Computers Are Your Future
Eleventh Edition

Chapter 2: Inside the System Unit

11th Edition

Computers Are Your Future

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Inside the System Unit

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Objectives

- Understand how computers represent data.

- Understand the measurements used to describe data transfer rates and data storage capacity.

- List the components found inside the system unit and explain their use.

Objectives

- List the components found on the computer's motherboard and explain their role in the functioning of the computer's systems.

- Discuss (in general terms) how a CPU processes data.

- Explain the factors that determine a microprocessor's performance.

Objectives

- List the various types of memory found in a computer system and explain the purpose of each.

- Describe the various physical connectors on the exterior of the system unit and explain their use.

How Computers Represent Data

- Computers work with **binary numbers**, which include only 0s and 1s.

- The smallest piece of data a computer can work with is known as a **bit**.
  - A bit is either "on" or "off," a 0 or a 1.
  - Eight bits, a **byte**, signify a single unit of storage.

How Computers Represent Data

- The common measurement of a modem's data transfer rate is in bits per second, such as gigabits per second (Gbps).

- The common measurement of data storage is in bytes, such as gigabytes (GB).

How Computers Represent Data

- **Characters** (letters, numbers, and symbols) are converted into numbers the computer understands.
- **Character code** performs this conversion.
- Three main types of character coding are:
  - American Standard Code for Information Interchange (ASCII)
  - Extended Binary Coded Decimal Interchange Code (EBCDIC)
 - Unicode

Introducing the System Unit

- The **system unit** is the case that contains the major hardware components of a computer.

- System units come in different styles and have varying **footprints**—the amount of space that the unit uses.

Introducing the System Unit

- Some units have embedded biometric authentication devices.

- System units vary in their **form factor**, which specifies how the internal components are located within the system unit.

