



Hardware Basics: Inside the Box

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What Computers Do

- Basic Functions of a Computer
 - ✓ Receive input: Accept information from the outside world
 - ✓ Process information: Perform arithmetic or logical (decision-making) operations on information
 - ✓ Produce output: Communicate information to the outside world
 - ✓ Store information: Move and store information in memory

What Computers Do

- Basic Components of a Computer

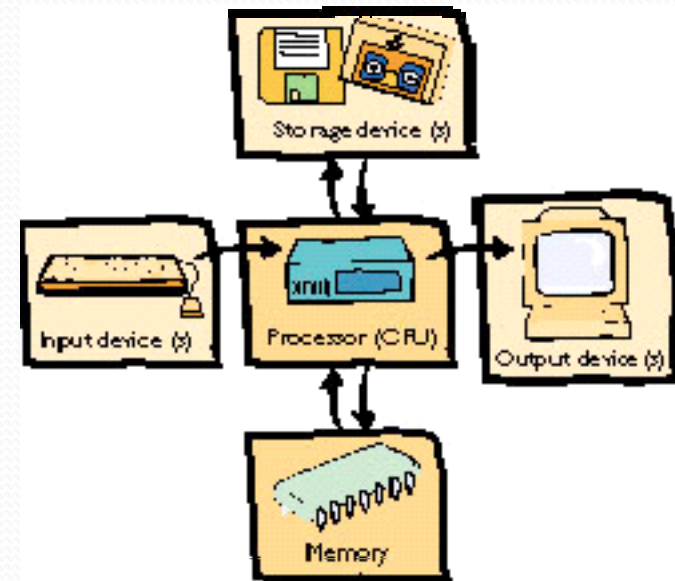
- ✓ Input devices

- Keyboards and pointing devices (mouse)

- ✓ Output devices

- Display or video monitor
- Printer
- Speakers

- ✓ Central Processing Unit (CPU)



What Computers Do

- Basic Components of a Computer

- ✓ Memory and storage devices

- Primary storage: RAM (Random Access Memory)
- Secondary storage: Storage devices that serve as long-term repositories for data:
 - ❑ Hard disk drives
 - ❑ Recordable CD and DVD drives
 - ❑ Tape drives



A Bit About Bits

✓ Information

- Communication that has value because it informs
- Anything that can be communicated, whether it has value or not

✓ Information comes in many forms

- Words, numbers, pictures
- Sound, movies



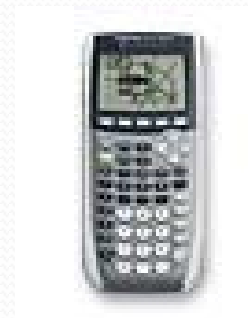
A Bit About Bits

- ✓ Computer's information is digital
 - Bit, or binary digit
 - ❑ The smallest unit of information
 - ❑ Can have one of two values: 1 or 0
 - ❑ Can represent numbers, codes, or instructions
 - Byte: a collection of 8 bits



A Bit About Bits

- ✓ Using two symbols all numbers can be represented on a calculator as well as performing arithmetic
- ✓ A calculator translates the touch on the numeric keypad into series of 0s and 1s.
 - Each number then is looked at as a component of its positional values (each a power of 2).
 - 19 will be represented as 00010011.



A Bit About Bits

- Bits as Codes
 - ✓ ASCII
 - The most widely used code
 - An abbreviation of American Standard Code for Information Interchange
 - ✓ Unicode
 - A coding scheme that supports 65,000 unique characters

Character	ASCII binary code
A	01000001
B	01000010
C	01000011
D	01000100
E	01000101
F	01000110
G	01000111
H	01001000
I	01001001
J	01001010
K	01001011
L	01001100
M	01001101
N	01001110
O	01001111
P	01010000
Q	01010001
R	01010010
S	01010011
T	01010100
U	01010101
V	01010110
W	01010111
X	01011000
Y	01011001
Z	01011010
[01011011
\	01011100
]	01011101
^	01011110
_	01011111
0	00110000
1	00110001
2	00110010
3	00110011
4	00110100
5	00110101
6	00110110
7	00110111
8	00111000
9	00111001

A Bit About Bits

- Bits as Instructions in Programs
- ✓ Programs are stored as collections of bits.
 - Program instructions are represented in binary notation through the use of codes.



