

Introduction To Computers: **Hardware and Software**

In this section of notes you will learn about the basic parts of a computer and how they work.

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What Is Hardware?

- A computer is made up of hardware.
- Hardware is the physical components of a computer system e.g., a monitor, keyboard, mouse and the computer itself.



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Basic Units Of Measurement

Bit



- Binary digit
- Smallest unit of measurement
- Two possible values

Byte



- 8 bits

Word

- The number of adjacent bits that can be stored and manipulated as a unit
- 32, 64 for home computers, 128 for the most powerful

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Large Units Of Measurement (Memory, Storage)

- Note: powers of two are used because computer memory and storage are based on the basic unit (bit).
- Kilobyte (kB) – a thousand bytes ($1,024 = 2^{10}$)
- Megabyte (MB) - a million ($1,048,576 = 2^{20}$)
- Gigabyte (GB) – a billion ($1,073,741,824 = 2^{30}$)
~ A complete set of encyclopedias requires about 600 MB of storage
- Terabyte (TB) – a trillion ($1,099,511,627,776 = 2^{40}$)
~ 20 million four-drawer filing cabinets full of text

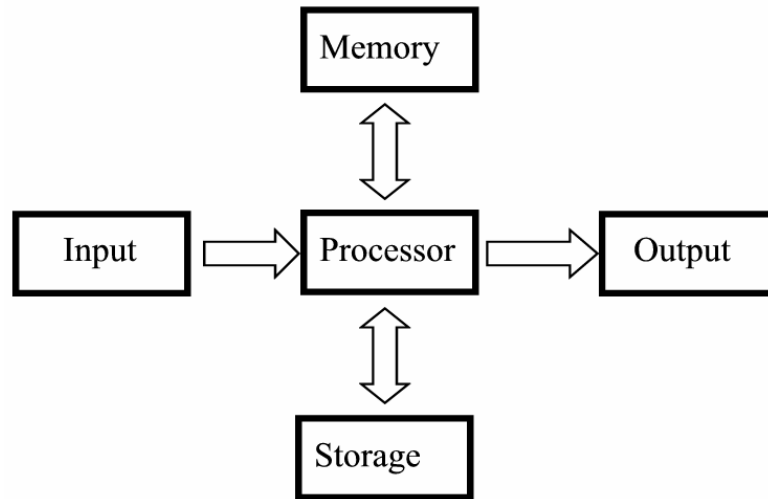
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Small Units Of Measurement (Speed)

- Millisecond (ms) – a thousandth of a second ($1/1,000 = 10^{-3}$)
- Microsecond (μs) - a millionth of a second ($1/1,000,000 = 10^{-6}$)
- Nanosecond (ns) – a billionth of a second ($1/1,000,000,000 = 10^{-9}$)

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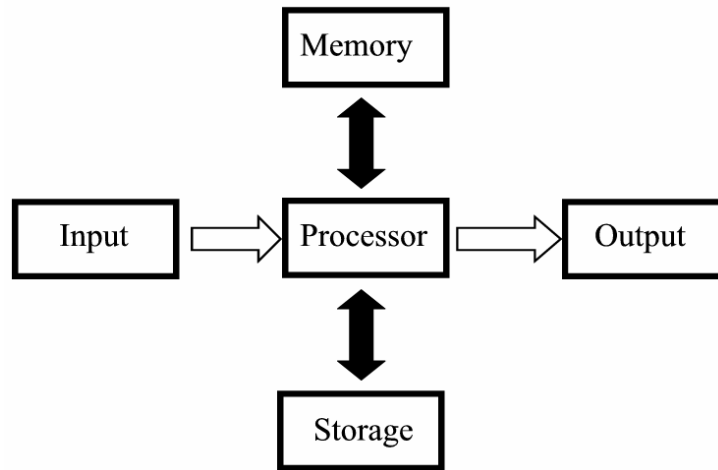
High Level View Of A Computer



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Buses

- Connect the different parts of the computer together



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Buses (2)