Inside the System Unit

a. System unit

b. System unit

c. System unit
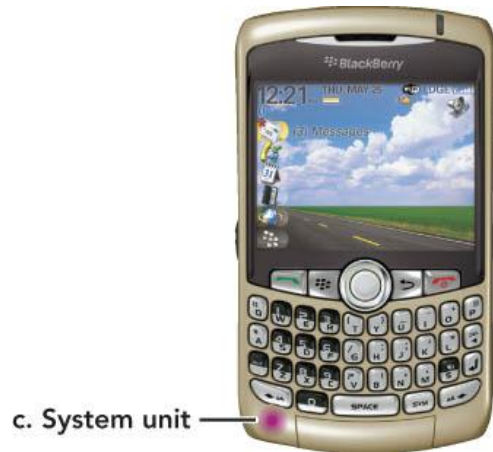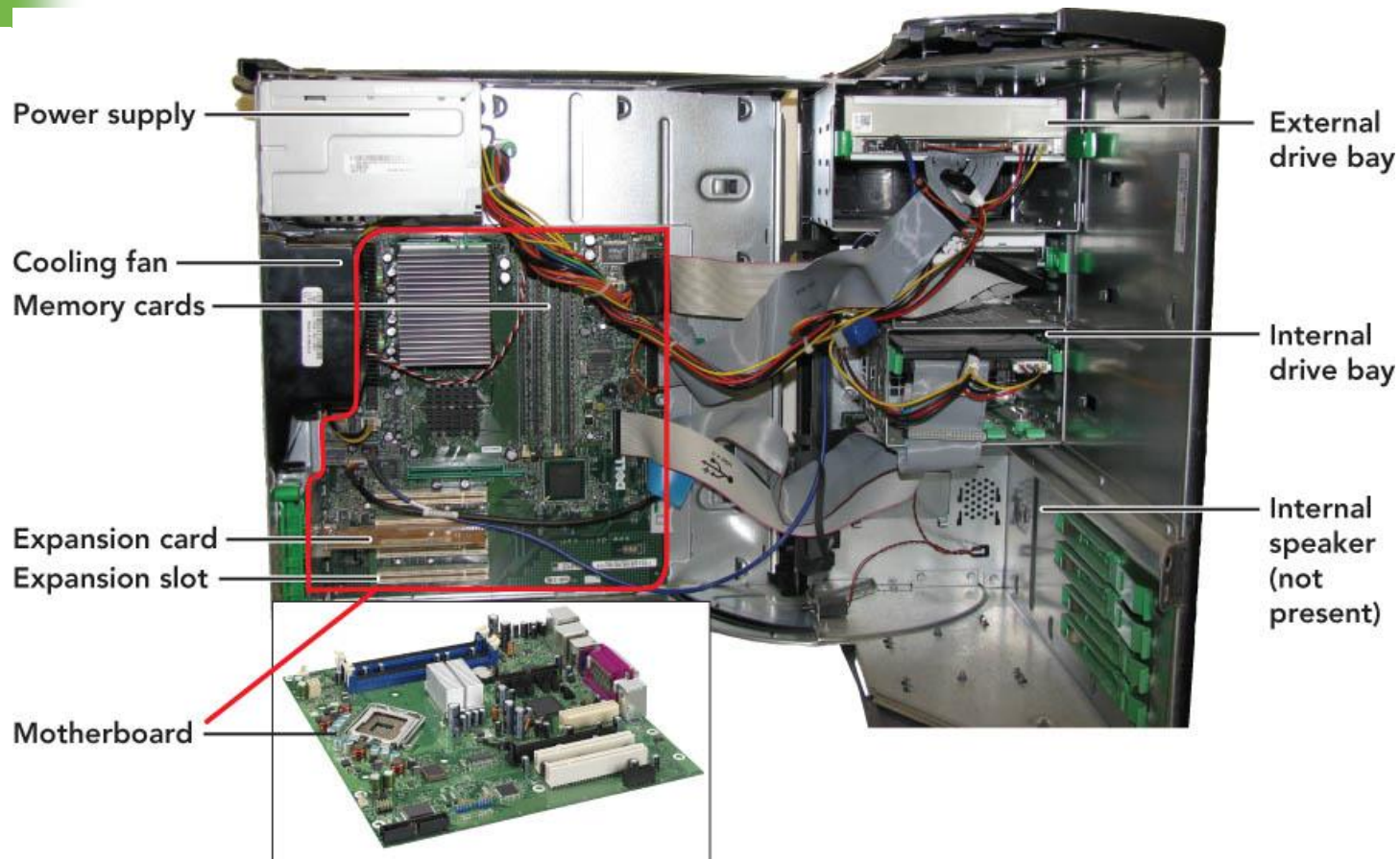
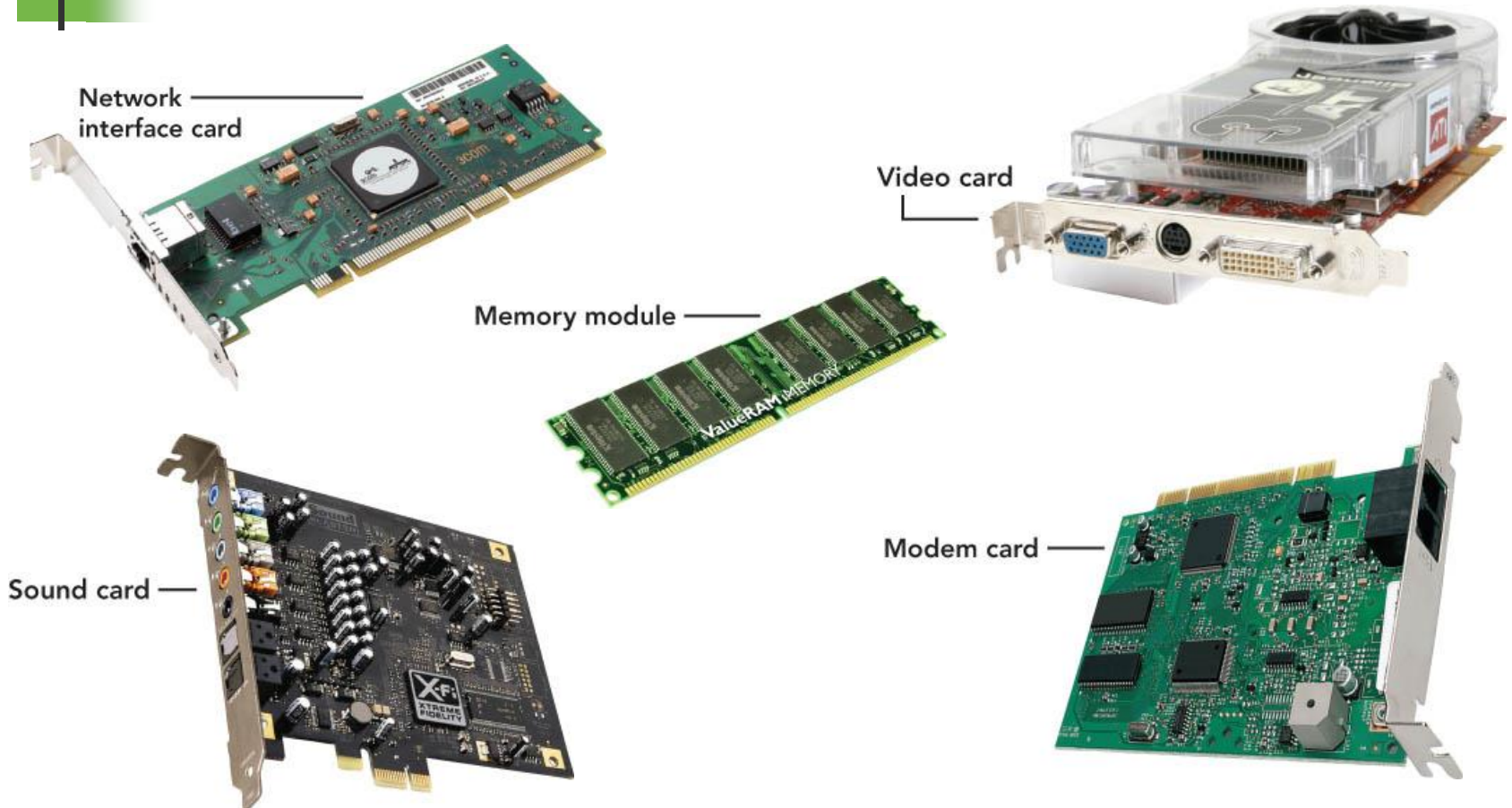d. System unit