A Bit About Bits

- Bits, Bytes, and Buzzwords
- Bit-related terminology

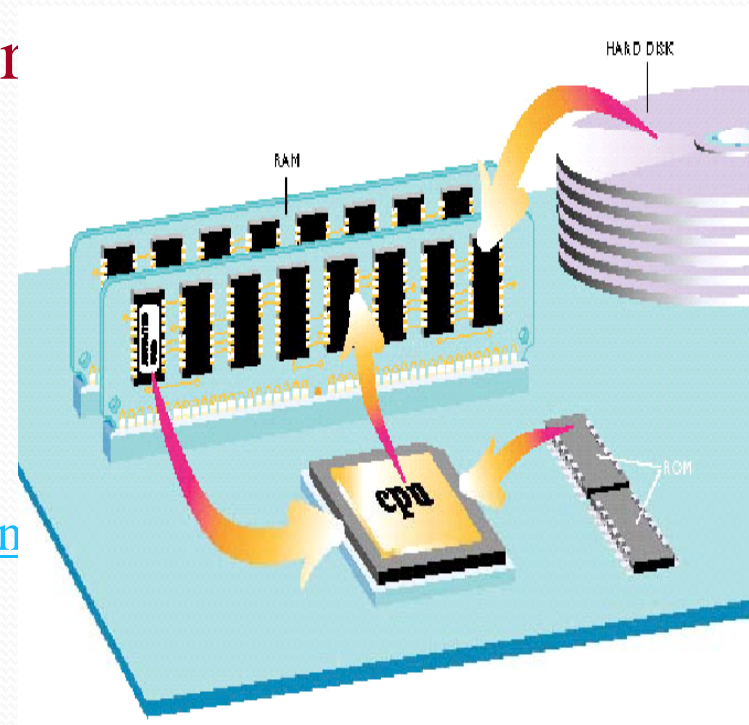
– Byte	= 8 bits
– Kilobyte (KB)	= 1 Thousand Bytes
– Megabytes (MB)	= 1 Million Bytes
– Gigabytes (GB)	= 1 Billion Bytes
– Terabytes (TB)	= 1 Trillion Bytes

The Computer's Core: The CPU and Memory

- The CPU: The Real Computer

- ✓ CPU (microprocessor)

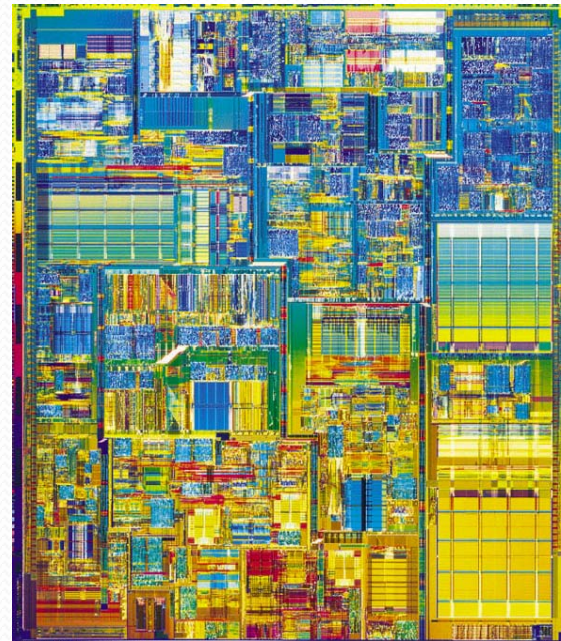
- Interprets and executes the instructions in each program
- Supervises arithmetic and logical data manipulations
- <http://www.youtube.com/watch?v=yn>



The Computer's Core: The CPU and Memory

✓ CPU (microprocessor)

- Communicates with all the other parts of the computer system indirectly through memory
- An extraordinarily complex collection of electronic circuits
- Housed along with other chips and electronic components on the **motherboard**



Compatibility

- ✓ All software is not necessarily compatible with every CPU.
 - Software written for the PowerPC family of processors used in Macintosh computers won't run on Intel processors.
 - Programs written for Linux can't run on Windows.
 - ❑ Both systems run on PCs powered by Intel's microprocessor.
 - CPUs in the same family are generally designed to be **backward compatible**.
 - ❑ Newer processors can process all of the instructions handled by earlier models.



