

## 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

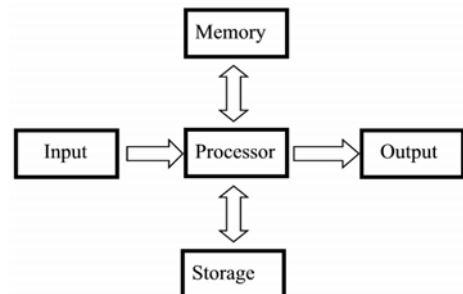
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## Small Units Of Measurement (Speed)

- Millisecond (ms) – a thousandth of a second ( $1/1,000 = 10^{-3}$ )
- Microsecond ( $\mu$ s) - 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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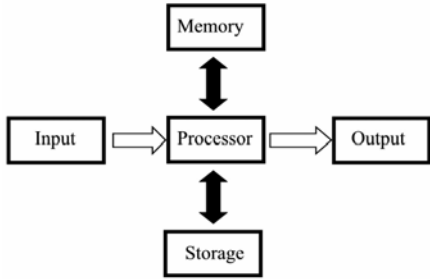
## High Level View Of A Computer



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## Buses

- Connect the different parts of the computer together



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## Buses (2)

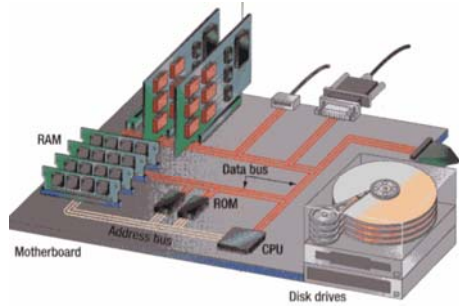
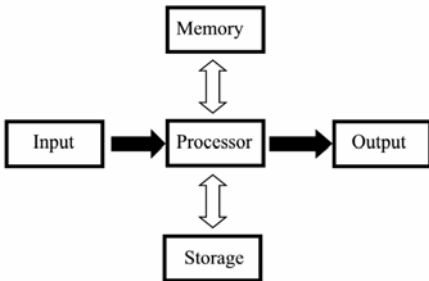


Image from Peter Norton's Computing Fundamentals (3rd Edition) by Norton P.

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## Ports

- Connects the computer to the outside



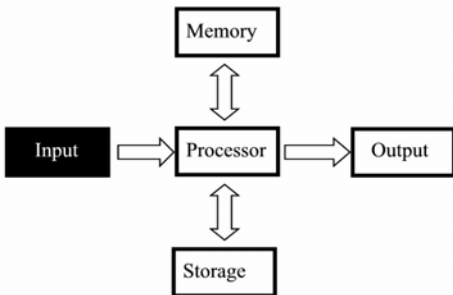
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## Ports



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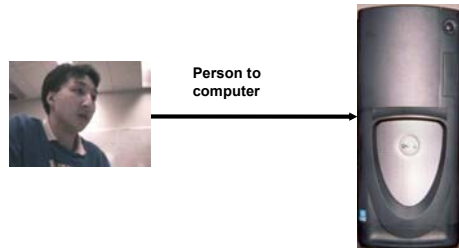
## Input



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## Input Devices

- Used by a person to communicate to a computer.



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## Example Input Devices

•Keyboard



•Mouse



•Need not be mundane!



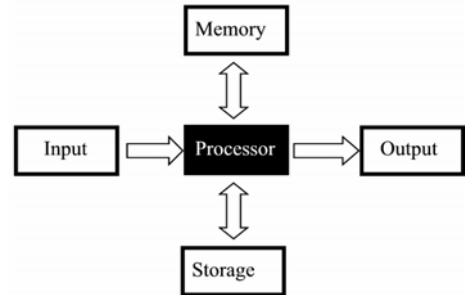
From <http://www.jouse.com/>



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](http://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

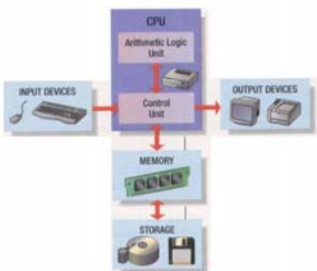
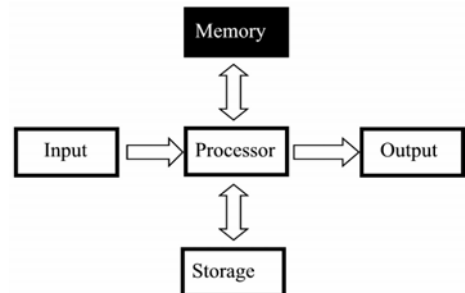


Image from Peter Norton's Computing Fundamentals (3rd Edition) by Norton P.

