



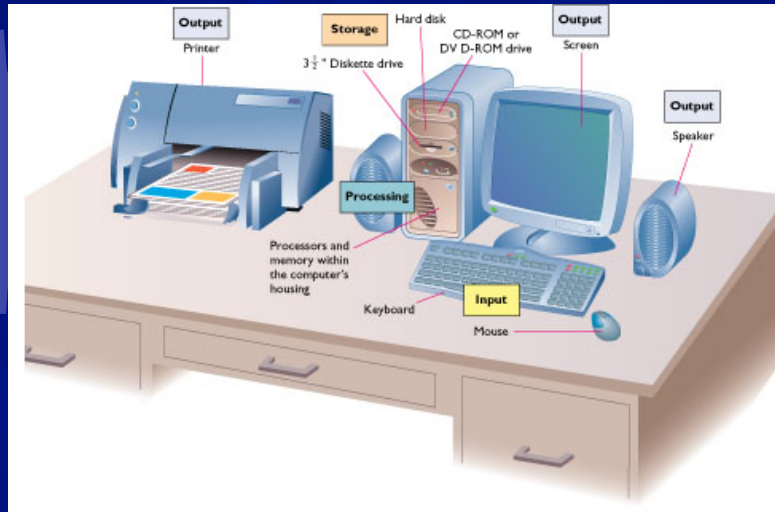
Introduction to Computer Science

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Inside Your PC

Today's Computer Real Life View



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Hardware

3

Inside Your PC

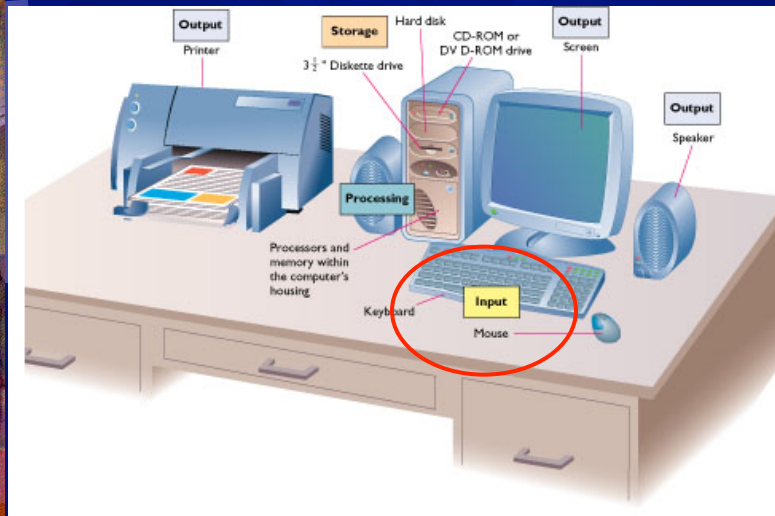
- ☀ Input/Output
- ☀ On the Inside
 - Storage
 - Processing
 - Other parts not on standard teaching material
- ☀ Looking into the Future

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Today's Computer Real Life View



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

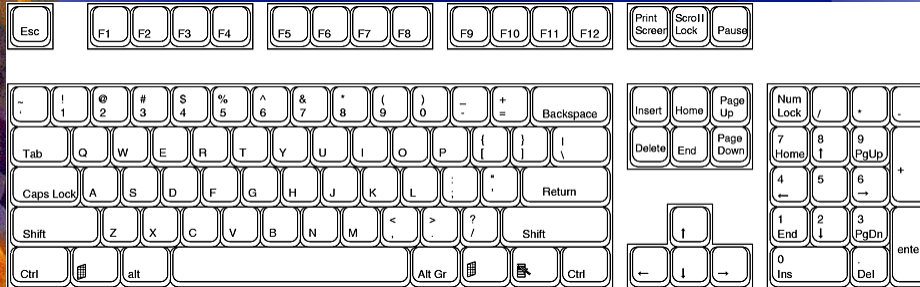


Types of Keyboard

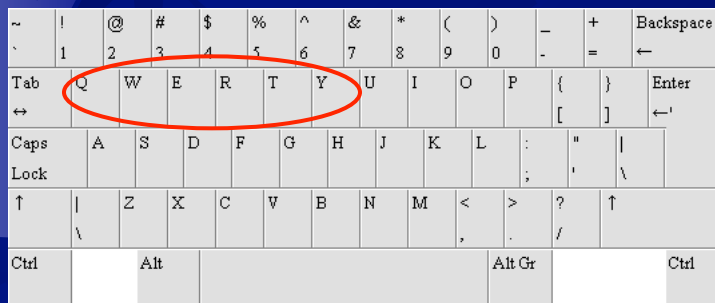
- 101-key Enhanced keyboard
- 104-key Windows keyboard
 - 3 more keys?