Inside the System Unit

- System unit main components
  - Motherboard
  - CPU
  - Power supply
  - Cooling fan
  - Internal speaker
  - Drive bays
  - Expansion slots

Inside the System Unit

Power supply

Cooling fan

Memory cards

Expansion card

Expansion slot

Motherboard

External drive bay

Internal drive bay

Internal speaker (not present)

Inside the System Unit

Network interface card

Video card

Memory module

Sound card

Modem card

What's on the Motherboard?

- The **motherboard** is the printed circuit board that contains the electrical circuitry for the computer.
- The majority of parts found on the motherboard are integrated circuits.
  - An **integrated circuit (or chip)** includes millions of transistors and carries electrical current.
  - A **transistor** is a switch that is able to control the electrical signal flow to the circuit.

What's on the Motherboard?

- The integrated circuit chip that processes electronic signals is called the **central processing unit (CPU)**.

- The CPU is also known as a **microprocessor** or **processor.**

What's on the Motherboard?

- Each operation performed by the CPU is assigned a specific number, called an **instruction**.

- An **instruction set** is the list of CPU instructions for the operations that it performs.
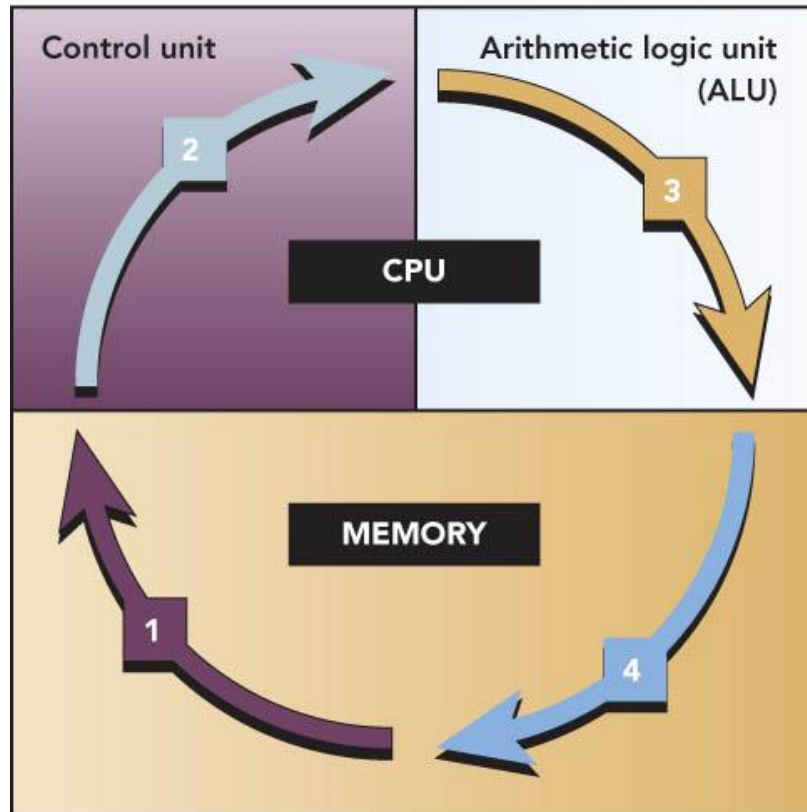
What's on the Motherboard?

