainframe computers.
 - Information is accessed sequentially
 - Massive storage for low cost but retrieval is slow
 - DAT (digital audio tape) is preferred for storage on small computers



Magnetic Disks



Hard Disk



Floppy Disk



Zip Disks and Zip Drive

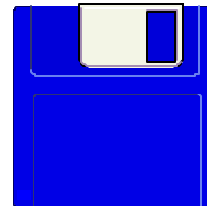
Hard Disks

- Hard disks are:
 - Rigid, magnetically sensitive metal disks.
 - Designed so that information can be randomly accessed
 - Designed for large storage capacity
 - Able to access data quickly
 - Not removable from the drive



Diskettes

- Diskettes are:
 - Flexible, magnetically sensitive plastic disks
 - Information can be randomly accessed.
 - Has limited storage capacity
 - Access of data not as quick as hard disks
 - Removable from the drive



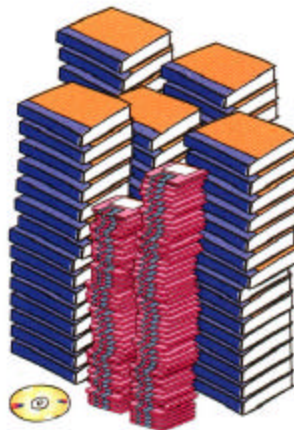
Optical Disks

- CD-ROM and magneto-optical disks provide:
 - Random access of information
 - A high storage capacity
- CD-ROM and magneto-optical disks:
 - Have an access time that varies but is slower than hard disks
 - Are removable from the drive



Storage Capacity

- A single CD-ROM can hold as much information as
 - 450 1440K diskettes
 - 500 books (text only)



Consumer View

- There is an ad in a newspaper selling a computer of the following configuration:
 - Intel PII 450 MHz, 128 RAM, HDD 10 GB, 512 KB L2 cache, 24X Acer CD-ROM, CD-RW, 4MB 3D Video Card, Motorola 56k PCI Modem Data/Fax/Voice, 4 PCI and 2 ISA slots, 15" monitor.
- **Explain what is each of the components for?**