Introduction to Computer Science

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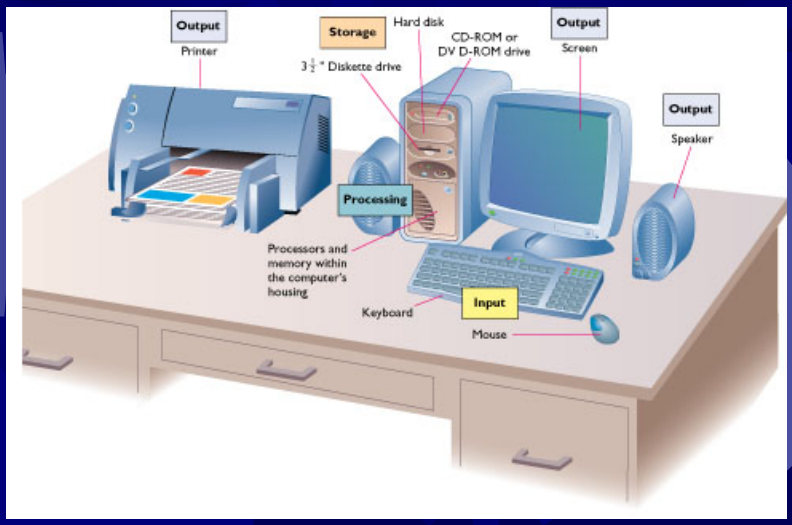
Inside Your PC

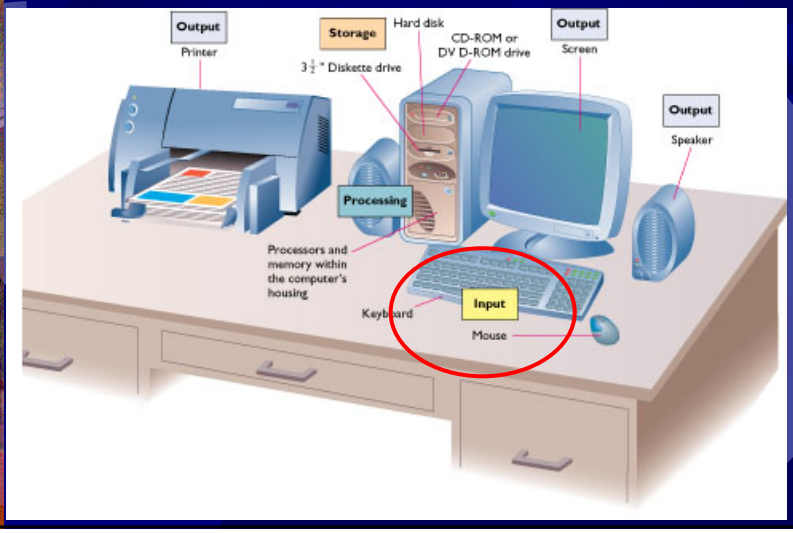
Today's Computer Real Life View



Inside Your PC

- Input/Output
- On the Inside
  - Storage
  - Processing
  - Other parts not on standard teaching material
- Looking into the Future

Today's Computer Real Life View



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Input devices

- Accept data or commands and convert them to electronic form
- Getting data into the computer
  - Typing on a **keyboard**
  - Pointing with a **mouse**
  - Scanning with a **scanner** or bar-code reader

Keyboard

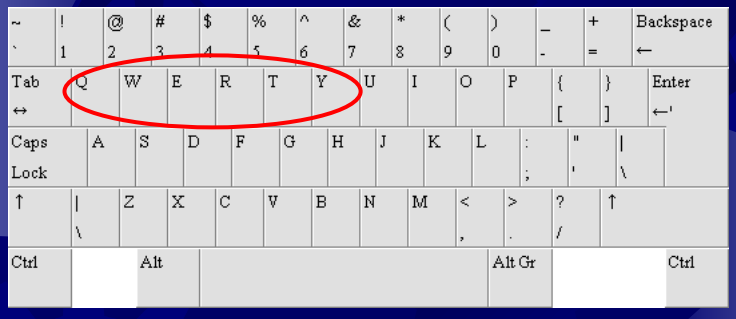
Types of Keyboard

- 101-key Enhanced keyboard
- 104-key Windows keyboard
  - 3 more keys?