Types of Keys

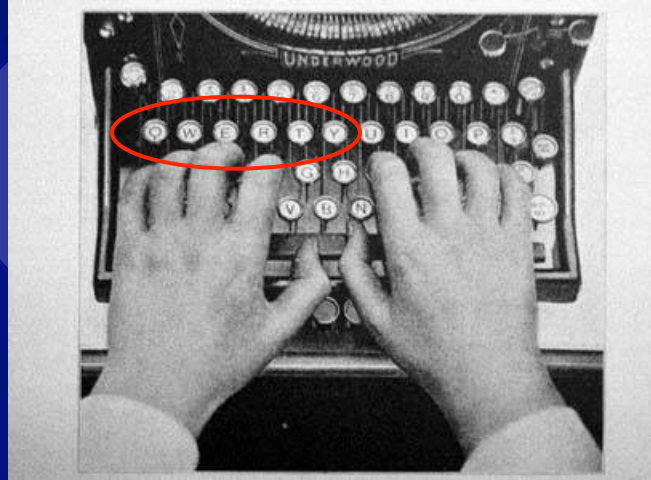
- Typing, numeric, function, and control keys



QWERTY Layout



A Legacy Technology



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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

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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 solution

A Computer Itself

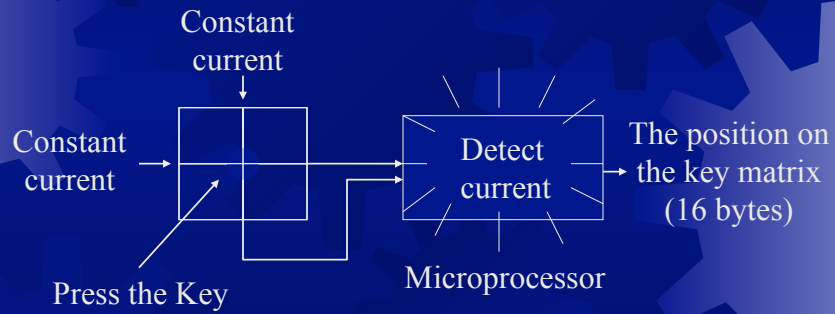


Key Matrix

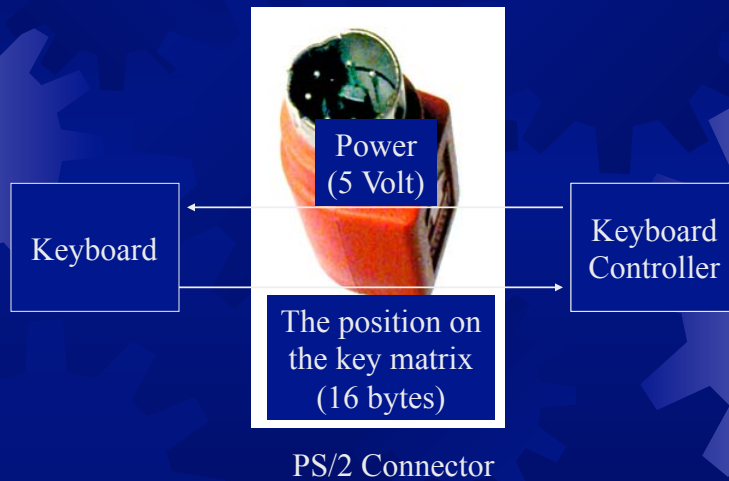


Microprocessor

Circuit Underneath A Key



To the PC



Mouse



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>”<



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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



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• Optical

- Use a tiny camera to track the motion
- LED (red light beamer)