- The two main parts of the CPU are the control unit and the arithmetic logic unit.
    - The **control unit** retrieves instructions from memory and interprets and performs those instructions.
    - The control unit manages the **machine cycle** or **processing cycle**, the four-part process performed by the CPU.

What's on the Motherboard?

- The control unit manages four operations:
  - **Fetch**: Retrieves program instructions
  - **Decode**: Determines what the program is telling the computer to do
  - **Execute**: Performs the requested action
  - **Store**: Stores the results to an internal register

What's on the Motherboard?

What's on the Motherboard?

- The **arithmetic logic unit (ALU)** performs arithmetic and logical operations.
  - **Arithmetic operations** involve adding, subtracting, multiplying, and dividing.
  - **Logical operations** involve comparisons between two or more data items.
- **Registers** store data when it must be temporarily stored in the CPU.

What's on the Motherboard?

- Factors that affect the performance of a CPU include:
  - The number of existing transistors
  - Data bus width and word size
  - Clock speed
  - Operations per microprocessor cycle
  - Use of parallel processing
  - Type of chip

What's on the Motherboard?

- A **data bus** is the group of parallel wires that connect the CPU's internal components.
  - Data bus width is measured in bits.
  - The maximum number of bits the CPU can process at once is called the **word size**.
  - Word size determines which operating systems and software a CPU can run.
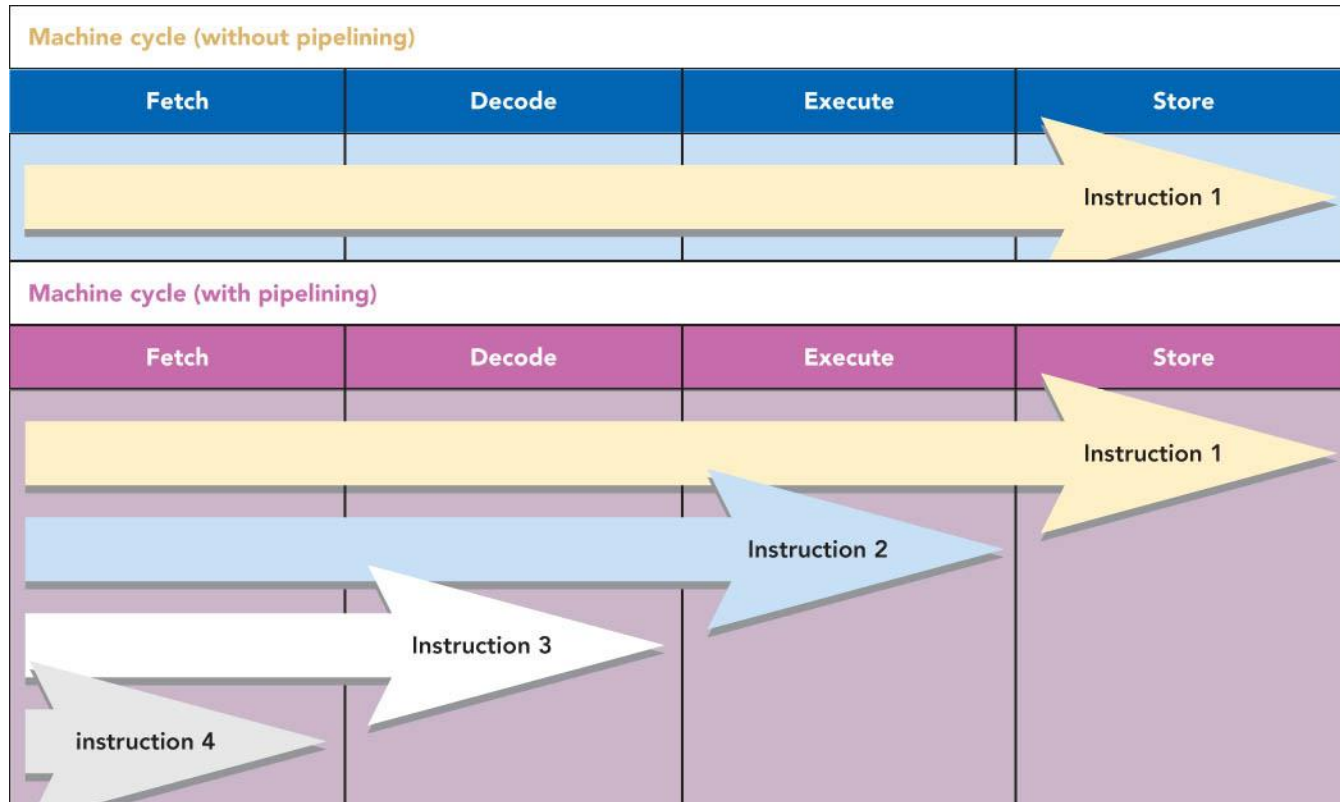
What's on the Motherboard?