Types of Keys

- Typing, numeric, function, and control keys

QWERTY Layout



A Legacy Technology

Slower is Better

- The mechanical typewriter
  - Key attached to the typebar
  - Typebar tip molded with the corresponding letter
  - So striking the key will rest the typebar on the paper, and therefore leave a print of the letter
- The design consideration
  - If typed too fast, typebars jam
  - To SLOW DOWN the speed, spread the often-typed letters apart in the layout

But computer keyboards are no longer mechanical….

There Are Alternatives

- Dvorak Layout
  - To minimize the amount of finger movement

It’s not a perfect world.

Polly’s Law:

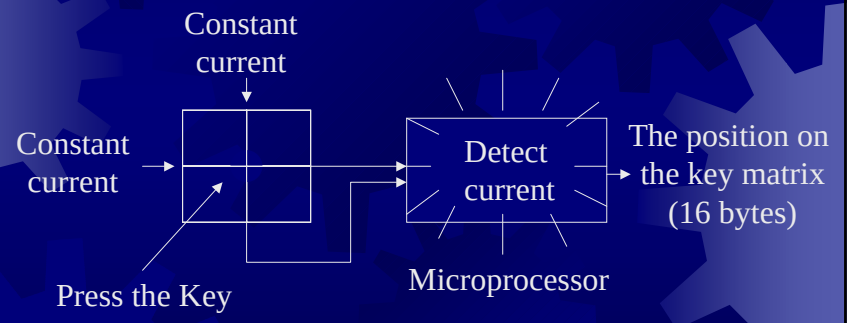
Consumers takes the cheap and good-enough option

A Computer Itself

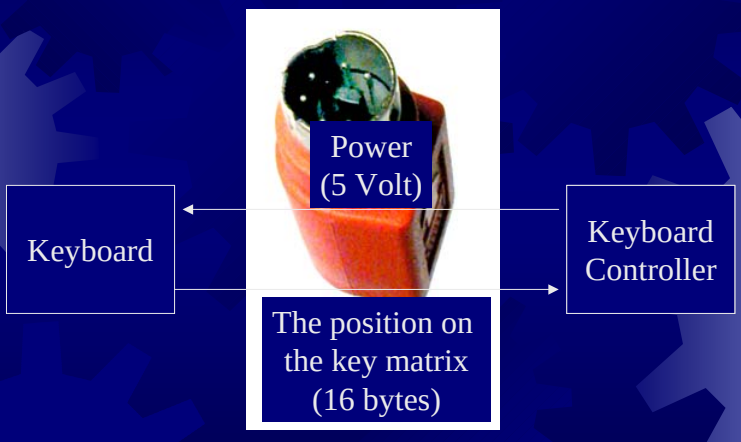
Key Matrix

Microprocessor

Circuit Underneath A Key



To the PC



Mouse

>”<

A Natural Interface

- Now, think back when you are a baby
  - You saw there's some nice apple juice in your bottle right on the desk
- What do you do to let your mom know you want that bottle?

Moms Are Great

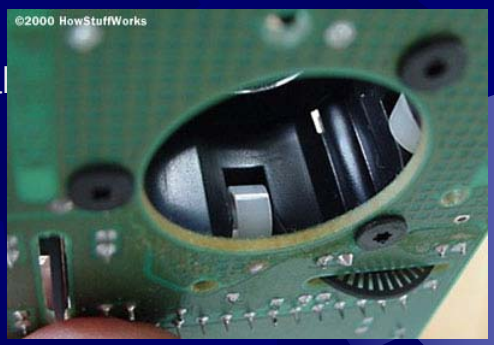
- Computers are stupider than the moms
- They only start to know what people mean by pointing in about late 1970's
  - Macintosh APPLE II's evolve first
  - Windows 3.1 comes later for IBM PCs
  - GUI (Graphical User Interface)
  - This explains why would anyone use 'command line' at all

Types of Mouse

- Mechanical
  - Use rollers to track motion
  - Track ball
- Optical
  - Use a tiny camera to tracking the motion
  - LED (red light beamer)

