

ISD100-Introduction to Systems & Informatics

Hardware and Mobile Devices

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Outline

- Anatomy of a Computer.
- Computer Systems.
- Hardware Components in Action.
- Processing and Memory Devices.
- Memory Characteristics and Functions.
- Types of Memory.
- Enterprise Storage Options.
- Input and Output Devices.
- Computer System Types.

Anatomy of a Computer

- Computer system hardware components include devices that perform input, processing, data storage, and output.
- These include the processor, memory, and input/output devices.

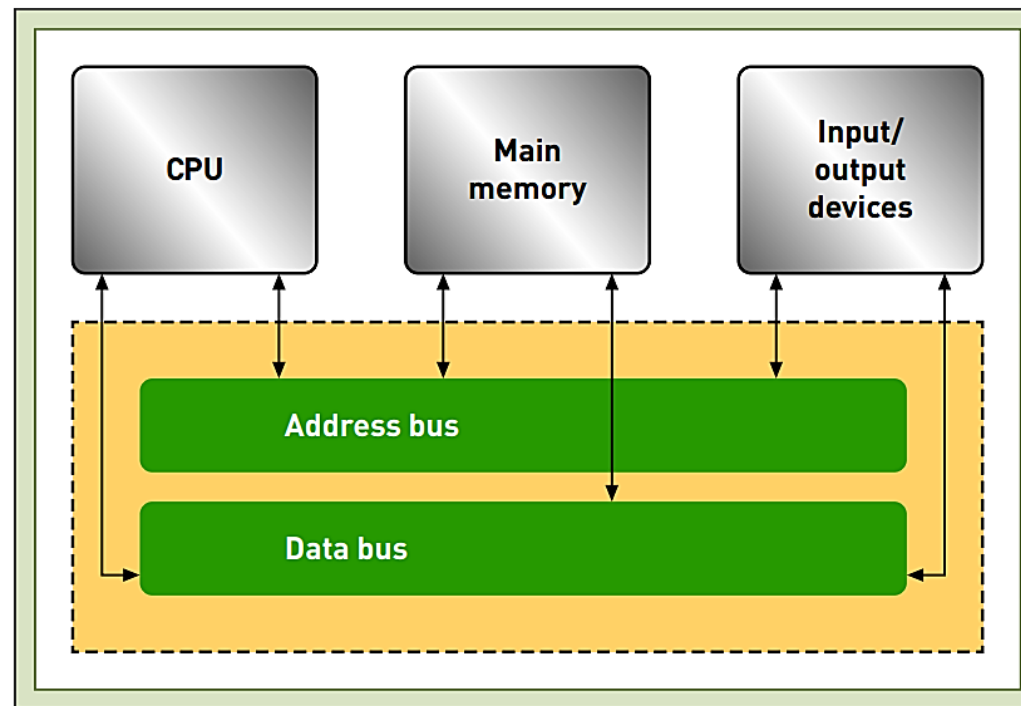


FIGURE 3.1
Basic anatomy of a computer
Computer hardware components include the processor (CPU), memory, address and data bus, and input/output devices.

Why Learn About Hardware

➤ Hardware:

- Any machine that assists in the input, processing, storage, and output activities of an information system.

➤ When making hardware decisions, businesses must consider how the hardware can support:

- Objectives of the information system.
- Goals of the organization.

Computer Systems: Integrating the Power of Technology

➤ Hardware components:

— Central processing unit (CPU)

- Arithmetic/logic unit, the control unit, and the register areas.

— Arithmetic/logic unit (ALU)

- Performs mathematical calculations and makes logical comparisons.

— Control unit

- Sequentially accesses program instructions, decodes them, and coordinates the flow of data in and out of the ALU, registers, primary storage, and even secondary storage and various output devices.

Computer Systems: Integrating the Power of Technology

- Registers:
 - High-speed storage areas.
- Primary storage:
 - Closely associated with the CPU.