- The **system clock** is an electronic circuit that produces rapid pulses and coordinates the computer's internal activities.

  - **Clock speed** is the measurement of the electrical pulses generated by the system clock and is usually measured in gigahertz (GHz).

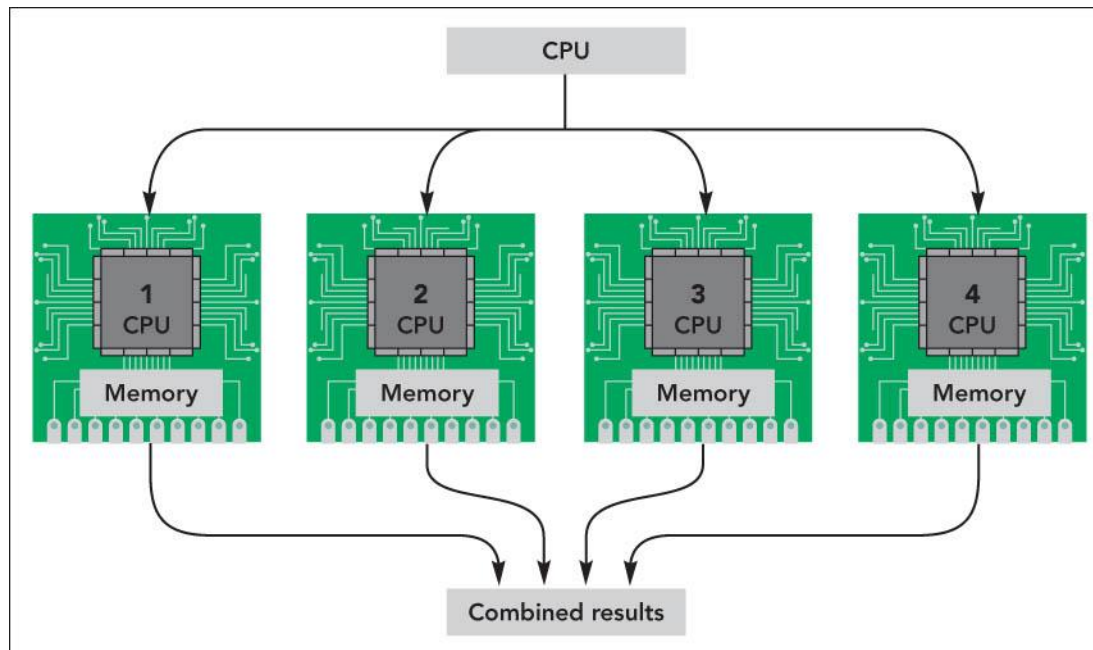 - In general, the higher the clock speed, the faster the computer.

What's on the Motherboard?

- The number of operations per tick of the system clock affects microprocessor performance.

  - **Superscalar architecture** enables the CPU to perform more than one instruction for each clock cycle.

  - **Pipelining** enables the CPU to process more than one instruction at a time, which improves CPU performance.

What's on the Motherboard?

Machine cycle (without pipelining)			
Fetch	**Decode**	**Execute**	**Store**
			Instruction 1

Machine cycle (with pipelining)			
Fetch	**Decode**	**Execute**	**Store**
			Instruction 1
		Instruction 2	
	Instruction 3		
instruction 4			

What's on the Motherboard?

- **Parallel processing** is a method in which more than one processor performs at the same time, resulting in faster processing.

What's on the Motherboard?

- The set of chips that collectively supply the switching circuitry the CPU requires to move data throughout the computer is called the **chipset**.

  - The CPU and the input/output bus are linked through the chipset.

 - The **input/output (I/O) bus** provides a means to communicate with input and output devices.

What's on the Motherboard?

- **Random access memory (RAM)**
  - Temporarily stores data and instructions to be used by the central processing unit
  - Is considered volatile because its contents are erased when the computer is shut off
  - Permits the CPU to access or store data and instructions quickly through RAM's **memory address** feature, which is a way to identify and locate stored data

What's on the Motherboard?
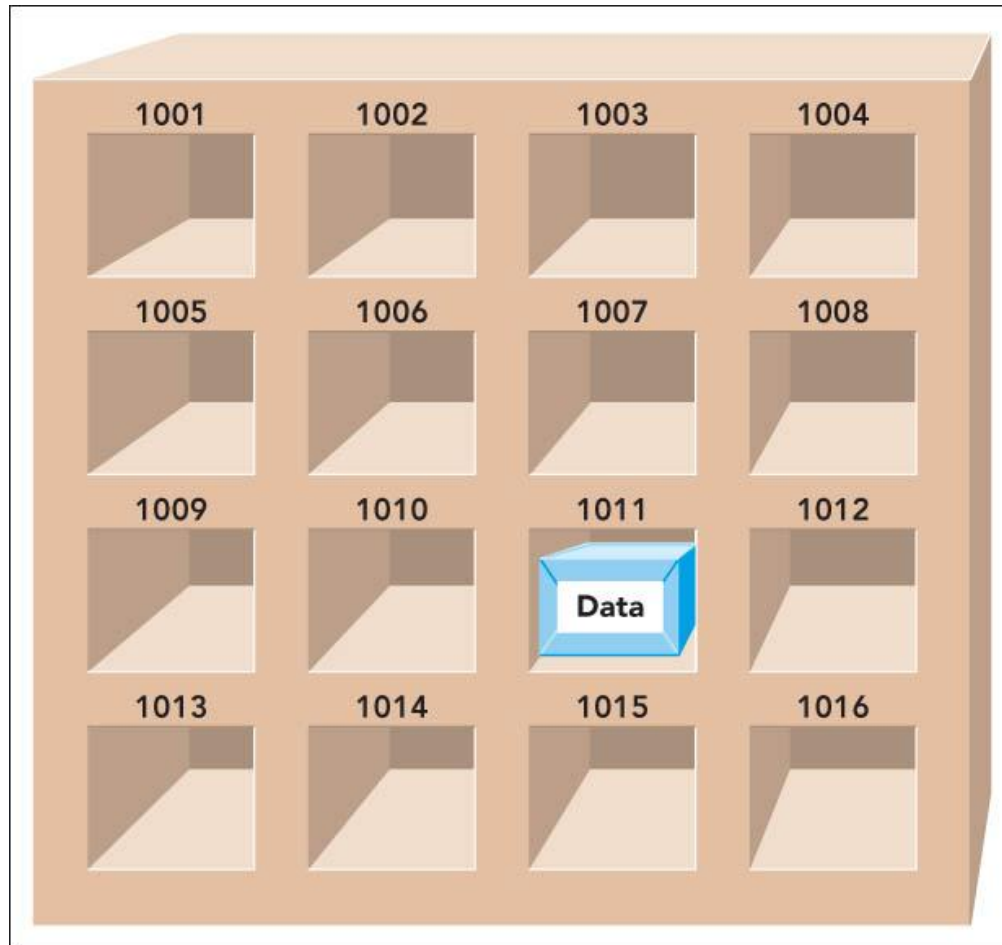
What's on the Motherboard?