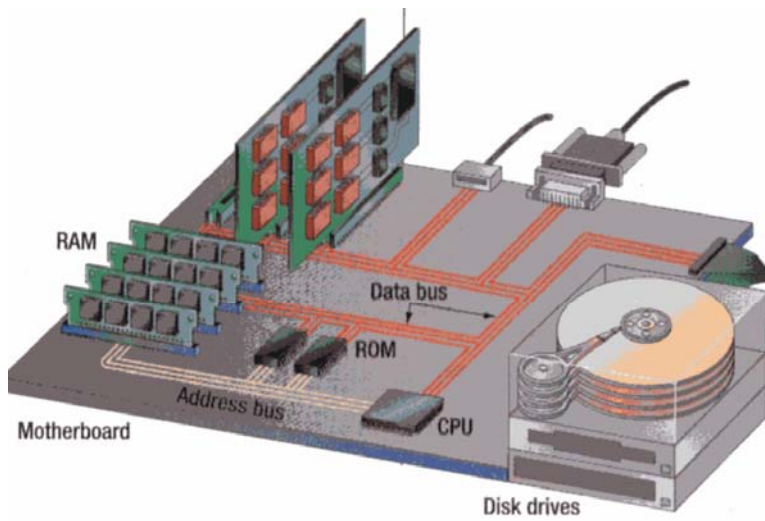
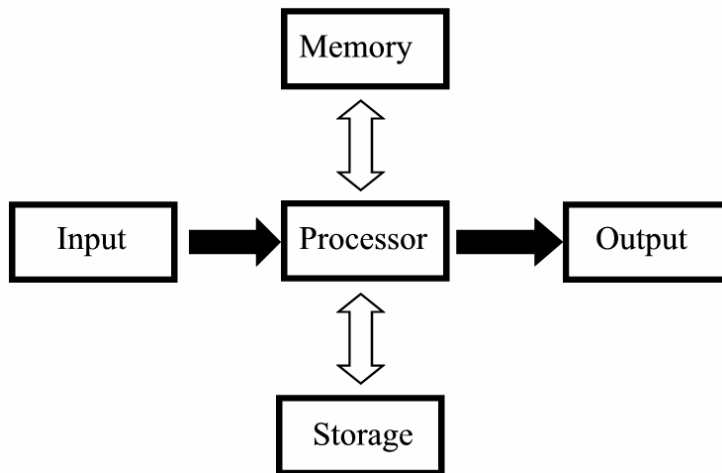


Image from Peter Norton's Computing Fundamentals (3rd Edition) by Norton P.

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Ports

- Connects the computer to the outside



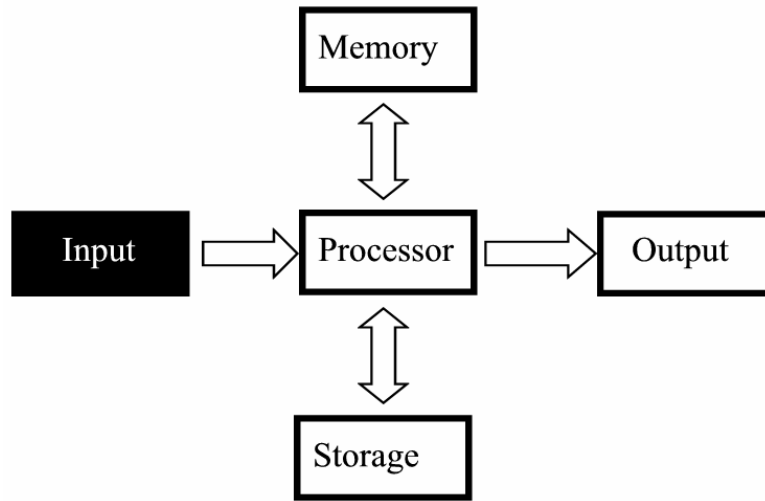
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Ports



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Input



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Input Devices

- Used by a person to communicate to a computer.



Person to
computer



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Example Input Devices

- Keyboard



- Mouse



- Need not be mundane!