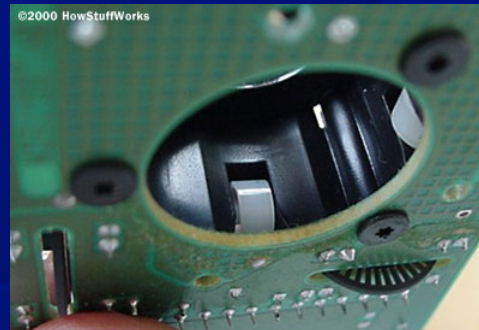
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Mechanical Mouse

• Two Rollers

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



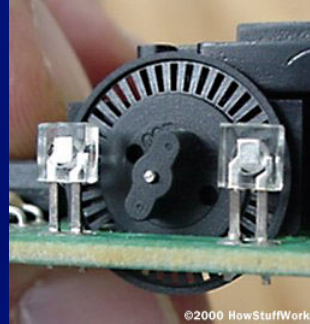
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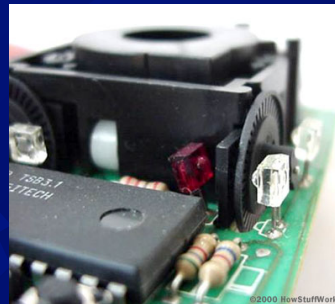
Spinning Disk

- 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 camera senses the image from the bounced light



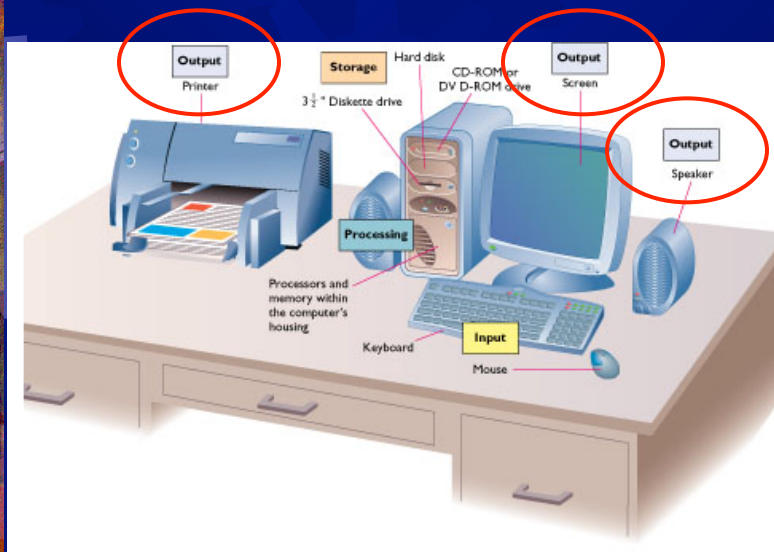
CMOS >"<

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

Quiz Time!

Today's Computer Real Life View



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

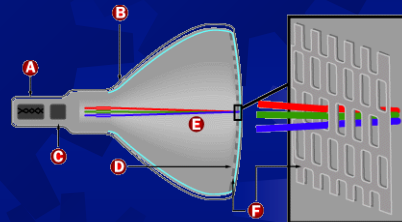
- ☀ **Cathode** in vacuum glass **tube** pouring a **ray** of electrons

- ☀ **Anode positive**

- Pulling negative electrons off from Cathode

- ☀ **Phosphor**

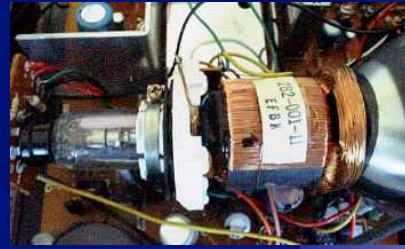
- Glows when hit by beams of electrons



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

Why the Thickness?

- ☀ Steering coils
 - Creating magnetic fields
 - Bend 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”, etc

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 is 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

Three Essay Examples

- ☀ Keyboard
 - Review of the technology
- ☀ Mouse
 - Mechanical vs. Optical
- ☀ Monitor
 - CRT vs. LCD

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!