Hardware Components in Action

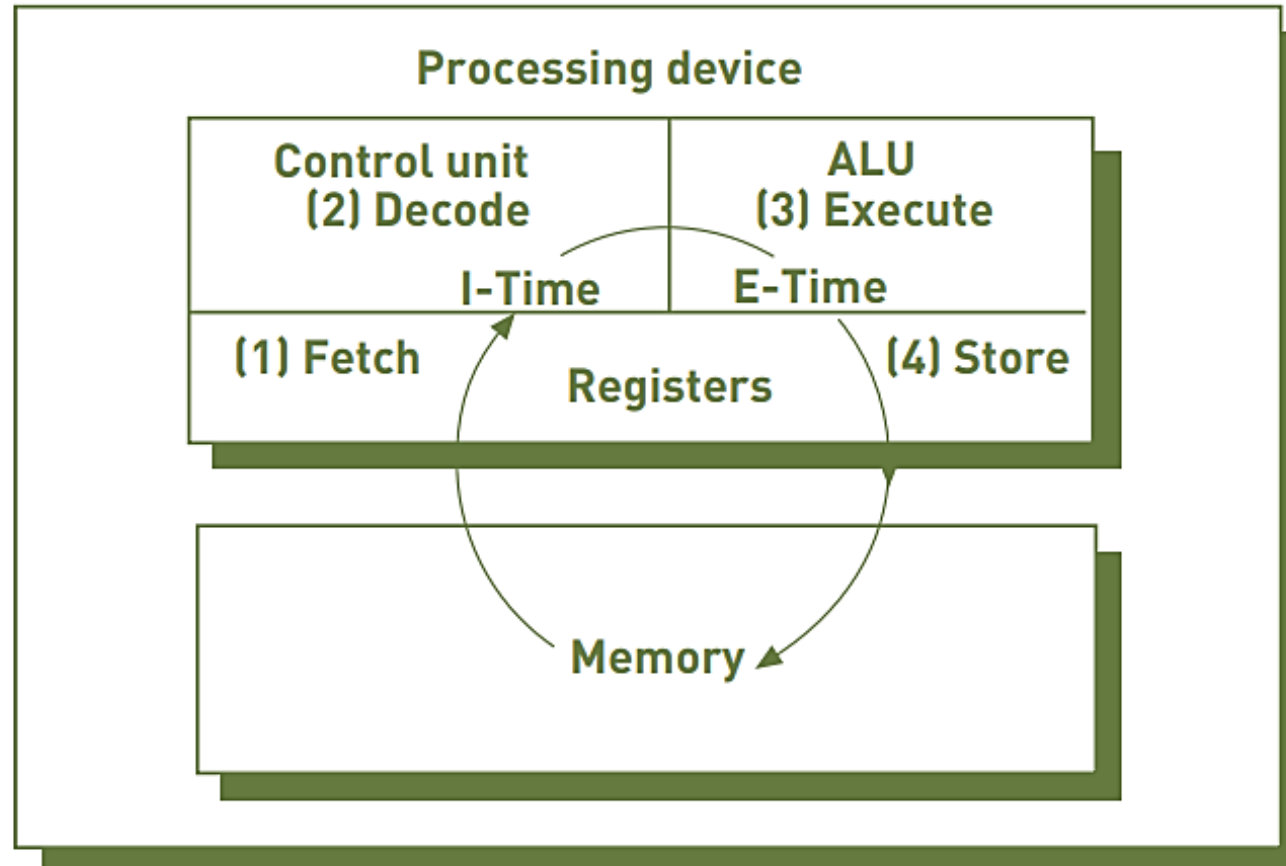
- Step 1: Fetch instruction.
- Step 2: Decode instruction.
- Step 3: Execute instruction.
- Step 4: Store results.

Hardware Components in Action

FIGURE 3.2

Execution of an instruction

(1) In the instruction phase, a program's instructions and any necessary data are read into the processor. (2) The instruction is then decoded by the control unit of the CPU so that the central processor can understand what to do. (3) In the execution phase, the arithmetic and logic unit (ALU) component of the CPU does what it is instructed to do, making either an arithmetic computation or a logical comparison. (4) The results are then stored in the registers or in memory. The instruction and execution phases together make up one machine cycle.



Processing and Memory Devices: Power, Speed, and Capacity

- System unit
 - Houses the components responsible for processing (the CPU and memory).
- All other computer system devices are linked either directly or indirectly into the system unit housing.

Processing Characteristics and Functions

- Machine cycle time is measured in:
 - Nanoseconds (1 billionth of a second).
 - Picoseconds (1 trillionth of a second).
 - MIPS (Millions of instructions per second).

Physical Characteristics of the CPU

- Digital circuits on chips.
- Electrical current flows through silicon.

Memory Characteristics and Functions

➤ Main Memory:

- Located physically close to the CPU, but not on the CPU chip itself.
- Rapidly provides data and instructions to the CPU.

➤ Storage Capacity:

- Eight bits together form a byte (B).

Memory Characteristics and Functions

Name	Abbreviation	Number of Bytes
Byte	B	1
Kilobyte	KB	1,000
Megabyte	MB	$1,000^2$
Gigabyte	GB	$1,000^3$
Terabyte	TB	$1,000^4$
Petabyte	PB	$1,000^5$
Exabyte	EB	$1,000^6$
Zettabyte	ZB	$1,000^7$
Yottabyte	YB	$1,000^8$

Types of Memory

➤ Random access memory (RAM):

- