Computers Are Your Future

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Chapter 6

Inside the System Unit

What You Will Learn . . .

- ✓ Understand how computers represent data
- ✓ Understand the measurements used to describe data transfer rates and data storage capacity
- ✓ List the components inside the system unit
- ✓ List the components on the motherboard
- ✓ How a CPU processes data

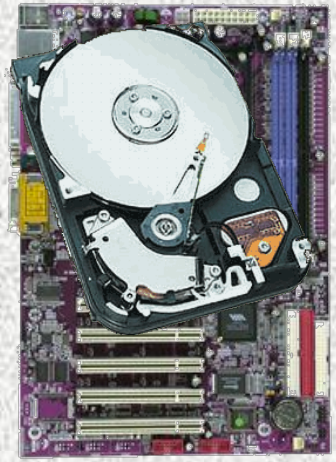
What You Will Learn . . .

- ✓ Factors that determine a microprocessors performance
- ✓ The types and purpose of memory in a computer system
- ✓ The physical connectors on the exterior of the system unit

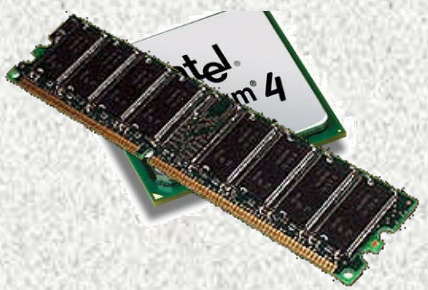



Describing Hardware Performance

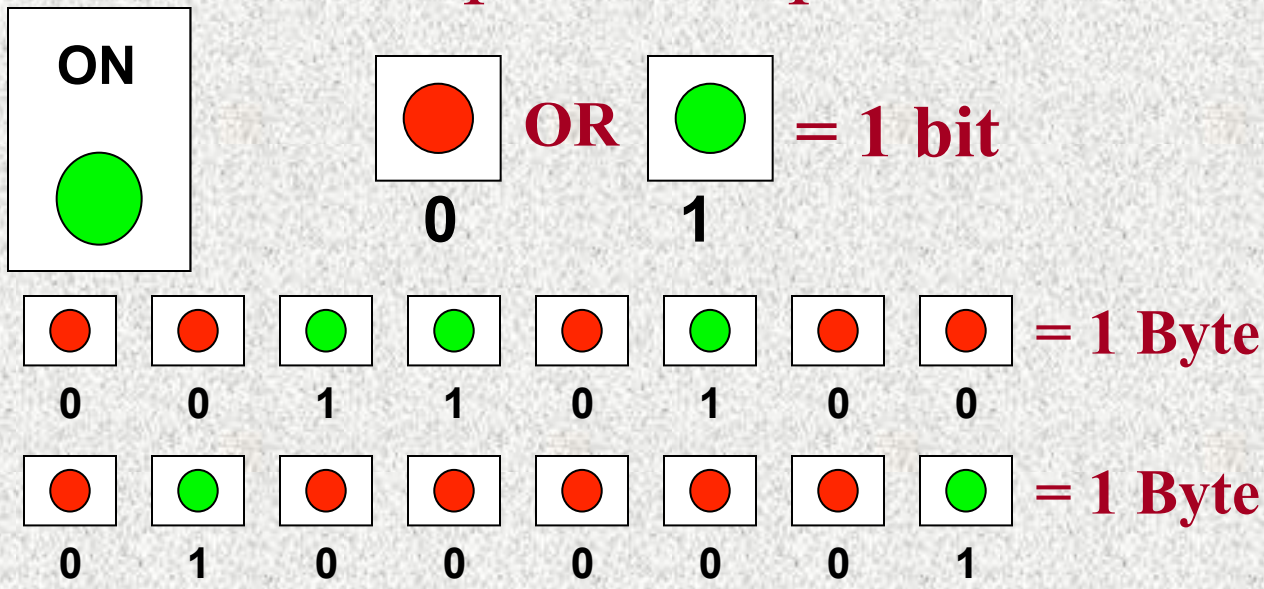
- Hardware performance refers to the amount of data a computer can store and how fast it can process the data



System Case

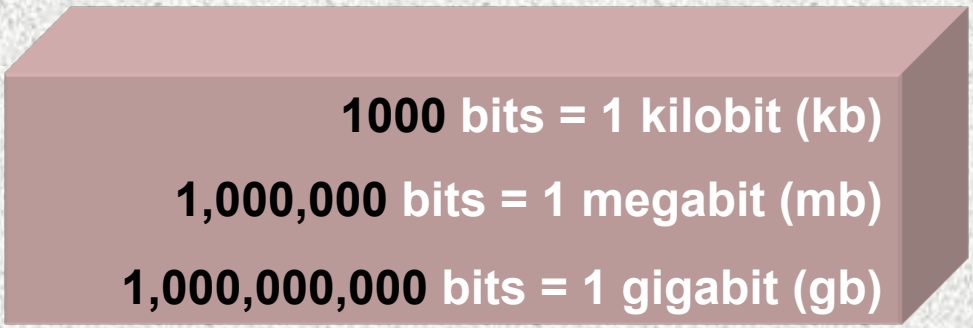


How Computers Represent Data



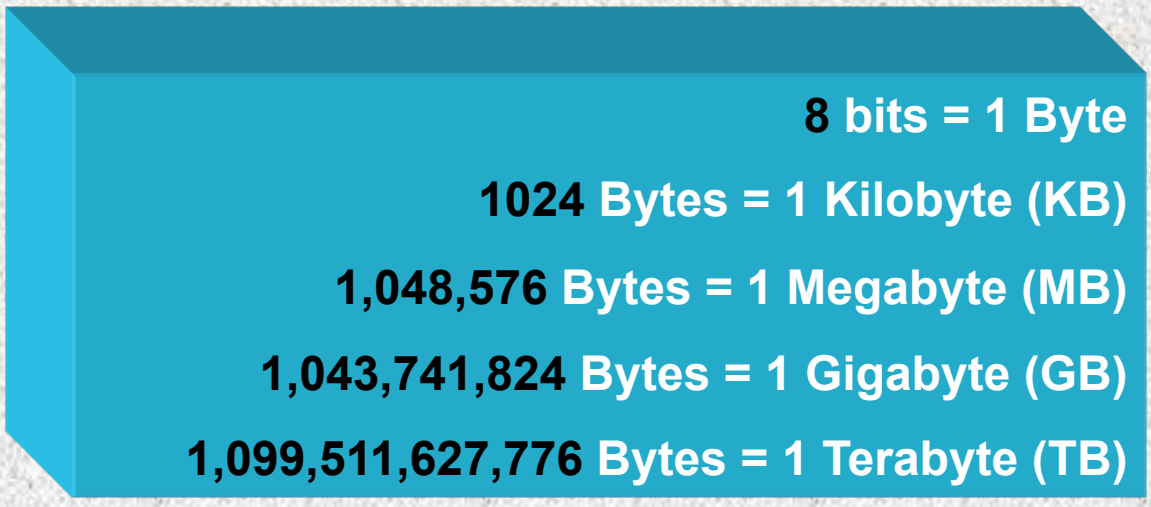
- **Bit** (Binary digit) – On or off state of electric current; considered the basic unit of information; represented by 1s and 0s (binary numbers)
- **Byte** – Eight bits grouped together to represent a character (an alphabetical letter, a number, or a punctuation symbol); 256 different combinations

Bits



- **Kilobits per second** (Kbps), **megabits per second** (Mbps), and **gigabits per second** (Gbps) are terms that describe units of data used in measuring data transfer rates
  - Example: 56 Kbps modem

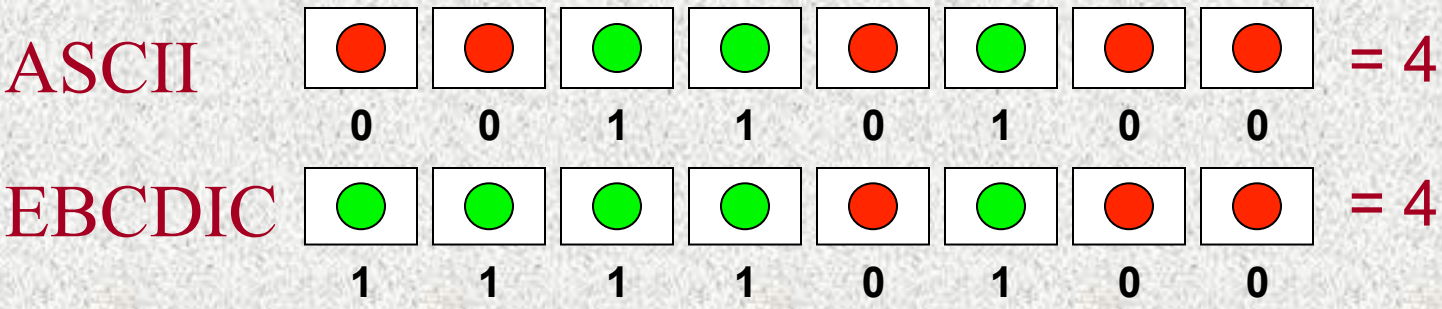
Bytes



- **Kilobyte**, **megabyte**, **gigabyte**, and **terabyte** are terms that describe large units of data used in measuring data storage
  - Example: 20 GB hard drive

Representing Characters: Character Codes

- Character codes translate numerical data into characters readable by humans
  - **American Standard Code for Information Interchange** (ASCII) – Eight bits equals one character; used by minicomputers and personal computers
  - **Extended Binary Coded Decimal Interchange Code** (EBCDIC) – Eight bits equals one character; used by mainframe computers
  - **Unicode –** Sixteen bits equals one character; over 65,000 combinations; used for foreign language symbols



ASCII and EBCDIC Code

ASCII	SYMBOL	EBCDIC
00110000	0	11110000
00110001	1	11110001
00110010	2	11110010
00110011	3	11110011
00110100	4	11110100
00110101	5	11110101
00110110	6	11110110
00110111	7	11110111
00111000	8	11111000
00111001	9	11111001
01000001	A	11000001
01000010	B	11000010
01000011	C	11000011
01000100	D	11000100
01000101	E	11000101
01000110	F	11000110
01000111	G	11000111
01001000	H	11001000
01001001	I	11001001
01001010	J	11010001
01001011	K	11010010
01001100	L	11010011
01001101	M	11010100