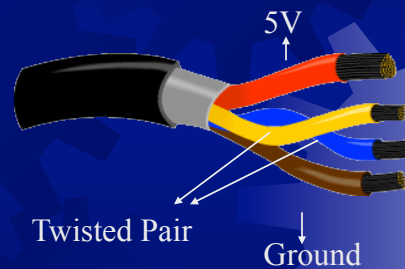
It's Extendable

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



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

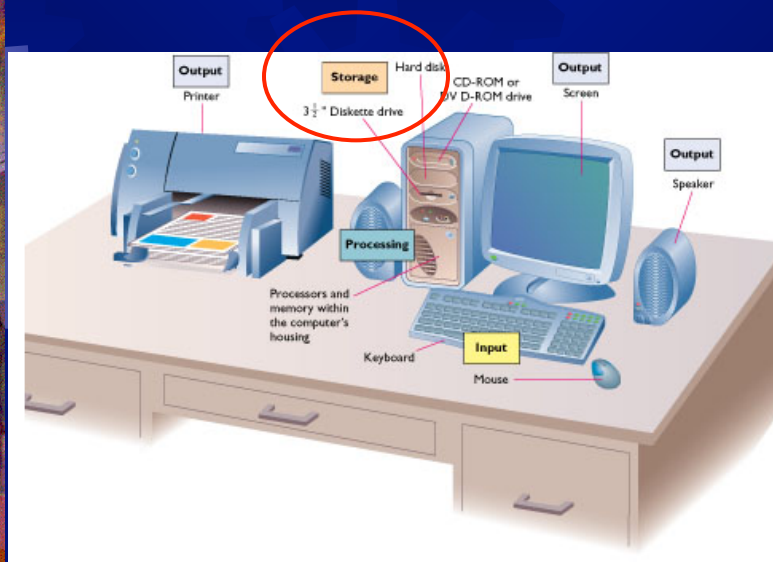
- VGA port
- Video card



- Speaker and microphone

- Speaker, mic, audio in/out ports
- Sound card

Today's Computer Real Life View



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

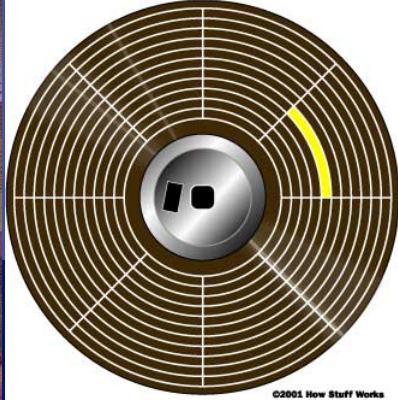


Floppy Disk Drive

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

Floppy Internal

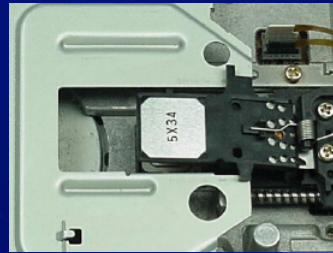
Inside a floppy disk



©2001 How Stuff Works

Tapes circled up
Disk rotates

Inside a floppy disk drive



Head slides

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Hard Disk Internal

Birdseye View



Profile



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CD-ROM Drive

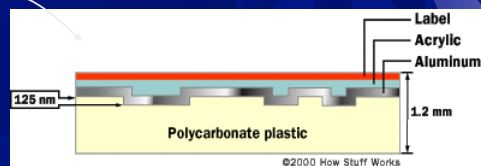
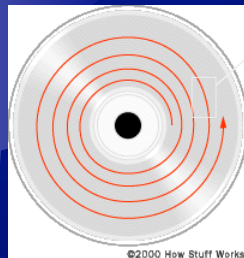
☀ CD-ROM R Drive