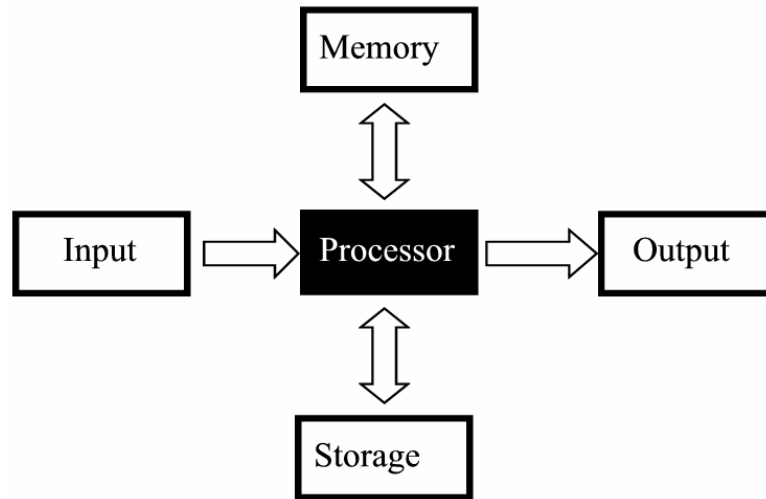
From <http://www.jouse.com/>



Parker, J.R., Baumbach, M., *Visual Hand Pose Identification for Intelligent User Interfaces*, Vision Interface 2003, Halifax, Nova Scotia, Canada Jun 11-13, 2003

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Processor



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Processor

- The brains of a computer



www.howstuffworks.com

- A common desktop processor



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Processor Speed

- Determined by:

- Type of processor e.g., Pentium IV, AMD Athlon, Opteron
- Clock speed
 - 1 Hz = 1 pulse is sent out each second (1 second passes between each pulse)
 - 10 Hz = 10 pulses are sent out each second (0.1 seconds passes between each pulse)
 - :
 - 25 MHz = 25 million pulses sent out each second (0.000 000 04 seconds between each pulse or 40 ns between pulses)
 - 3.6 Ghz = 3.6 billion pulses sent out each second (0.27 ns between pulses)

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The Processor And The Computer

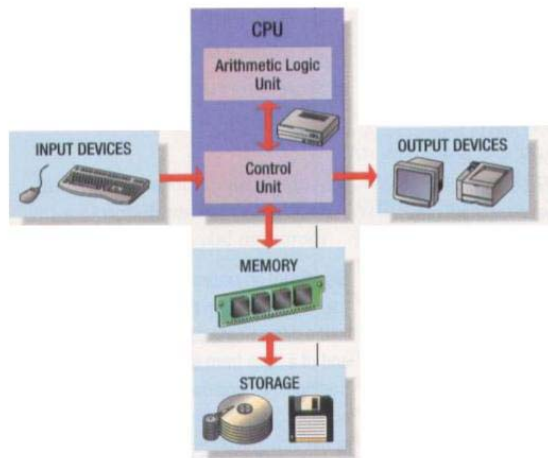
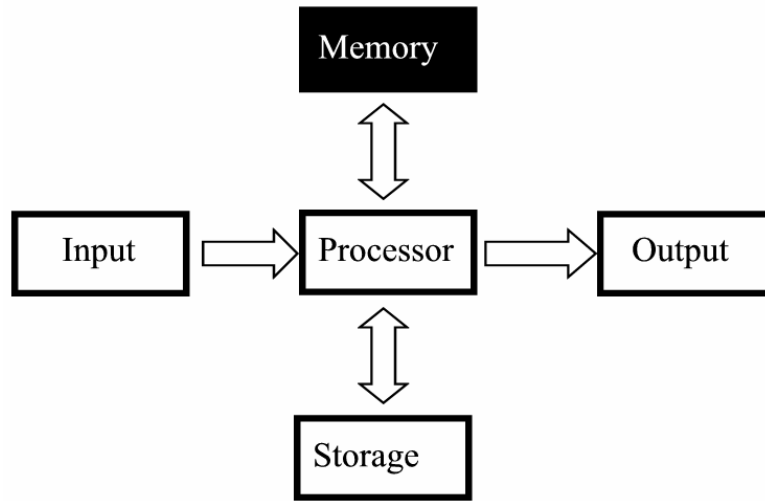


Image from Peter Norton's Computing Fundamentals (3rd Edition) by Norton P.