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## Memory



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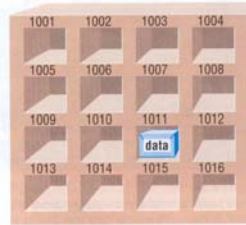
## RAM

- 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

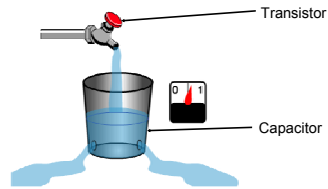


From www.howstuffworks.com

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## How Does DRAM Work?

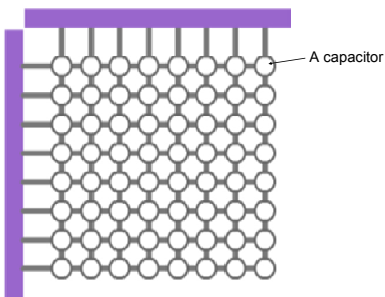
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From www.howstuffworks.com

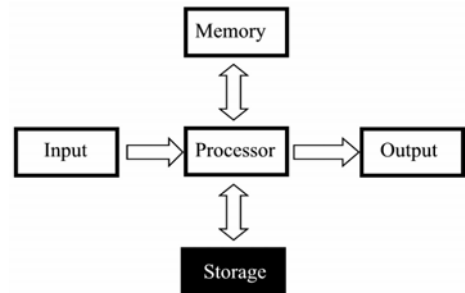
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## DRAM: A Collection Of Capacitors



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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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## Categories Of Storage

1. Magnetic
  - Floppy disks
  - Zip disks
  - Hard drives
2. Optical
  - CD-ROM
  - DVD

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## Magnetic Drives



Pictures from [www.howstuffworks.com](http://www.howstuffworks.com)

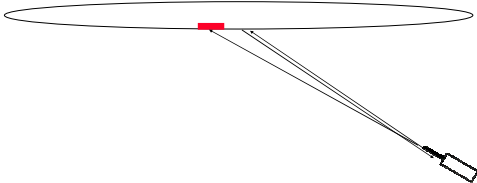
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## Magnetic Drives: Storage Capacities

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

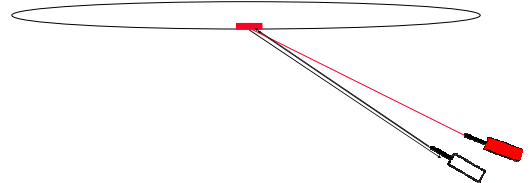
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## Optical Drives: Reading Information



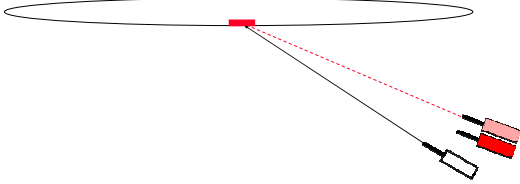
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## Optical Drives: Recording and Reading Information



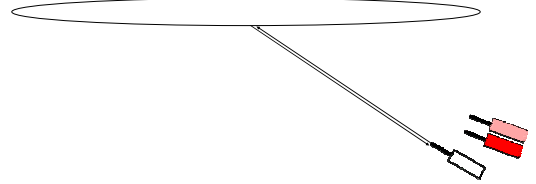
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### Optical Drives: Re-Writing



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### Optical Drives: Re-Writing



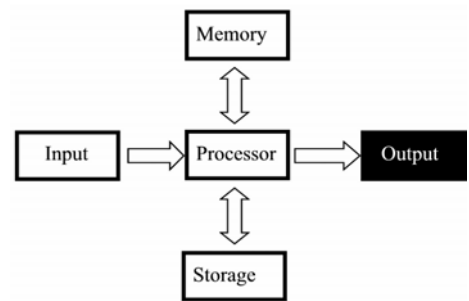
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### Optical Drives