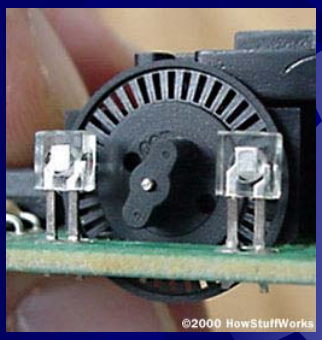
Mechanical Mouse

- Two Rollers
  - One vertical
  - One horizontal
  - Rolled by the track ball



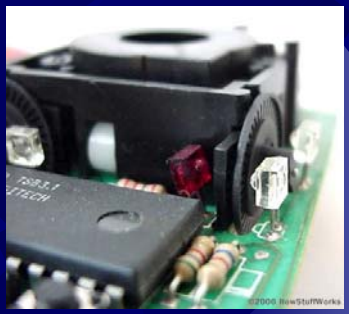
Spinning Disk

- Each roller connects to a shaft
- The shaft spins a disk
- The disk has 36 holes around the outer edge



Pulses of Light

- A pair of infra-red LED and sensor on either side of the disk
  - LED beams infra-red light
  - The holes break the beam of light as the disk spins
  - Sensor receives pulses of light



The Mouse Guts

- The microprocessor detects
  - The number of pulses
  - 3 bytes
- Send the data through
  - PS/2 connector

Optical Mouse

- A tiny camera
- 1,500 pictures every second

Taking the Pictures

- Red LED beams
- Mouse pad bounces back the light
- CMOS senses the image from the bounced light

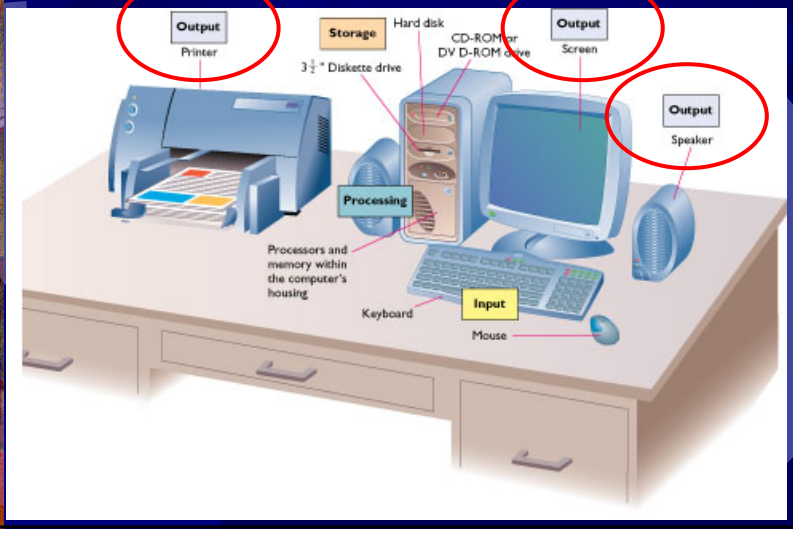
CMOS >”<

Mechanical vs. Optical

- The microprocessor detects
  - The number of pulses
  - 3 bytes
- Send the data through
  - PS/2 connector

- The microprocessor detects
  - The change in images
  - Find the motion direction and speed
  - A digital signal processor (18 MIPS)
- Send the data through
  - PS/2 connector

Today's Computer Real Life View



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Output devices

- Convert from electronic form to some other form
- Getting data out of the computer
  - Displaying on a **monitor**
  - Printed out with a **printer**
  - Played out with speakers

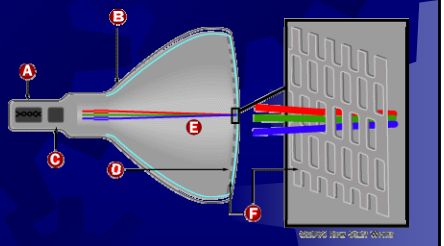
Monitor

Types of Monitor

- CRT
  - Cathode ray tube
  - About creating light when needed
- LCD
  - Liquid crystal display
  - About blocking light when not needed

CRT

- **Cathode** in vacuum glass **tube** pouring a **ray** of electrons
- Anode positive
  - Pulling negative electrons off from Cathode
- Phosphor
  - Glows when hit by beams of electrons



A Cathode
B Conductive coating
C Anode
D Phosphor-coated screen
E Electron beams
F Shadow mask

Why the Thickness?