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Memory



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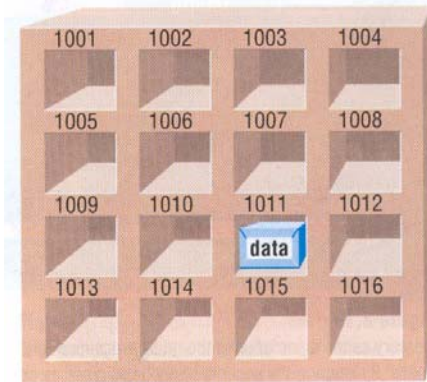
RAM

- Volatile
- Used for temporary storage
- Typical ranges 256 MB - 4 GB

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RAM (2)

- Means direct access to any part of memory
- The typical form of RAM is DRAM (Dynamic RAM)



Picture from Computers in your future by Pfaffenberger B

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How Does DRAM Work?

- Most RAM is DRAM (Dynamic RAM)
- Acts like a leaky bucket

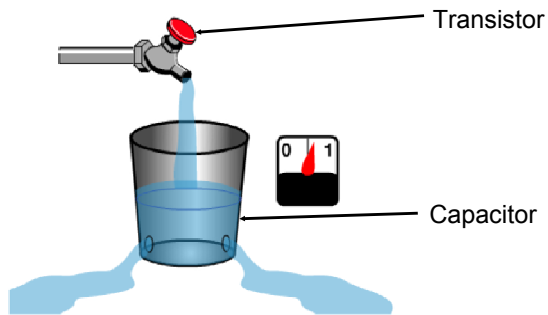


From www.howstuffworks.com

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How Does DRAM Work?

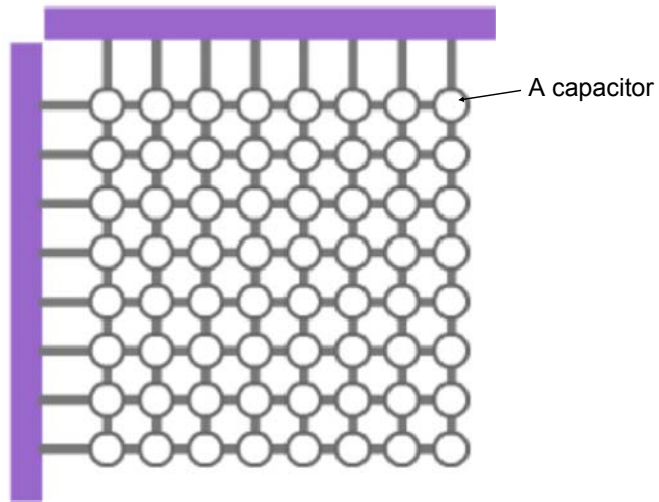
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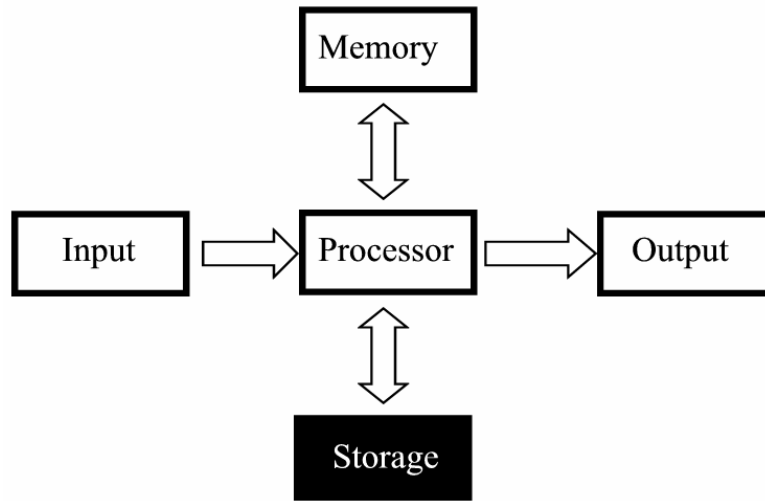
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DRAM: A Collection Of Capacitors



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Storage



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Storage Vs. Memory?