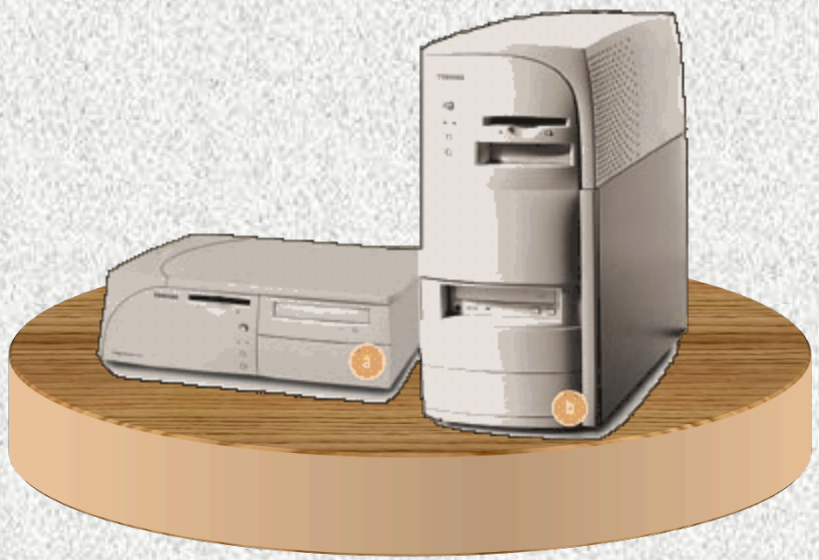
ASCII	SYMBOL	EBCDIC
01001110	N	11010101
01001111	O	11010110
01010000	P	11010111
01010001	Q	11011000
01010010	R	11011001
01010011	S	11100010
01010100	T	11100011
01010101	U	11100100
01010110	V	11100101
01010111	W	11100110
01011000	X	11100111
01011001	Y	11101000
01011010	Z	11101001
00100001	!	01011010
00100010	"	01111111
00100011	#	01111011
00100100	$	01011011
00100101	%	01101100
00100110	&	01010000
00101000	(	01001101
00101001	)	01011101
00101010	*	01011100
00101011	+	01001110

The System Unit

- The **system unit** is a boxlike case that houses the computer's main hardware components
- A **footprint** is the space taken up on the desk by the computer
- **Form factor** refers to the way the internal components are mounted in the unit