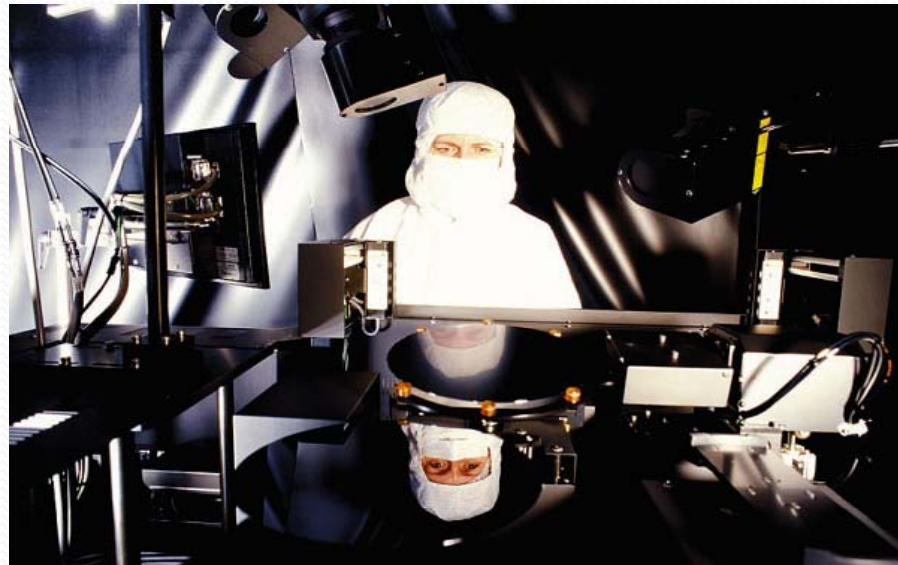
Performance

- ✓ Applications require faster machines to produce satisfactory results.
- ✓ A computer's overall performance is determined by:
 - Its microprocessor's internal **clock speed**
 - ❑ Measured in units called gigahertz (GHz) for billions of clock cycles per second
 - The **architecture** and **word size** of the processor
 - ❑ High-end workstations and servers use 64-bit processors.
 - ❑ Most PCs and Macintoshes use 32-bit processors.
 - ❑ Some embedded and special-purpose computers still use 8- and 16-bit processors.



Performance

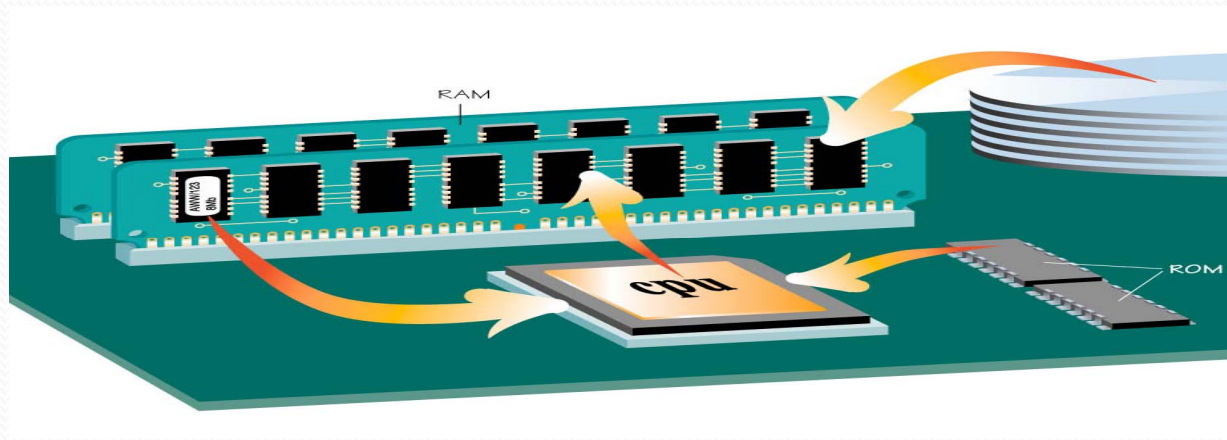
- ✓ Techniques for speeding up a computer's performance:
 - Parallel processing
 - Server clusters



The Computer's Memory

✓ RAM (random access memory)

- Used to store program instructions and data temporarily
- Unique addresses and data can be stored in any location
- Can quickly retrieve information
- Will not remain if power goes off (volatile)