Memory (e.g., RAM)

- Keep the information for a shorter period of time (usually volatile)
- Faster
- More expensive

Storage (e.g., Hard disk)

- The information is retained longer (non-volatile)
- Slower
- Cheaper

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Magnetic Drives



Pictures from www.howstuffworks.com

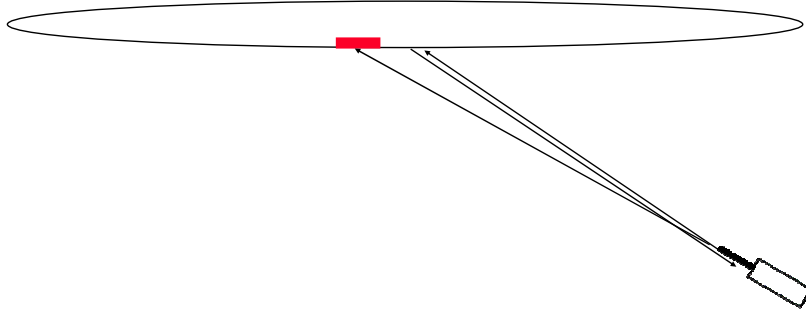
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Magnetic Drives: Storage Capacities

- Floppy disks
 - ~ 1 MB
- Zip disks
 - 100, 250, 750 MB
- Hard drives
 - ~80 – 300 GB

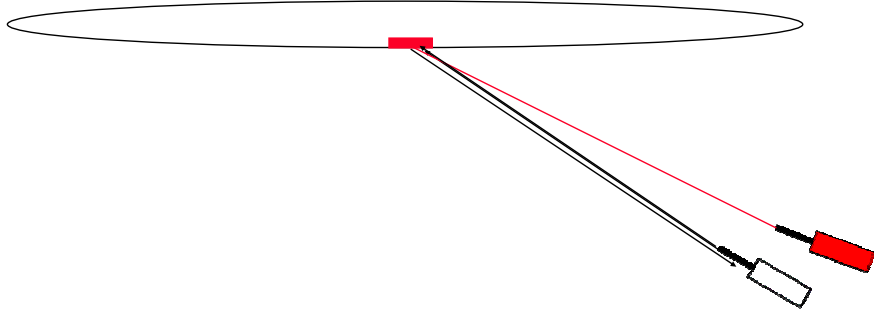
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Optical Drives: Reading Information



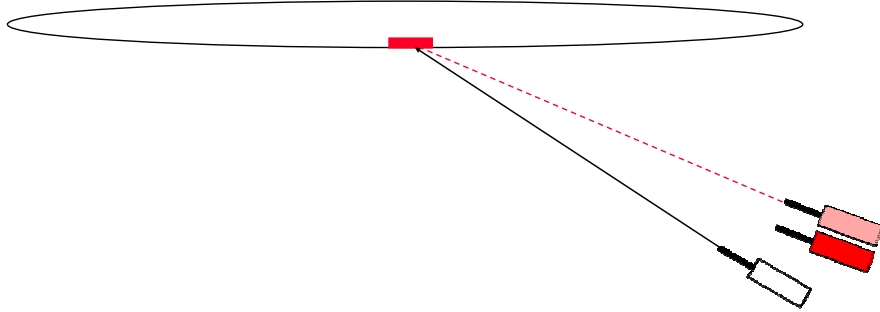
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Optical Drives: Recording and Reading Information



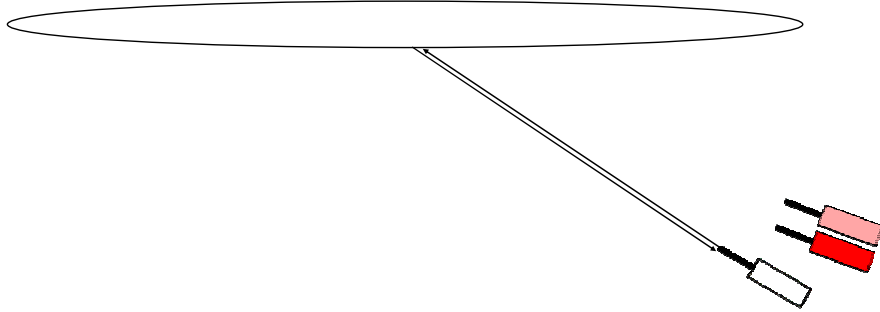
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Optical Drives: Re-Writing