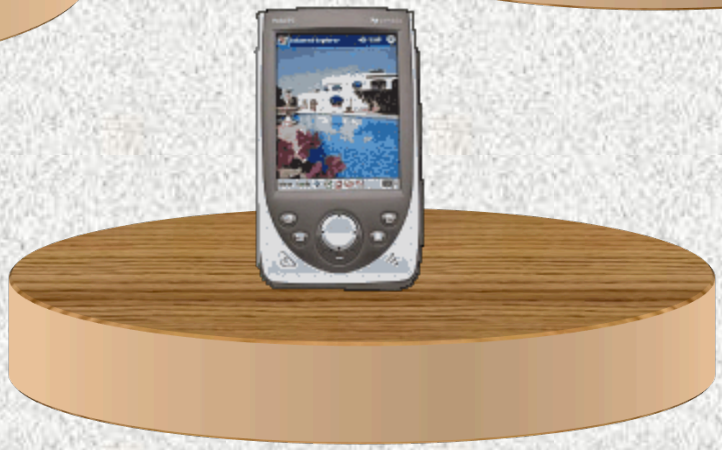
Types of System Units

Desktop



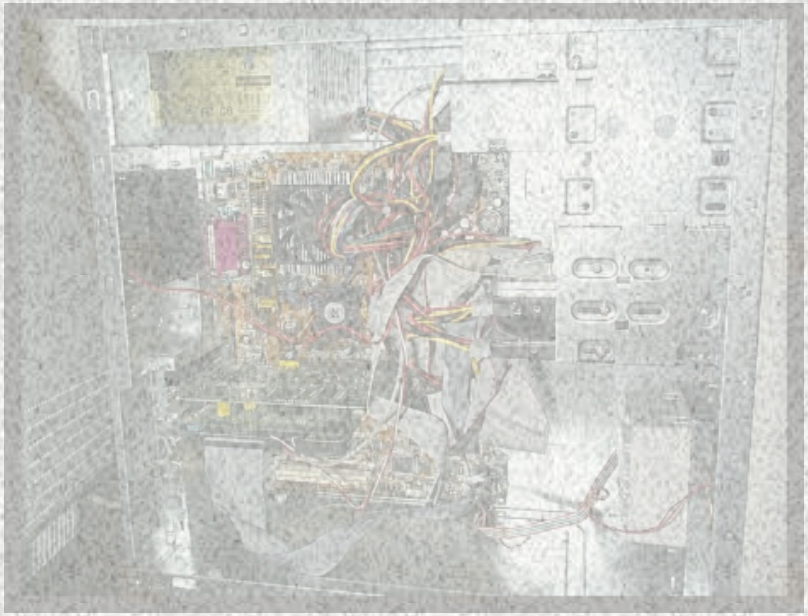
Notebook

Personal Digital Assistant



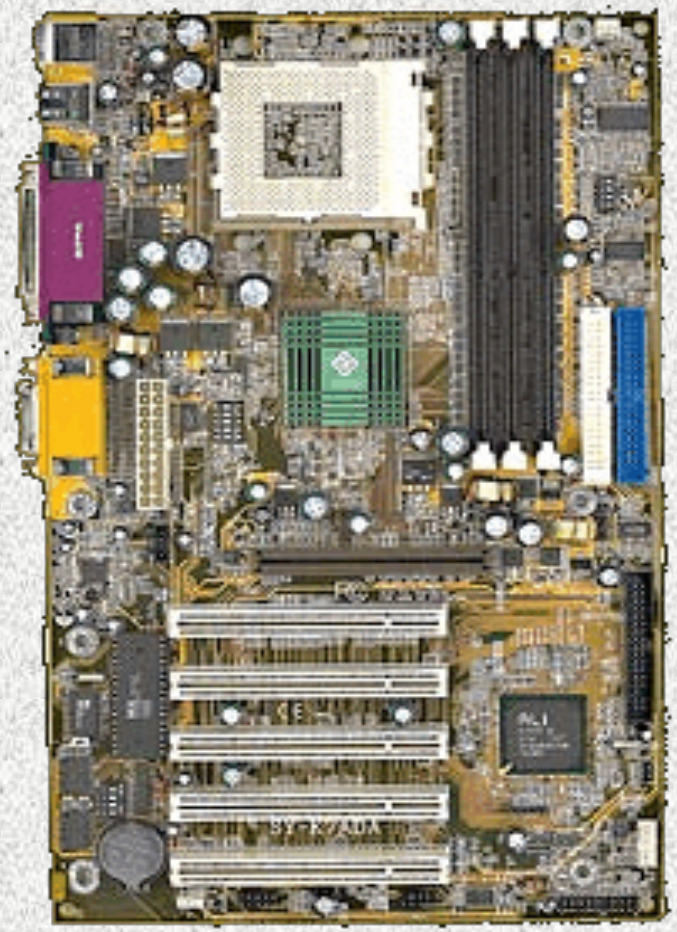
Inside the System Unit

- **Motherboard** (mainboard) – Large printed circuit board with thousands of electrical circuits
- **Power supply** – Transforms alternating current (AC) from wall outlets to direct current (DC) needed by the computer
- **Cooling fan** – Keeps the system unit cool
- **Internal Speaker** – Used for beeps when errors are encountered
- **Drive bays** – Housing for the computer's hard drive, floppy drive, and CD-ROM / DVD-ROM drives

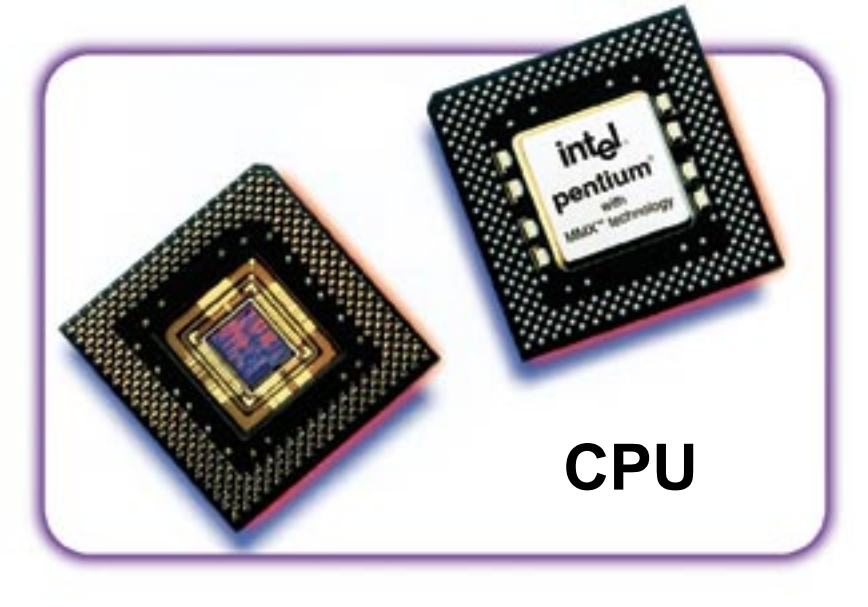


The Motherboard

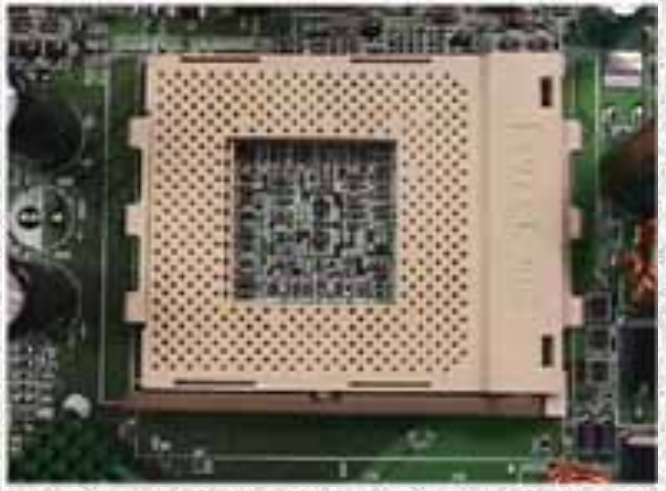
- The motherboard provides the centralized connection point for the computer's components
  - Most components are integrated circuits (chips)
    - **Chips** carry electrical current and contain electronic switches or **transistors**



The Central Processing Unit: The Microprocessor



CPU



CPU socket

- ✓ Central processing unit (**CPU**) – A microprocessor that interprets and carries out instructions given by software. It controls the computer's components

Components of the CPU

- **Control unit** – Coordinates and controls all parts of the computer system
- **Arithmetic-logic unit** – Performs arithmetic or logical operations
- **Registers** – Temporarily store the most frequently used instructions and data




The Control Unit

- The **control unit** manages four basic operations (fetch, decode, execute, and write-back)
  - The four-step process is known as the **machine cycle** or **processing cycle**
  - The processing cycle consists of two phases:
    - **Instruction Cycle**
      - **Fetch** – Gets the next program instruction from the computer's memory
      - **Decode** – Figures out what the program is telling the computer to do
    - **Execution Cycle**
      - **Execute** – Performs the requested action
      - **Write-back** (Store) – Writes (stores) the results to a register or to memory

The Arithmetic-Logic Unit

- **The arithmetic-logic unit** (ALU) performs basic arithmetic and logic operations
  - Adds, subtracts, multiplies, and divides
  - Compares alphanumeric data

Microprocessor Performance

- **Data bus width** – The number of pathways within the CPU that transfer data; they are measured in bits (8, 16, 32, or 64)
- **Word size** – The maximum number of bits of data that the CPU can process at one time (8 bits, 16 bits, 32 bits, or 64 bits)
- **System Clock** – electronic circuit that generates pulses at a rapid rate and synchronizes the computers internal activities