- **Read-only memory (ROM)**
  - Contains prerecorded instructions used to start the computer
  - Is considered nonvolatile because its contents are are stored when CPU power is turned off
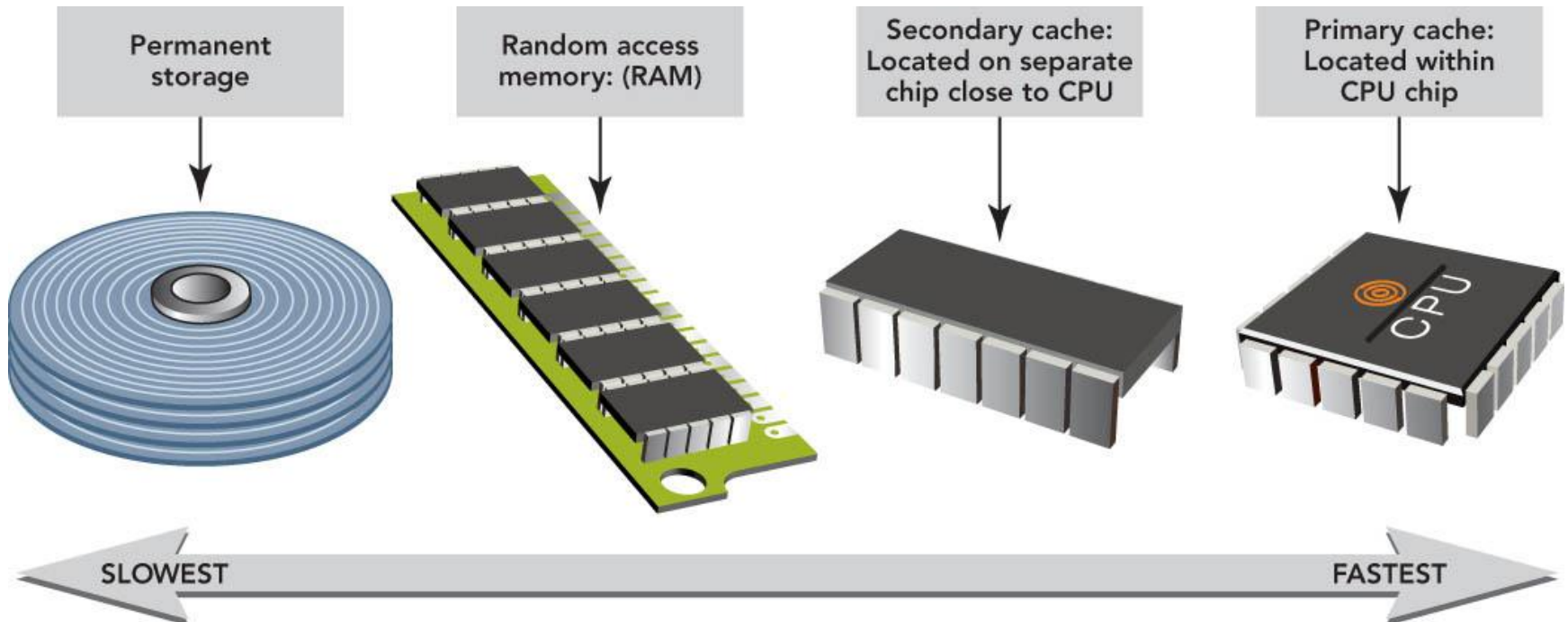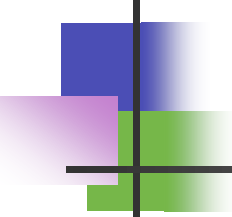
What's on the Motherboard?

- **Cache memory**
  - Is a small unit of fast memory built into the processor to improve performance
  - Is more expensive than RAM
  - Comes in two types:
    - **Primary cache**, found in the microprocessor chip
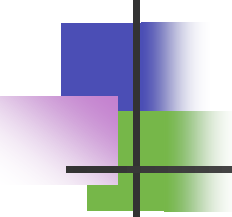   - **Secondary cache**, located on the circuit board

What's on the Motherboard?

Permanent storage

Random access memory: (RAM)