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Optical Drives: Re-Writing



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Optical Drives

- CD's**

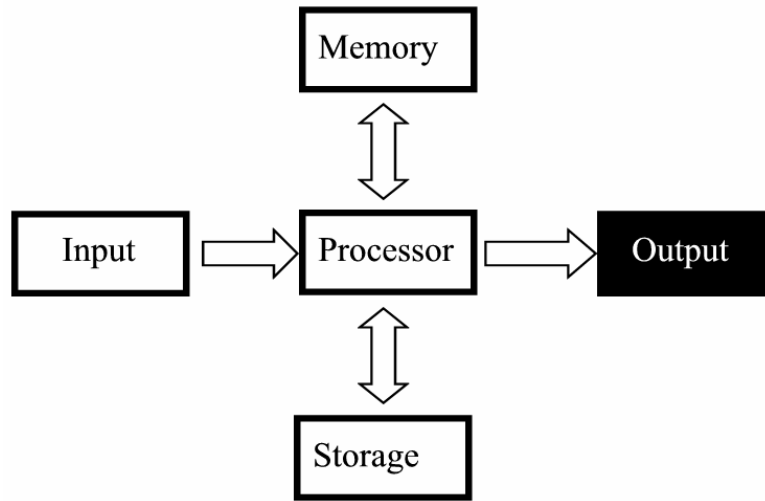
- ~ 700 MB storage
- CD-ROM (read only)
- CD-R: (record) to a CD
- CD-RW: can write and erase CD to reuse it (re-writable)

- DVD-ROM**

- Over 4 GB storage (varies with format)
- DVD- ROM (read only)
- Many recordable formats (e.g., DVD-R, CD-RW; DVD+R, DVD+RW)

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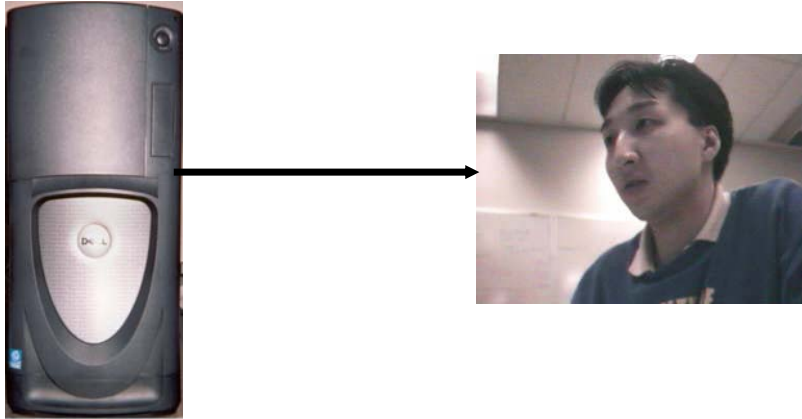
Output



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Output Devices

- Displays information from the computer to the a person.



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The Most Common Output Device: The Monitor

Types of computer monitors

- 1) CRT's (Cathode Ray Tube)



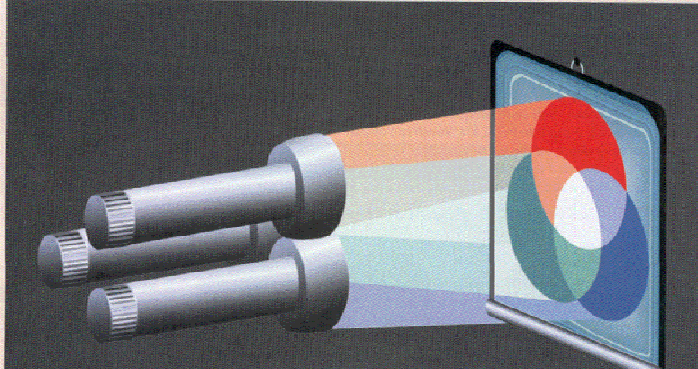
- 2) LCD's (Liquid Crystal Display)