Microprocessor Performance

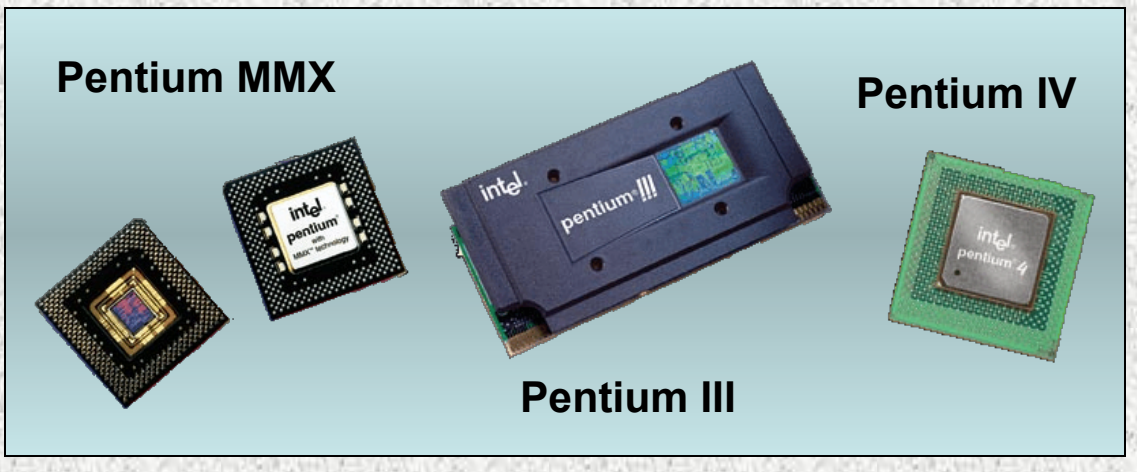
- **Operations per cycle** (clock speed) – The number of clock cycles per second measured in megahertz (MHz) or gigahertz (GHz)
  - **Superscalar** operations – Carrying out more than one instruction per clock cycle
  - **Pipelining** operations – Feeding a new instruction into the CPU at every step of the processing cycle

Parallel Processing

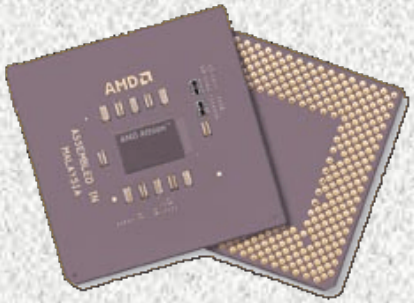
- Parallel processing involves using more than one CPU to improve performance
- **Complex instruction set computer** (CISC) – A chip that includes special-purpose circuits that carry out instructions at high speeds
- **Reduced instruction set computer** (RISC) – A chip with a bare-bones instruction set that results in a faster processing speed than CISC chips

Popular CPUs

Intel



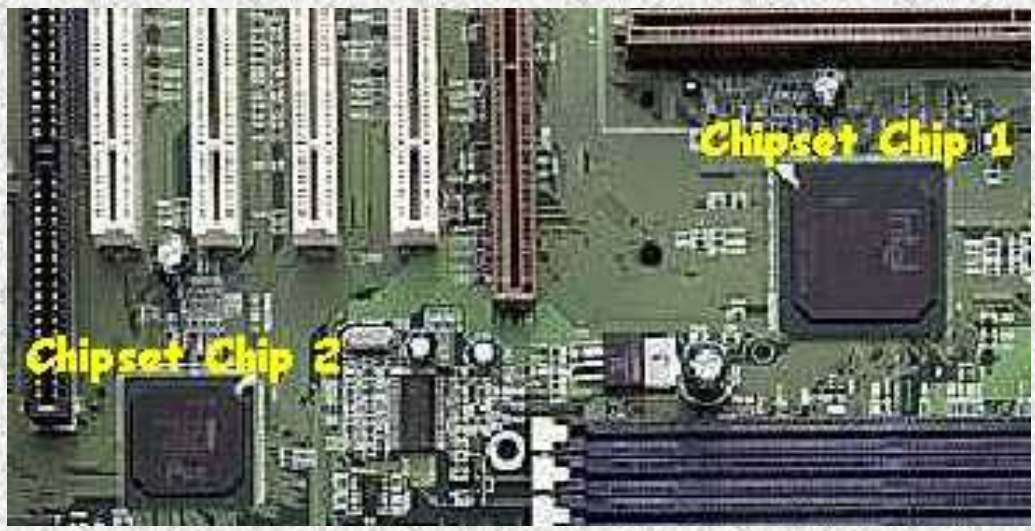
Advanced Micro Devices (AMD)



Cyrix

Motorola (Apple)