Secondary cache: Located on separate chip close to CPU

Primary cache: Located within CPU chip

CPU

SLOWEST → FASTEST
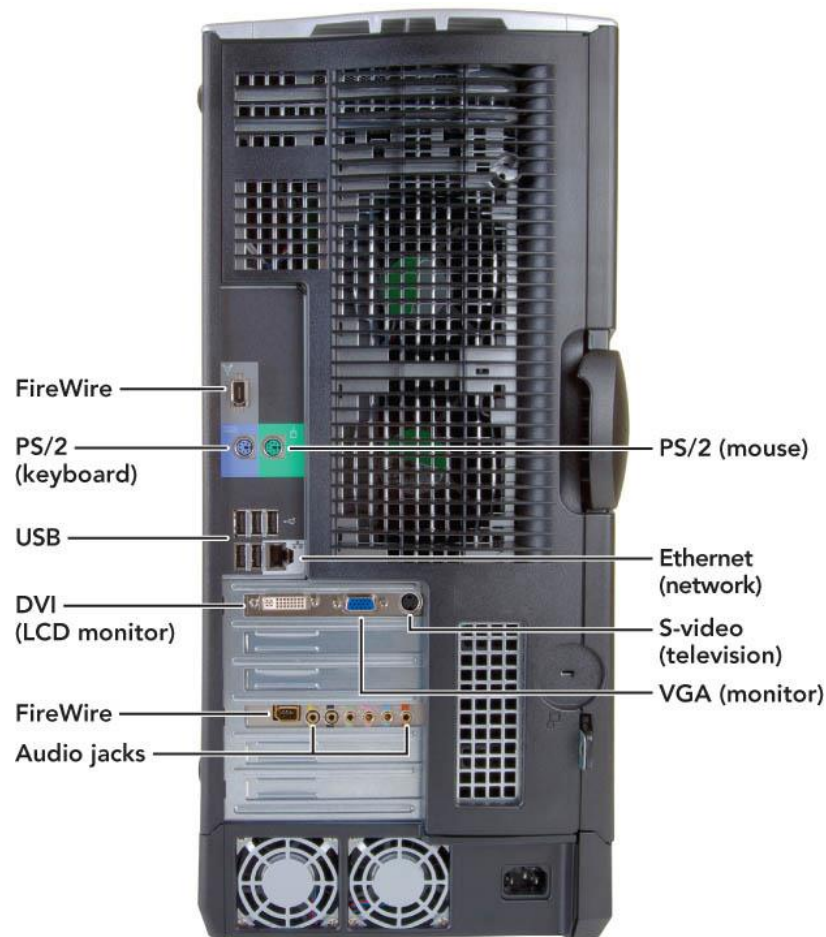
What's on the Outside of the Box?

- The front panel includes:
  - The **power switch**, which is used to turn the computer on
  - The **drive activity light**, which advises the user that the hard drive is retrieving data
  - The **power-on light**, which shows whether or not the power is on

What's on the Outside of the Box?

- Other features on the outside of a system unit:
  - A **port** is an interface used to send data into and retrieve data from the computer. An example is a USB port.
  - A **connector** is a physical receptacle where the user can plug a peripheral device into the computer. An example is a telephone jack.

What's on the Outside of the Box?

FireWire

PS/2 (keyboard)

USB

DVI (LCD monitor)

FireWire

Audio jacks

PS/2 (mouse)

Ethernet (network)

S-video (television)

VGA (monitor)

What's on the Outside of the Box?

Different devices use different connectors.

Connector	Use	Connector	Use
Current Technologies		**Legacy Technologies**	
USB	many devices including mice, keyboards, printers, external hard drives, digital cameras, and USB drives	Serial	dial-up modems, mice, scanners, or printers
FireWire	digital cameras and digital video camcorders	Parallel	printers, external storage devices, or scanners
VGA	analog video and CRT monitors	PS/2	mice and keyboards
DVI	digital video and LCD monitors	SATA	interface
S-Video	analog video for TVs		
RJ-11	phone line		
Ethernet/RJ-45	network connections and cable modems		
Audio/Video	microphones, speakers, or headphones		

Chapter Summary

- Computers work with binary numbers, which include only 0s and 1s.

- The smallest piece of data a computer can work with is known as a bit; eight bits equal a byte. Bytes are used to represent a character.

Chapter Summary

- Data transfer rates for communication devices (modems) are measured in bits per second.

- Data storage is measured in bytes.

- The system unit's main circuit board is the motherboard, to which the processor, memory, circuits, and other computer components are connected.

Chapter Summary

- Other elements of the system unit include the power supply, cooling fan, internal speaker, drive bays, and expansion cards.

Chapter Summary

- The CPU is made up of the control unit and the ALU.

- The control unit manages the four-step machine cycle: fetch, decode, execute, and store.

- The ALU performs calculations and logical operations.

Chapter Summary

- Factors that influence the performance of the CPU include the data bus width, clock speed, pipelining, and parallel processing.

Chapter Summary

- Main memory, RAM, is volatile. It temporarily holds programs, data, and instructions.

- ROM, which is nonvolatile, contains prerecorded computer start-up instructions.

- Cache memory is additional CPU memory that operates at very fast speeds.

Chapter Summary

- Computers use ports, such as a USB port, to send and retrieve computer data.

Quiz

1. List the four operations of the processing cycle and provide a brief description of their function.

2. What is the difference between registers and primary cache?

3. List three to five factors that affect the performance and speed of a computer.

4. What is the difference between pipelining and parallel processing?