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.
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

- 1000 bits = 1 kilobit (kb)
- 1,000,000 bits = 1 megabit (mb)
- 1,000,000,000 bits = 1 gigabit (gb)

**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

- 8 bits = 1 Byte
- 1024 Bytes = 1 Kilobyte (KB)
- 1,048,576 Bytes = 1 Megabyte (MB)
- 1,043,741,824 Bytes = 1 Gigabyte (GB)
- 1,099,511,627,776 Bytes = 1 Terabyte (TB)

- 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

```
0 0 1 1 0 1 0 0
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= 4

EBCDIC

```
1 1 1 1 0 1 0 0
```

= 4
**ASCII and EBCDIC Code**

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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
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 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 alphanumericalic 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

Pentium MMX

Pentium III

Pentium IV

Advanced Micro Devices (AMD)

Cyrix

Motorola (Apple)
A **chipset** is a collection of chips that provide the switching circuitry needed to move data throughout the computer.
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.
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:
- 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

KEYBOARD

CPU

RAM

CLICK ONCE TO BEGIN ANIMATION
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
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

- **PS/2 port (mouse port)** - Special serial port to connect mouse.
- **PS/2 port (keyboard port)** - Special serial port to connect keyboard.
- **Universal Serial Bus (USB)** - Allows up to 127 devices to be connected at a time.
- **Serial port** - Data flows in a series of pulses, one after another one bit at a time; slow data transfer rate.
- **Parallel port** - Data flows through eight wires allowing the transfer of eight bits of data simultaneously; faster than serial ports.
- **VGA connector** - A 15 pin connector used for monitors.
- **Game port** - A connector for high speed access for graphics-intensive interaction.
- **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.