Chapter 4
The Components of the System Unit

Chapter 4 Objectives
- Describe the components in the system unit
- Explain how the CPU uses the four steps of a machine cycle to process data
- Compare and contrast various personal computer processors on the market today
- Define a bit and describe how a series of bits represents data
- Differentiate among the various types of memory
- Explain the difference between a serial, a parallel, and a USB port
- Describe how buses contribute to a computer's processing speed
- Describe the types of expansion slots and cards in the system unit
- Identify components in a notebook computer
- Identify components in a handheld computer

The System Unit
- What is the system unit?
  - Box-like case that contains computer's electronic components
  - Sometimes called the chassis

- What are common components inside the system unit?
  - Processor
  - Memory module
  - Expansion cards
    - Sound card
    - Modem card
    - Video card
    - Network interface card
  - Ports and Connectors

- What is the motherboard?
  - Main circuit board in system unit
  - Contains chips, integrated circuits, and transistors
  - Also called system board

- What chip packages are available?
  - Dual inline package (DIP)
  - Single edge contact (SEC) cartridge
  - Flip-chip-PGA (FC-PGA) package
  - Pin grid array (PGA)
Central Processing Unit

What is the central processing unit (CPU)?
- Interprets and carries out basic instructions that operate a computer
- Also called the processor

CPU

Control Unit

Arithmetic/Logic Unit (ALU)

What are the components of the CPU?

What is the control unit?
- Directs and coordinates operations in computer

Control unit repeats four basic operations:
- Fetch - obtain program instruction or data item from memory
- Decode - translate instruction into commands
- Execute - carry out command
- Store - write result to memory

An example of a machine cycle
- Student enters math problem (100 x 52) into computer’s memory
- Result in memory displays on monitor’s screen

How is the CPU’s speed measured?
- According to how many millions of instructions per second (MIPS) it can process

Four operations of the CPU comprise a machine cycle
- Instruction time (i-time) - time taken to fetch and decode
- Execution time (e-time) - time taken to execute and store

Machine cycle

1. Fetch
2. Decode
3. Execute
4. Store
5. Directs and coordinates operations in computer

Four operations of the CPU comprise a machine cycle
- Execution time (e-time) - time taken to execute and store
- Instruction time (i-time) - time taken to fetch and decode

Execution time (e-time)

Instruction time (i-time)
What are two designs used for the CPU?

- **CISC** (complex instruction set computing)
  - Supports large number of instructions
  - CPU executes complex instructions more quickly

- **RISC** (reduced instruction set computing)
  - Supports smaller number of instructions
  - CPU executes simple instructions more quickly

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What is the arithmetic/logic unit (ALU)?

- CPU component that performs execution part of the machine cycle

- Arithmetic (addition, subtraction, multiplication, and division)
- Logical (AND, OR, NOT)
- Comparison (greater than, equal to, or less than)

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What is pipelining?

- CPU begins executing second instruction before completing first instruction
- Results in faster processing

**Machine Cycle (without pipelining)**

**Machine Cycle (with pipelining)**

- Instruction 1
- Instruction 2
- Instruction 3
- Instruction 4

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What is a register?

- Stores location from where instruction was fetched
- Stores data while ALU processes it
- Stores results of calculation
- Stores instruction while it is being decoded

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What is the system clock?

- Synchronizes all computer operations
- Each tick is clock cycle

- **MHz** - one million ticks of system clock
- **GHz** - one billion ticks of system clock

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What is a microprocessor?

- Single processor chip found in personal computers
How do personal computer processors compare?

One type is a floating-point coprocessor, also known as a math or numeric coprocessor.

What is parallel processing?
- Using multiple processors simultaneously to execute program faster
- Requires special software to divide problem and bring results together

What is the binary system?
- Number system with two unique digits: 0 and 1

How do computers represent data?
- Most computers are digital
- Recognize only two discrete states: on or off

What is a byte?
- Eight bits grouped together

8-bit byte for the number 3

8-bit byte for the number 5

8-bit byte for the capital letter T
What are three popular coding systems to represent data?

- **ASCII** - American Standard Code for Information Interchange
- **EBCDIC** - Extended Binary Coded Decimal Interchange Code
- **Unicode** - coding scheme capable of representing all world’s languages

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<table>
<thead>
<tr>
<th>ASCII</th>
<th>Symbol</th>
<th>EBCDIC</th>
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<tr>
<td>00100000</td>
<td>0</td>
<td>11110000</td>
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<tr>
<td>00100001</td>
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<td>11110001</td>
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<td>00100010</td>
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<td>00101101</td>
<td>D</td>
<td>11000011</td>
</tr>
<tr>
<td>00101110</td>
<td>E</td>
<td>11000100</td>
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How is a character sent from keyboard to computer?

1. Press letter T
2. Electronic signal for letter T sent to system unit
3. Signal changed to its ASCII code (01010100) and stored in memory
4. After processing, binary code for letter T is converted to image on output device

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How is memory measured?

- By number of bytes available

<table>
<thead>
<tr>
<th>Term</th>
<th>Abbreviation</th>
<th>Approximate Memory Size</th>
<th>Exact Memory Amount</th>
<th>Approximate Number of Pages of Text</th>
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<tbody>
<tr>
<td>Kilobyte</td>
<td>KB or K</td>
<td>1 thousand bytes</td>
<td>1,024 bytes</td>
<td>1/2</td>
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<tr>
<td>Megabyte</td>
<td>MB</td>
<td>1 million bytes</td>
<td>1,048,576 bytes</td>
<td>500</td>
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<tr>
<td>Gigabyte</td>
<td>GB</td>
<td>1 billion bytes</td>
<td>1,073,741,824 bytes</td>
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<tr>
<td>Terabyte</td>
<td>TB</td>
<td>1 trillion bytes</td>
<td>1,099,511,627,776 bytes</td>
<td>500,000,000</td>
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What is random access memory (RAM)?