- CD's
  - ~ 700 MB storage
  - CD-ROM (read only)
  - CD-R: (re~~c~~ord) to a CD
  - CD-RW: can write and erase CD to reuse it (re-w~~r~~itable)
- 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)



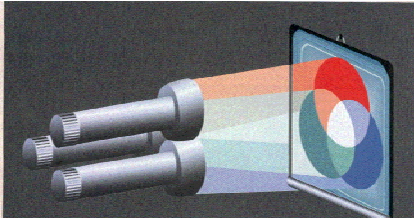
- 2) LCD's (Liquid Crystal Display)



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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

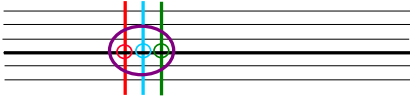
- Employ a conductive grid for each row and column
- The meeting of a row and column allows light to be emitted (a pixel can be seen)



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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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### 2) Monitor Quality (Resolution)

- (Columns of pixels) x (Rows of pixels)

Col 1, Row 1	Col 2, Row 1	Col 3, Row 1	...	Col [c], Row 1
Col 1, Row 2				Col [c], Row 2
Col 1, Row 3				Col [c], Row 3
⋮				⋮
Col 1, Row [r]	Col 2, Row [r]	Col 3, Row [r]	...	Col[c], Row[r]

- For a given monitor size, the higher the resolution the sharper the image

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### 3) Monitor Quality (Color Depth)

•The number of possible colors that can be displayed for each pixel.

e.g. monochrome (single color) 1  
2 possible values  
Uses up 1 bit of space

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### 3) Monitor Quality (Effects Of Color Depth)



2 colors



16 colors



256 colors

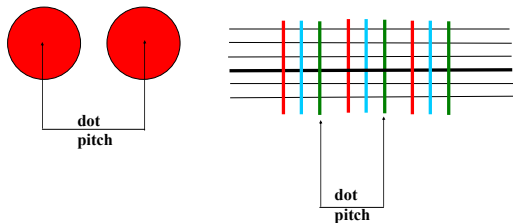


16 million colours

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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

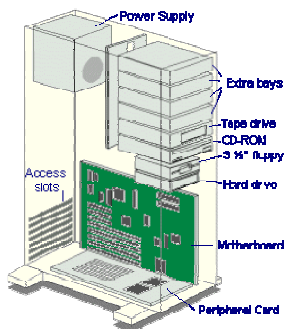


Diagram from <http://www.jegsworks.com>

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### The Motherboard

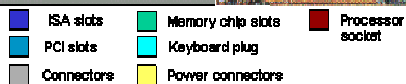
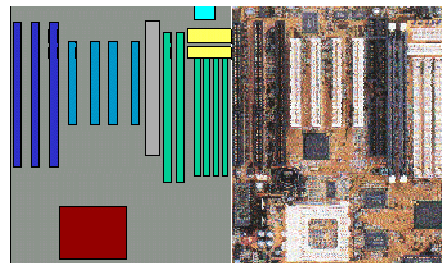
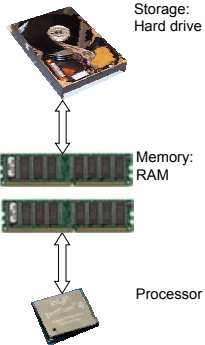


Diagram from <http://www.jegsworks.com>

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## Relating The Speed Of The Computer To Its Components



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## Printers

### •Common types

- Inkjet



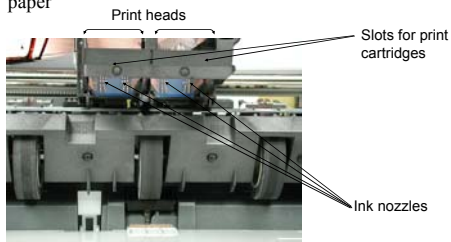
- Laser



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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.bowestuffworks.com](http://www.bowestuffworks.com)

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## How Laser Printers Work

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

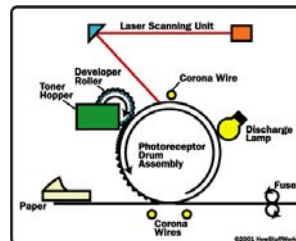


Diagram from [www.bowestuffworks.com](http://www.bowestuffworks.com)

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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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