- Steering coils
  - Creating magnetic fields
  - Band the beams of electrons by certain angles
- A large screen
  - Large angle or
  - Long distance

LCD

- Polarized light changed by **liquid crystal**

A Bag of Nice Tricks

- Light can be polarized
  - Divided into vertical and horizontal components
  - Polarized lens blocks out a certain component and lets out the other component
- Liquid crystal can change polarized light
  - Change from vertical to horizontal or vice versa
- Liquid crystal can be twisted by electric current
  - Praise the nature
  - And whoever discovers this

Illustration

http://static.howstuffworks.com/flash/lcd-twisted.swf

Monitor Standard

IBM	Standard	Color	Resolution
1981	CGA	4	320x200
1984	EGA	16	640x350
1987	VGA*		
1990	XGA*	True color	800x600
Now	UXGA*	True color	1600x1200

Bottleneck

- * stuff
  - Graphics card dependent
- Maximum resolution
  - Depends on number of colors you wish to display
  - UXGA for example
    - True color (16.8 million) at 800x600
    - 65536 at 1600x1200

Viewable Area

- Aspect ratio
  - Height:width
  - 4:3 – computer, TV
  - 16:9 - cinema
- Screen size
  - Distance between diagonal corners
  - 15”, 17”, 19”, 21”

Dot Pitch

- Distance between the display dots
- The smaller the better
  - More dots per inch
  - Higher resolution

CRT Monitor Specific

- Refresh frequency
  - Number of times the images on the screen in drawn row by row top-down per second
  - For example, 72Hz
  - The higher the better
  - Can sense flicking if too low
- Interlacing
  - Draw the odd rows first and then even rows
  - Reduce the sense of flicking at the same drawing rate

Power Consumption

- CRT – 110 watt
- LCD – 30-40 watt

Questions?

Peripherals and the PC

Remember This?

Keyboard

PC

PS/2 Connector

To the PC

- Keyboard
  - Out: position of a keystroke on the key matrix
  - In: 5V power
  - Interface: PS/2
- Same for mouse
  - Out: motion of the mouse in (x, y) directions
  - In: 5V power
  - Interface: PS/2

But you know what?

It’s not the only way.

Past, Present, and Future

Serial PS/2 USB

Ways of Connecting to the PC

- Serial port
  - Many pins in the connector
  - Using 1 pin for data
  - Sending data 1 bit at a time
- Parallel port
  - Many pins in the connector
  - Using 8 pins for data
  - Sending data 8 bits in parallel at a time

1:8

- Serial port
  - For devices NOT sending lots of data to the PC per time unit
  - Modems, keyboards, mouse, and etc
    - Keyboard and mouse going PS/2 for a while
- Parallel port
  - For devices sending lots of data to the PC per time unit
  - Printers, scanners, CD burners, ZIP drives

All going USB now

USB

- Universal Serial Bus
  - For everything from mouse to printers
  - Can connect up to 127 devices at a time

Device Side PC Side

127…Wait a Minute

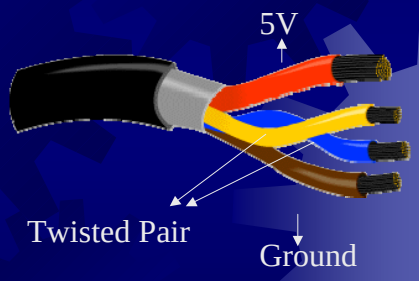
My PC has only 2 of these!