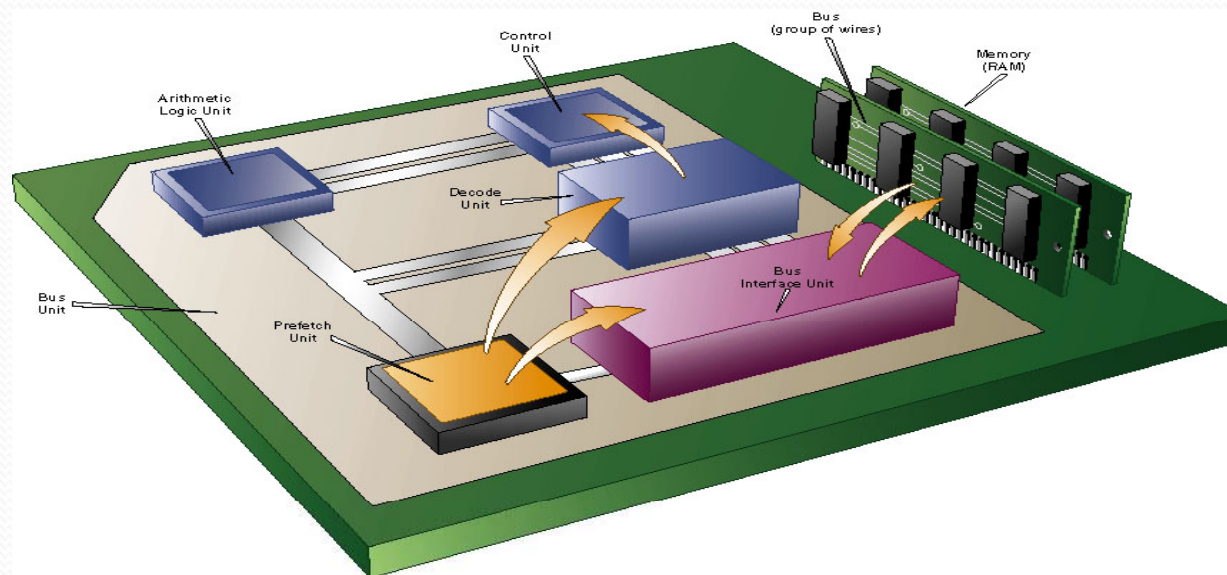
The Computer's Memory

- ✓ ROM (read-only memory)
 - Information stored permanently on a chip
 - Contains startup instructions and other permanent data
- ✓ CMOS (complementary metal oxide semiconductor)
 - Special low-energy kind of RAM
- ✓ Flash memory
 - Used for phones, pagers, portable computers, handheld computers, and PDAs



Buses, Ports, and Peripherals

- ✓ Information travels between components on the motherboard through groups of wires called **system buses**, or just **buses**.



Buses, Ports, and Peripherals

✓ Buses

- Typically have 32 or 64 wires
- Connect to storage devices in bays
- Connect to expansion slots
- Connect to external buses and ports

✓ Slots and ports

- Make it easy to add external devices, called **peripherals**.



Inventing the Future

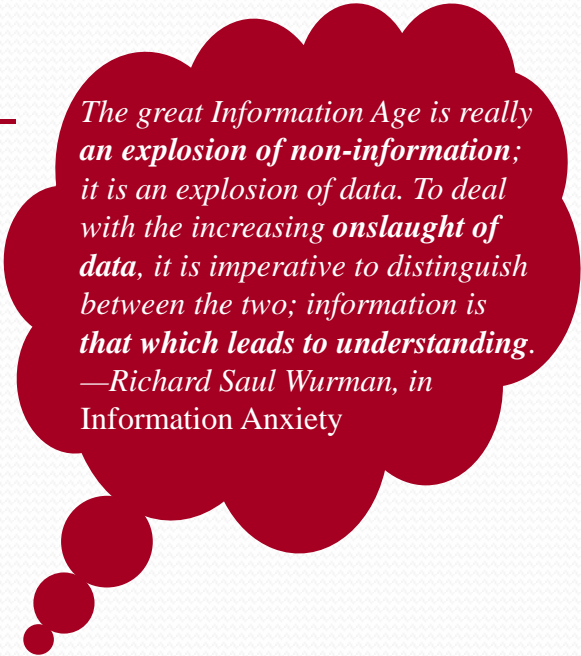
- ✓ New laser etching technology called extreme ultraviolet lithography (EUVL) could reduce chip size and increase performance radically.
- ✓ Superconductors that transmit electricity without heat could increase computer speed a hundredfold.
- ✓ The optical computer transmits information in light waves rather than electrical pulses.

*The only thing that has consistently **grown faster** than hardware in the last 40 years is **human expectation**.*

—Bjarne Stroustrup, AT&T Bell Labs, designer of the C++ programming language

Lesson Summary

- ✓ A computer manipulates patterns of bits - binary digits of information.
- ✓ The CPU follows software instructions, reduced to strings of bits, to perform the calculations and logical manipulations that transform input data into output.
- ✓ Not all CPUs are compatible with each other.



The great Information Age is really an explosion of non-information; it is an explosion of data. To deal with the increasing onslaught of data, it is imperative to distinguish between the two; information is that which leads to understanding.
—Richard Saul Wurman, in Information Anxiety

Lesson Summary (continued)

- ✓ The CPU uses:
 - RAM (random access memory) as a temporary storage area—a scratch pad—for instructions and data
 - ROM (read-only memory), which contains unchangeable information that serves as reference material for the CPU as it executes program instructions
- ✓ The CPU and main memory are housed in silicon chips on the motherboard.