- Memory chips that can be read from and written to by processor
- Most RAM is volatile
- The more RAM a computer has, the faster it operates
What are two basic types of RAM chips?

**Dynamic RAM (DRAM)**
- Most common type
- Also called main memory

**Static RAM (SRAM)**
- Used for special applications such as cache
- Faster and more reliable than DRAM chips

How much RAM is needed?
- Depends on type of applications you intend to run on your computer

What is cache?
- Helps speed computer processes by storing frequently used instructions and data
- Also called memory cache, cache store, or RAM cache
- L1 cache built in processor
- L2 and L3 cache not built in processor
- L2 advanced transfer cache most common

What is read-only memory (ROM)?
- Memory chips that contain data, instructions, or information that is recorded permanently

Data can only be read, cannot be modified in ROM

ROM is nonvolatile contents not lost when computer is turned off

BIOS (basic input/output system) stored on ROM sequence of instructions computer follows to load operating system and other files when you turn on the computer

Types of ROM

**Firmware**
- ROM chips manufactured with permanently written data, instructions, or information

**PROM**
- Programmable read-only memory
- Blank ROM on which you can place items permanently

**EEPROM**
- Electrically erasable programmable read-only memory
- Type of PROM containing microcode programmer can erase
What is flash memory?
- Nonvolatile memory that can be erased electronically and reprogrammed
- Used with handheld computers and digital cameras, cellular phones, and automobiles

What is CMOS?
- Complementary metal-oxide semiconductor memory
- Stores information about the computer
- Type of disk drives
- Keyboard
- Monitor
- Current time and date
- Uses battery to retain information when computer is turned off

What is memory access time?
- Speed at which processor can access data from memory directly
- Measured in nanoseconds (ns), which is one billionth of a second
- It takes 1/10 of a second to blink your eye; a computer can perform up to 10 million operations in the same amount of time

<table>
<thead>
<tr>
<th>TIME</th>
<th>ABBREVIATION</th>
<th>SPEED</th>
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<tr>
<td>Millisecond</td>
<td>ms</td>
<td>One-thousandth of a second</td>
</tr>
<tr>
<td>Microsecond</td>
<td>μs</td>
<td>One-millionth of a second</td>
</tr>
<tr>
<td>Nanosecond</td>
<td>ns</td>
<td>One-billionth of a second</td>
</tr>
<tr>
<td>Picosecond</td>
<td>ps</td>
<td>One-trillionth of a second</td>
</tr>
</tbody>
</table>

What is an expansion slot?
- An opening, or socket, where circuit board is inserted into motherboard
- Expansion card inserted in expansion slot

How are expansion cards used?
- Computer automatically can configure cards and other devices as you install them
What is a PC card?

- Credit card-sized device used to add capabilities to notebook computers
- PCMCIA - Personal Computer Memory Card International Association
- Uses include modem, additional memory, and storage

What is a flash memory card?

- Adds memory to handheld computers, digital music players, cellular telephones, and similar devices

What is a port?

- Connects external devices to system unit
- Types include:
  - Keyboard
  - USB
  - Mouse
  - Telephone line
  - Game port
  - Monitor
  - S-video out
  - Network
  - Telephone line in
  - Printer (parallel port)
  - Speaker
  - Microphone
  - Telephone line out
  - FM reception
  - Cable TV

What is a serial port?

- Transmits one bit of data at a time
- Used to connect slow-speed devices, such as mouse, keyboard, modem
- DB-9 female connector
- DB-9 male connector
- Byte representation for number 5: (00110101)
- Byte representation for number 1: (00110001)
- Byte representation for number 3: (00110011)

What is a parallel port?

- Connects devices that can transfer more than one bit at a time, such as a printer
- DB-25 male connector
- DB-25 female connector
- Byte representation for number 1: (00110001)
- Byte representation for number 3: (00110011)
**Ports**

What is a universal serial bus port (USB)?

- Connector that supports newer peripherals and plug and play
- Other popular ports include 1394, MIDI, SCSI, and IrDA

1394 port

USB ports

**Buses**

What is a bus?

- Channel that allows devices inside computer to communicate with each other
- System bus connects processor and RAM
- Bus width determines number of bits transmitted at one time
- Word size determines number of bits processor can interpret and execute at a given time

**Bays**

What is a bay?

- Open area inside system unit used to install additional equipment

**Power Supply**

What is a power supply?

- Converts alternating current (AC) to direct current (DC)
- Some peripheral devices have AC adapter

**Mobile Computers**

What is a mobile computer?

- Notebook, which weighs between 2.5 and 8 pounds, or handheld
What ports are on a notebook computer?

- keyboard/mouse port
- IrDA port
- serial port
- parallel port
- video port
- USB port

How is data transferred from a handheld computer?

- An IrDA port allows the handheld computer to communicate wirelessly with other computers or devices.
- Handheld computers also can rest in a cradle, so you can transfer data to your desktop computer.

What are suggested processor, clock speed, and RAM requirements based on the needs of various types of users?

- Small Office/Home Office: Pentium® III or AMD-K6®-2-P 500 MHz or higher, 64 MB RAM
- Large Business: Pentium® 4 or Athlon™ 700 MHz or higher, 128 MB RAM
- Pentium® 4 or Itanium™ or Athlon™ 1 GHz or higher, 256 MB RAM

Summary of the Components of the System Unit

- The system unit
- Central processing unit
- Data representation
- Memory
- Expansion slots and expansion cards
- Ports, buses, bays
- Power supply
- Mobile computers

Chapter 4 Complete