It's Extendable

- Get these USB Hubs
  - This one on the right is a 4-port hub
- With an N port hub
  - 2 → 2N
  - 2N → $2N^2$

Cables Instead of Pins

- USB cable
  - No longer than 5 meters
  - 4 cables and that's all
- 2 for power
  - Red for 5V power
  - Brown to ground
- The other 2 for data
  - Twisted pair
  - 480 Mbps for USB 2.0



And the Rest

- Special connectors for special I/O
  - Monitor
    - VGA port
    - Video card
  - Speaker and microphone
    - Speaker, mic, audio in/out ports
    - Sound card

A Full Picture

http://www.howstuffworks.com/flash/tower.swf

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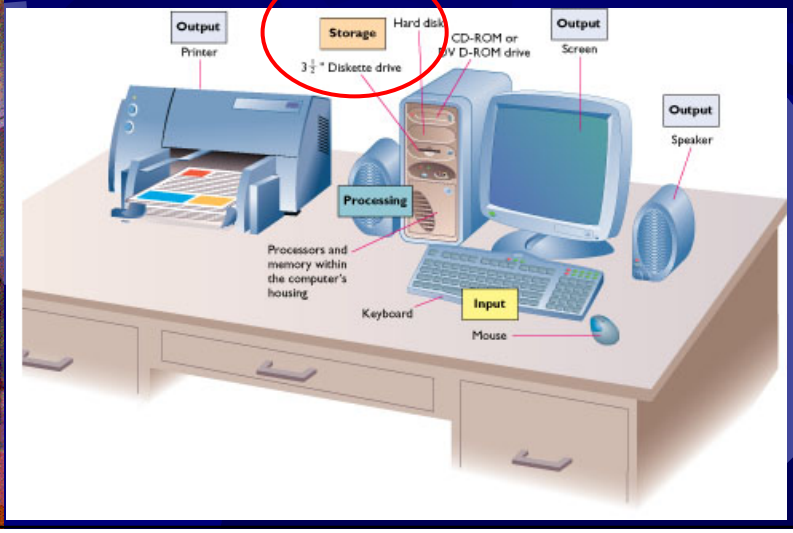


Storage

- Long-term storage
- Data and programs remain on the storage space until deleted specifically
- Storing data/programs on various media
  - Floppy disk
  - Hard disk
  - CD-ROM

Floppy Disk Drive

- Storing or retrieving data and programs from a floppy disk
- Pretty standard
  - 3.5”, 1.44MB
- Twisted cable
  - For drive A

Floppy Internal

Inside a floppy disk

Tapes circled up
Disk rotates

Inside a floppy disk drive

Head slides

Hard Disk Internal

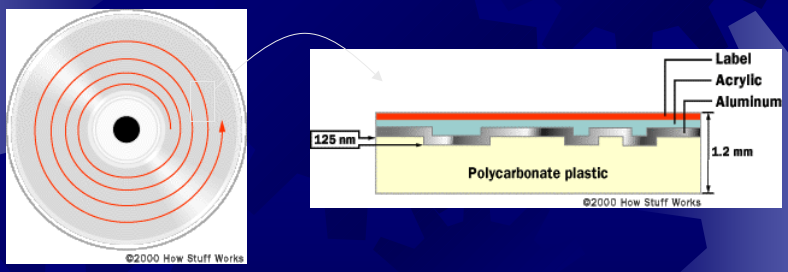
Birdseye View

Profile

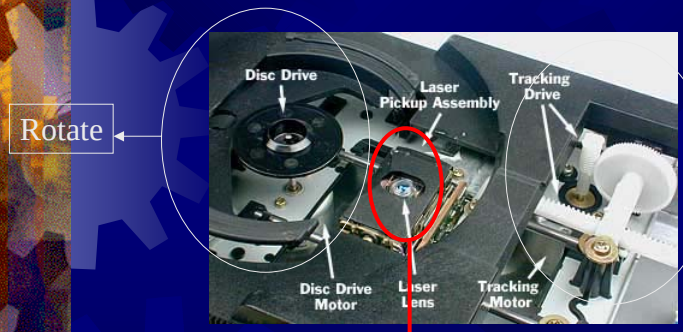
CD-ROM Drive

- CD-ROM R Drive
  - Read only
  - Read from both CD-R and CD-RW
  - Read speed, ex. 54x
- CD-ROM RW Drive
  - Read and Write
  - Read from both CD-R and CD-RW
  - Write to CD-R, Rewrite to CD-RW, Read speed, ex 40x12x48x