- Read only
- Read from both CD-R and CD-RW
- Read speed, ex. 54x

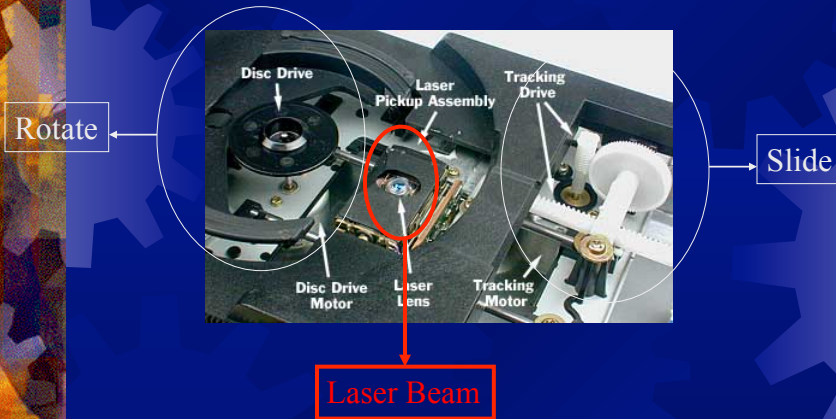
☀ CD-ROM RW Drive

- 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

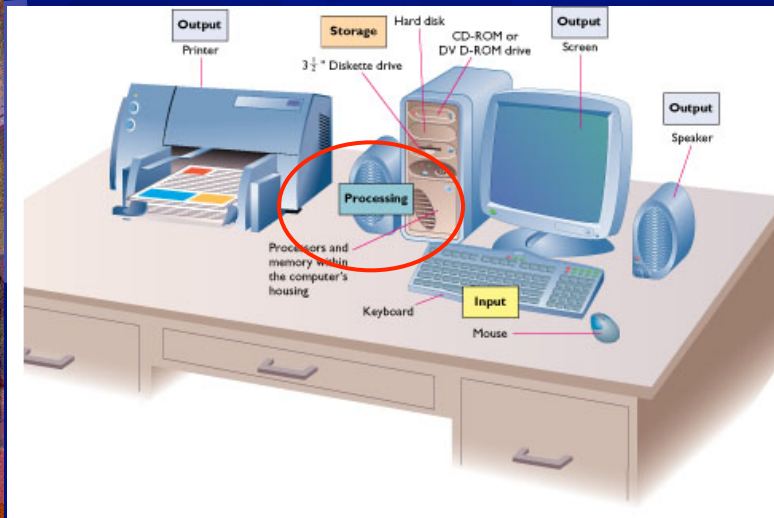


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Today's Computer Real Life View



68

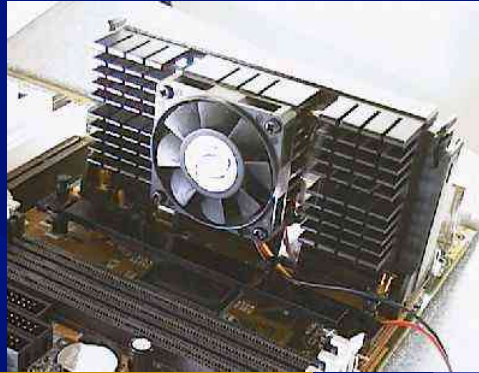
Processing

- ☀ 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



→ ?

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Do you believe in small screens?