The Chipset

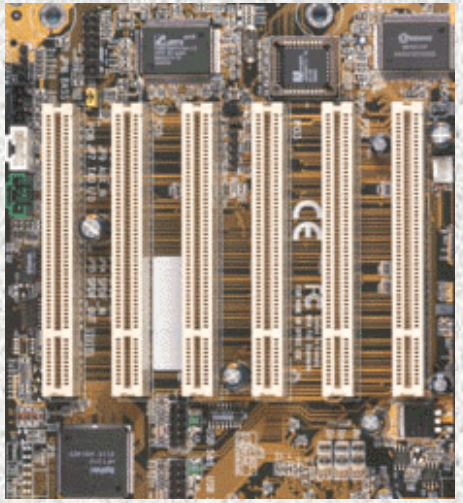


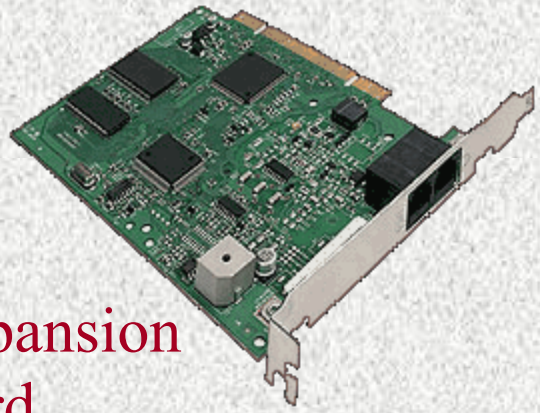
- ✓ A **chipset** is a collection of chips that provide the switching circuitry needed to move data throughout the computer

Input/Output Bus

- The **input/output bus** provides a pathway so that the microprocessor can communicate with input/output devices
- An input/output bus contains **expansion slots** which hold expansion cards
  - **PCI** (Personal Computer Interface) **slots** are receptacles in which expansion cards are inserted. They support Plug and Play (PnP) devices.

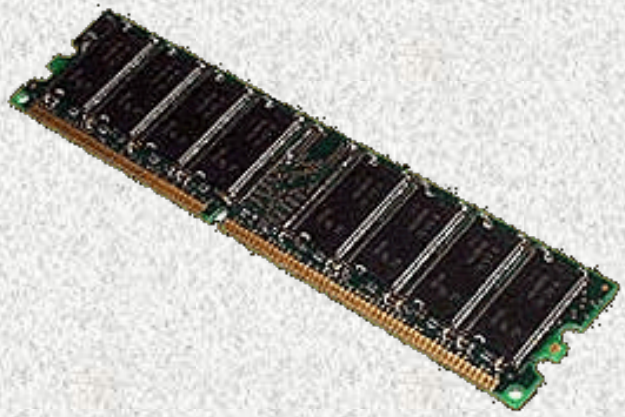
PCI slots





Expansion Card

Memory



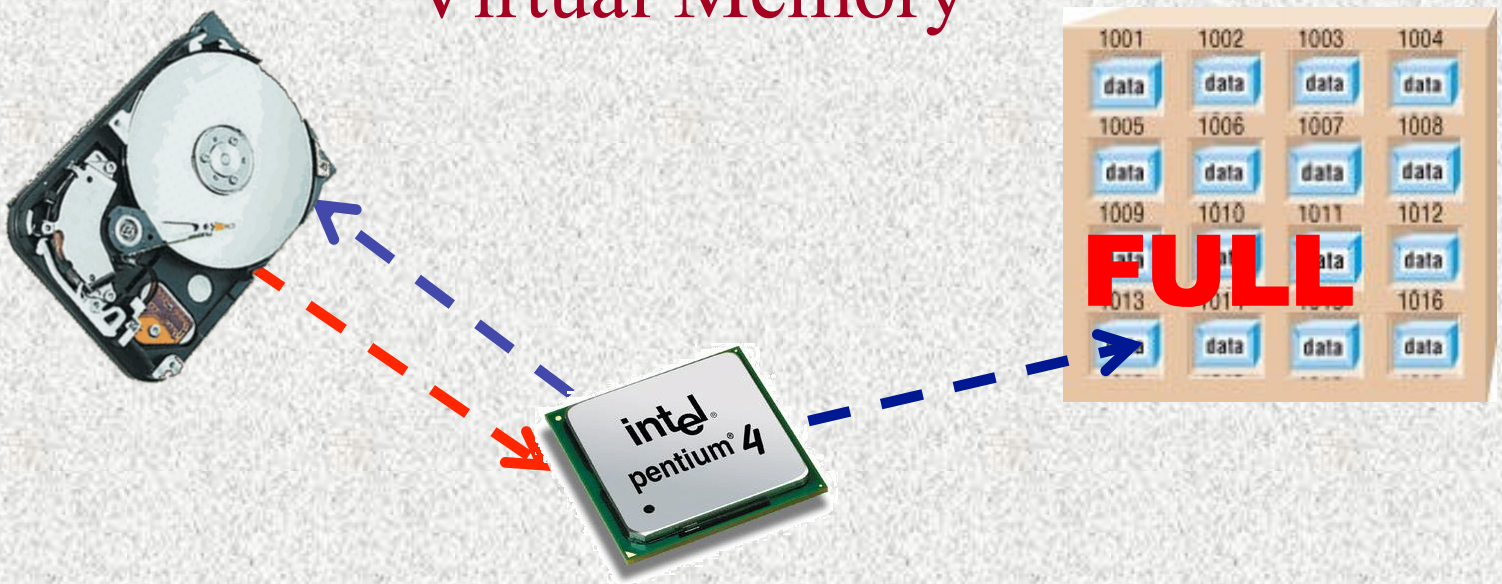
Random Access Memory (RAM)

Read-Only Memory (ROM)

Flash Memory

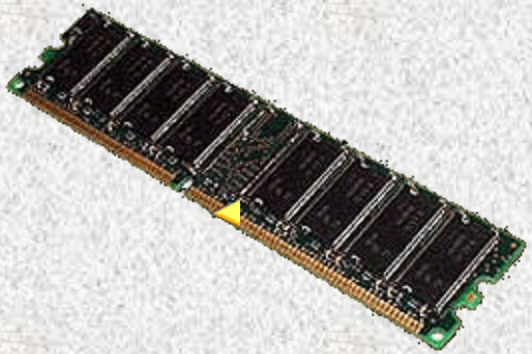
- ✓ **Memory** is the term used to describe devices that enable the computer to retain information. Program instructions and data are stored in memory chips for quick access by the CPU.