CD-ROM Disk Internal



CD-ROM Drive Internal

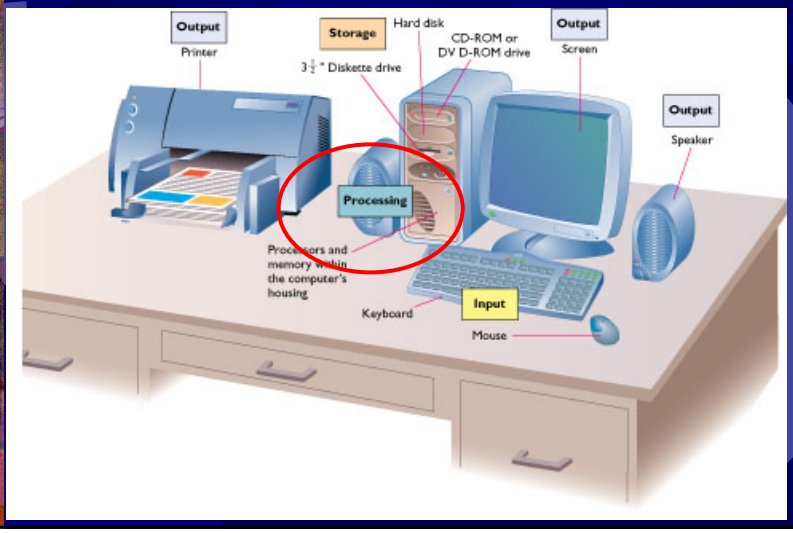


Rotate

Slide

Laser Beam

Today's Computer Real Life View



Processing

- CPU
  - Central Processing Unit
- Memory
  - Storing or retrieving data and programs currently in use

CPU - Microprocessors

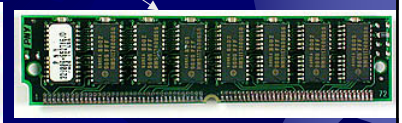
- Control Unit
  - Execute programs/instructions: the assembly language
  - Move data from one memory location to another
  - Communicate between other parts of a PC
- Arithmetic Logic Unit
  - Arithmetic operations: add, subtract, multiply, divide
  - Logic operations: and, or, xor
  - Floating point operations: real number manipulation
- Speed, ex. 2GHz

CPU Internal

Becoming not so micro…

Memory

- Data and programs disappear after task completed or power turned off
- Size, ex. 256MB
- Speed, ex. 266MHz
- Type, ex. DDR, DIMM, SIMM…



ROM

- Powered by the battery
- Containing
  - BIOS
    - The hardware configuration utility
  - System clock
    - The real-world time

People Also Classify This Way

- Memory
  - Primary storage
  - Temporary storage
- Storage
  - Secondary storage
  - Long-term storage

Your PC: More Than a Computer

- Computer
  - Attached to the motherboard
  - CPU, Memory
- Peripheral equipment
  - Connected to the computer by a cable
  - Input, output, storage

Parts Not Mentioned Yet

- Motherboard
  - Holds CPU, memory, PCI bays, etc
- Sound card
  - Ex. 16bit sound or …wide variety
- Video card
  - Ex. VRAM 64MB… wide variety
- Network card
  - 100Mbps
- Power Unit
  - Ex. 300W

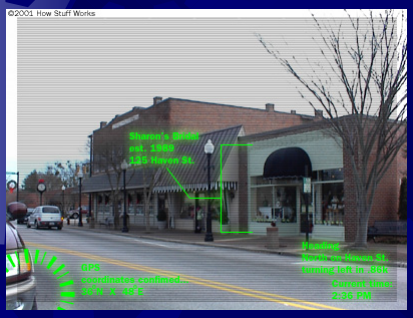
As For the Future



?

Do you believe in small screens?

Then Bring it Close



- Headset
  - Tiny projector on transparent glasses
  - For US$5000
    - 320x240 resolution
    - 12 bits color depth
    - Wireless
    - 28 gram

Looking Good?


Maybe just the models…
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Hardware
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Questions?
Polly Huang, NTU EE
Hardware
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