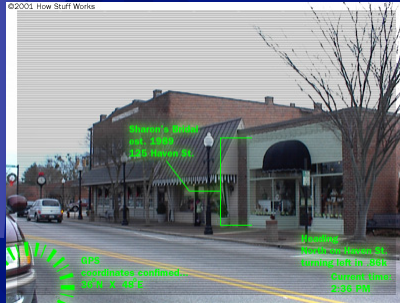


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Then Bring it Close



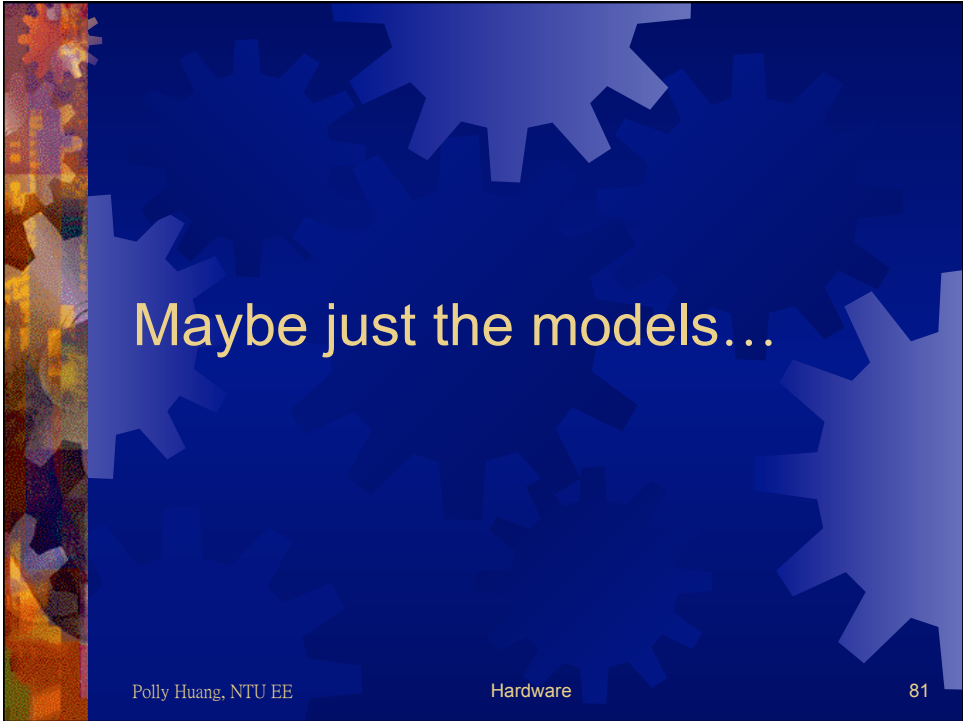
☀ Headset

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



Looking Good?

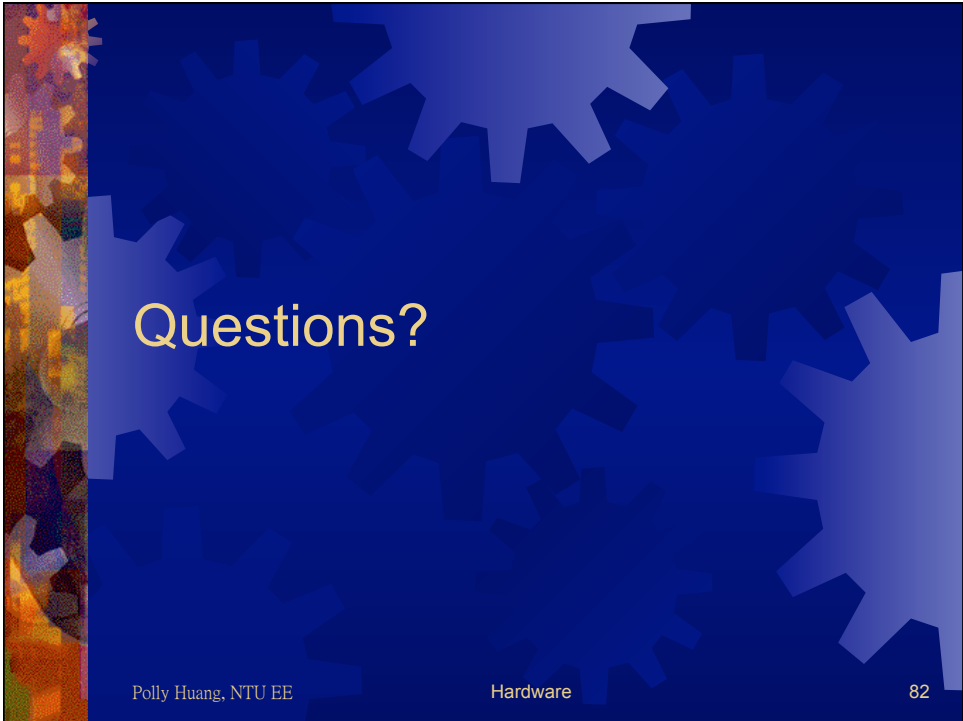




Maybe just the models...

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This slide features a dark blue background with a pattern of interlocking gears in various shades of blue. A vertical strip on the left side shows a colorful, abstract image of gears. The text "Maybe just the models..." is centered in a light yellow font. At the bottom, the text "Polly Huang, NTU EE", "Hardware", and "81" is displayed in a small white font.



Questions?

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This slide features a dark blue background with a pattern of interlocking gears in various shades of blue. A vertical strip on the left side shows a colorful, abstract image of gears. The text "Questions?" is centered in a light yellow font. At the bottom, the text "Polly Huang, NTU EE", "Hardware", and "82" is displayed in a small white font.