Virtual Memory



- Virtual memory:
  - Part of the hard disk is reserved as RAM
  - When RAM modules become full, the CPU accesses the hard disk to store and retrieve data
- ✓ Virtual memory is slower than RAM

Random Access Memory (RAM)



- **RAM** is a type of memory that stores information temporarily so that it's available to the CPU
- RAM is volatile; the memory's contents are erased when the power is turned off
- Each byte of memory has a unique location or **memory address**

Types of RAM

- **Dynamic RAM** (DRAM) – A memory chip that needs to be refreshed periodically or it will lose its data
  - **Synchronous DRAM** (SDRAM) is synchronized with the computer's system clock
  - **Rambus DRAM** (RDRAM) uses a fast bus to send and receive data within one clock cycle. It is faster than SDRAM
  - **Double data rate SDRAM** (DDR SDRAM) is a type of SDRAM that can send and receive data within one clock cycle

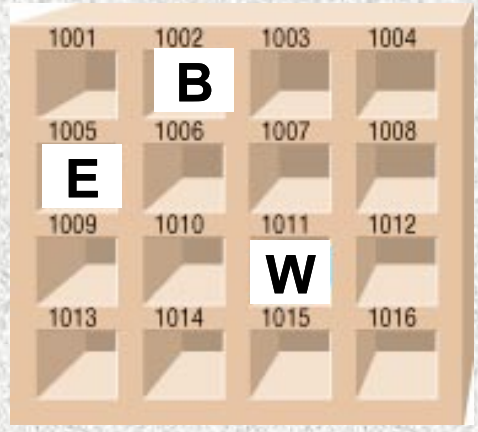
Processing a Word

MONITOR

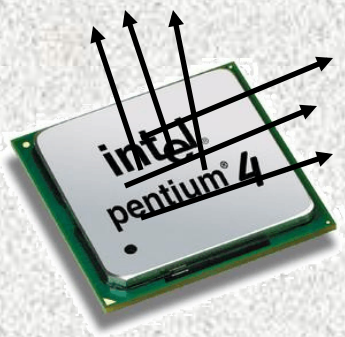
CLICK ONCE TO BEGIN ANIMATION

KEYBOARD

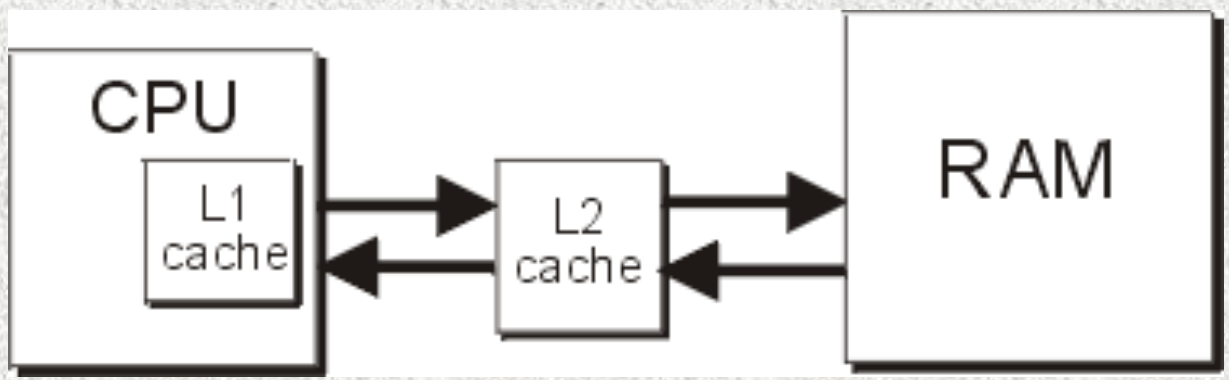
RAM



CPU

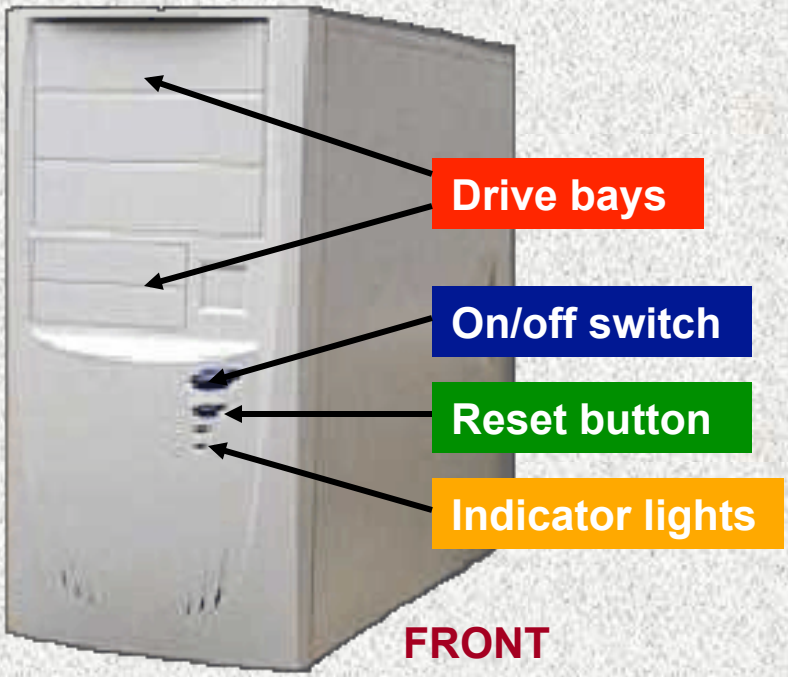


Cache Memory



- **Primary cache** (Level 1 or L1) – Located within the CPU chip, it is the memory that the microprocessor uses to store frequently used instructions and data
- **Secondary cache** (Level 2 or L2; Backside Cache) – Located near the CPU, it is the memory between the CPU and RAM
- Cache memory is faster than RAM