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CRT's Monitors

- Images are displayed with dots (pixels) drawn with light "guns"

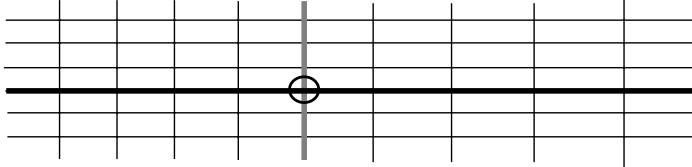


Picture from Computer Confluence by Beekman G.

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LCD Monitors

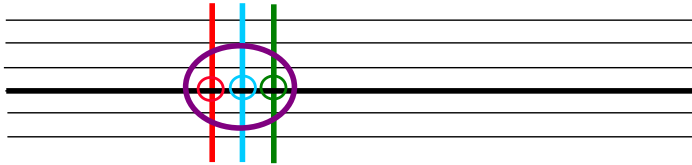
- Employ a conductive grid for each row and column
- The meeting of a row and column allows light to be emitted (a pixel can be seen)



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Colour LCD Monitors

- Use three sub pixels:
 - One wire for each row
 - One wire for each sub-pixel
 - One colour filter for each colour (red, blue, green)



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Some Determinants Of The Quality Of Monitors

- 1) Size
- 2) Resolution
- 3) Color depth
- 4) Dot pitch

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1) Monitor Quality (Size)

Measured diagonally



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3) Monitor Quality (Effects Of Color Depth)



2 colors



16 colors



256 colors

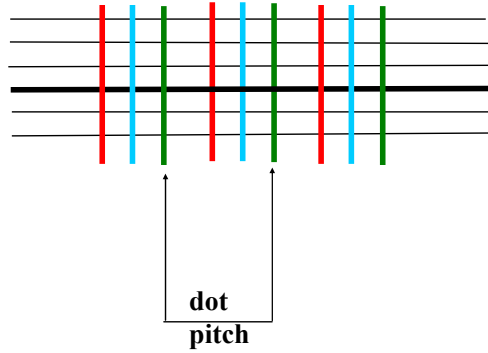
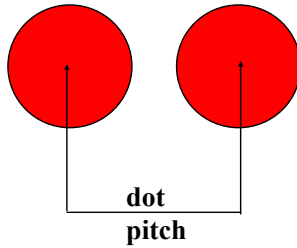


16 million
colours

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4) Monitor Quality (Dot Pitch)

- Dot pitch is the distance between picture elements e.g., the center of each color dot (mm)



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Refresh Rate Of Monitors

- How fast the screen is redrawn



- (70 Hz / 70 times per second is usually a good minimum)

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All The Basic Parts Together

