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.

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.

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

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

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})

High Level View Of A Computer

[Diagram showing the components of a computer: Memory, Processor, Input, Output, Storage]
Introduction to computers

**Buses**

- Connect the different parts of the computer together

```
Memory

Input  ──> Processor  ──> Output

Storage
```

**Ports**

- Connects the computer to the outside

```
Memory

Input  ──> Processor  ──> Output

Storage
```

**Input**

```
Memory

Input  ──> Processor  ──> Output

Storage
```

**Input Devices**

- Used by a person to communicate to a computer.

```
Person to computer
```
Example Input Devices

- Keyboard
- Mouse
- Need not be mundane!

From http://www.jouse.com/


Processor

- The brains of a computer
- A common desktop processor

www.howstuffworks.com

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 (0.000 000 04 seconds between each pulse or 0.27 ns between pulses)

The Processor And The Computer

Memory
RAM

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

RAM (2)

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

How Does DRAM Work?

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

DRAM: A Collection Of Capacitors

Storage

- Memory
- Input
- Processor
- Output
- Storage
**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

**Categories Of Storage**

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

**Magnetic Drives**

**Magnetic Drives: Storage Capacities**

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

**Optical Drives: Reading Information**

**Optical Drives: Recording and Reading Information**
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)

Output Devices

• Displays information from the computer to the person.

The Most Common Output Device: The Monitor

Types of computer monitors
1) CRT's (Cathode Ray Tube)
2) LCD's (Liquid Crystal Display)
CRT's Monitors

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

Picture from Computer Confluence by Beekman G.

LCM 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)

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)

Some Determinants Of The Quality Of Monitors

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

1) Monitor Quality (Size)

Measured diagonally

2) Monitor Quality (Resolution)

(Columns of pixels) x (Rows of pixels)

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For a given monitor size, the higher the resolution the sharper the image
3) Monitor Quality (Color Depth)

- The number of possible colors that can be displayed for each pixel.
- e.g. monochrome (single color) 2 possible values
- Uses up 1 bit of space

3) Monitor Quality (Effects Of Color Depth)

- 2 colors
- 16 colors
- 256 colors
- 16 million colours

4) Monitor Quality (Dot Pitch)

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

Refresh Rate Of Monitors

- How fast the screen is redrawn
- (70 Hz / 70 times per second is usually a good minimum)

All The Basic Parts Together

The Motherboard
Relating The Speed Of The Computer To Its Components

- Storage: Hard drive
- Memory: RAM
- Processor

Printers

- Common types
  - Inkjet
  - Laser

How Inkjet Printers Work.

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

How Laser Printers Work

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

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