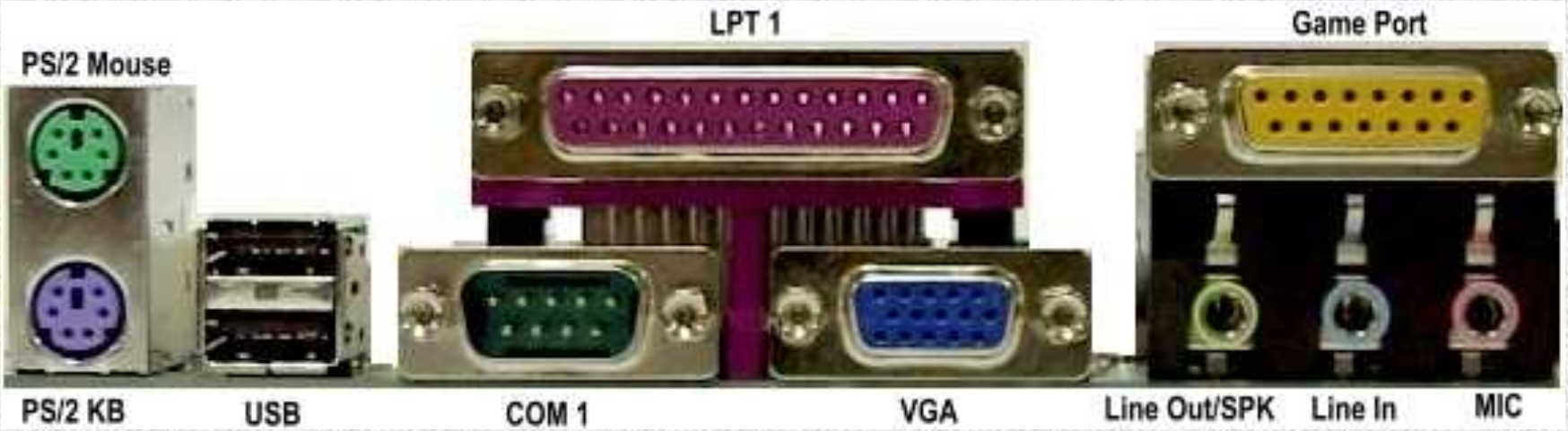
Outside the System Unit



- The **front panel** contains drive bays, various buttons, and indicator lights
- **Connectors and ports** are physical receptacles located on the back to connect peripheral devices to the computer

Types of Connectors

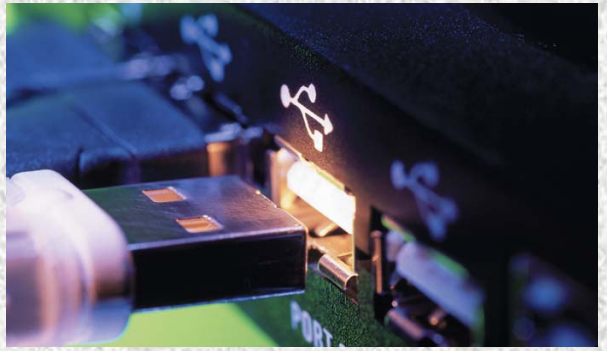
Point and click on a connector below to view information about it.
Click again to remove the text.



Sound card connectors – Also called jacks, sound card connectors accept stereo mini-plugs. Microphone, line-in, line-out, and speaker connectors are plugged into the card.

Other Types of Connectors

- ✓ Small computer system interface (**SCSI**) port – A parallel interface that enables up to eight devices to be connected to it
- ✓ 1394 (**FireWire**) port – A high-speed connection for up to 63 devices
- ✓ Infrared Data Association (**IrDa**) port – Infrared signals are used to communicate between peripheral devices and the system unit



Additional Ports and Connectors

- ✓ Telephone – modem interface
- ✓ Network – larger than telephone jack
- ✓ PC card slot – notebook computers have slot for PC cards
- ✓ Sound card connectors –
  - ➢ Mic – microphone input
  - ➢ Line In – input from audio devices
  - ➢ Line Out – output to another audio device
  - ➢ Speaker – output to external speakers
- ✓ TV/sound capture – turns computer into a TV tuner

Chapter 6 Summary

- The basic unit of information is the bit
- Large units of data are called kilobytes (KB), megabytes (MB), gigabytes (GB), and terabytes (TB)
- The system unit contains the motherboard, which is a circuit board that provides receptacles for chips and input/output buses
- The central processing unit (CPU) contains the control unit (CU) and the arithmetic-logic unit (ALU). It manages the four basic operations (fetch, decode, execute, and write-back).
- The CPU processes data in a four-step cycle called a machine cycle. The CU manages four basic operations: fetch, decode, execute, and store.

Chapter 6 Summary continued

- The CPU's performance is measured by the data bus width, operations per second, speed, and cache memory
- Random access memory (RAM) is the computer's main memory. It is volatile.
- There are various types of RAM, including dynamic RAM (DRAM), synchronous DRAM (SDRAM), Rambus DRAM (RDRAM), and double data rate (DDR) SDRAM
- Computers have ports such as serial ports, parallel ports, SCSI ports, USB ports, FireWire ports, and IrDA ports to connect input/output devices