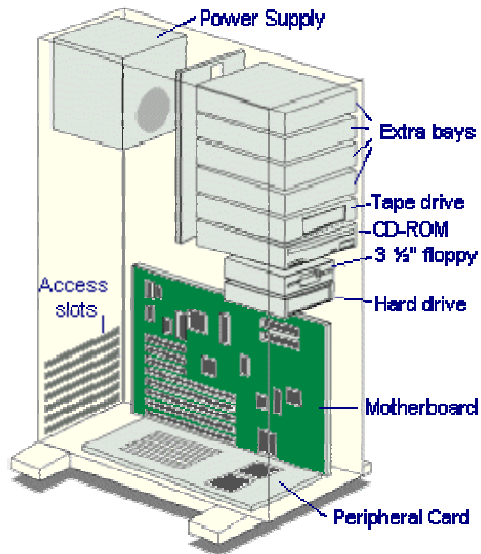


Diagram from <http://www.jegsworks.com>

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The Motherboard

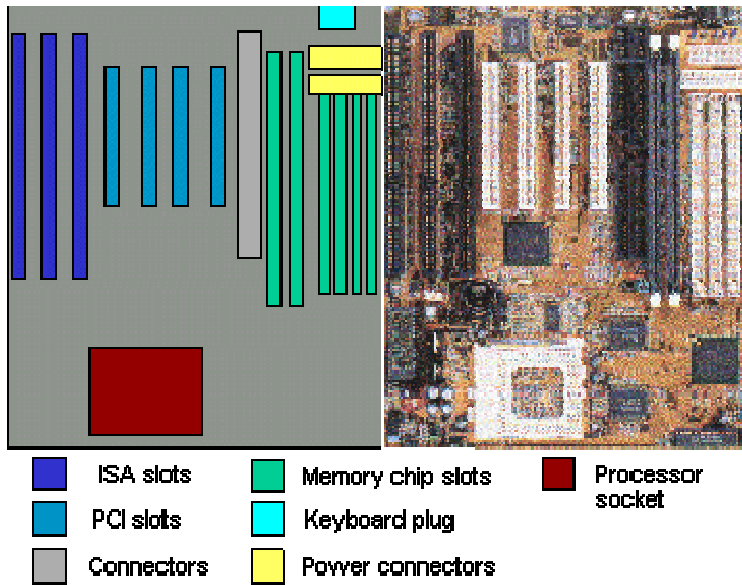


Diagram from <http://www.jegsworks.com>

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Relating The Speed Of The Computer To Its Components



Storage:
Hard drive



Memory:
RAM

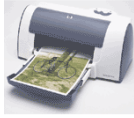


Processor

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Printers

- Common types
 - Inkjet



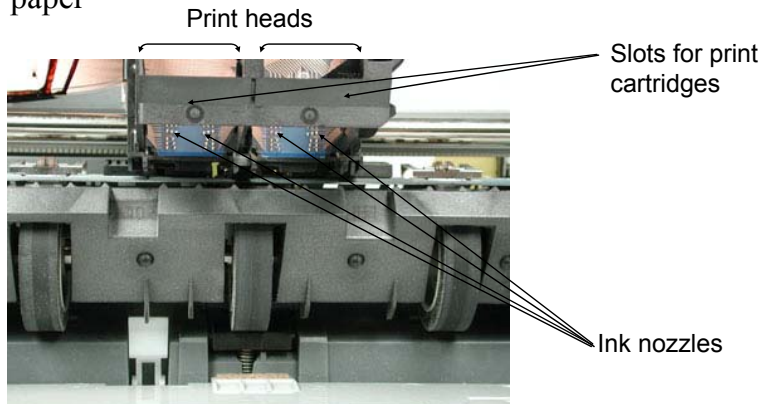
- Laser



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How Inkjet Printers Work.

- Use a series of nozzles to spray drops of ink directly on the paper



Picture from www.howstuffworks.com

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How Laser Printers Work

- Uses a laser to produce patterns on an ink drum using static electricity

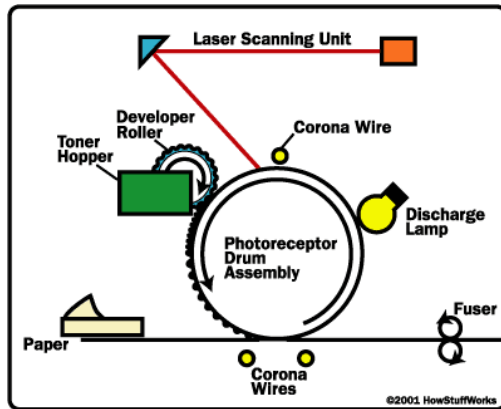


Diagram from www.howstuffworks.com

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You Should Now Know

- The basic components of a computer
 - What are common units of measurement
 - What are the basic parts of the high level view of a computer
 - Example input devices
 - The role of the processor in a computer
 - What determines processor speed
 - What are the characteristics of RAM
 - How does DRAM work
 - The difference between storage and memory
 - What are the different categories of storage devices as well as common examples of each
 - The approximate storage capacity of different storage devices
 - How do different storage devices work
 - How do computer monitors work
 - What determines the quality of a computer monitor
 - How hardware affects speed
 - How do printers work

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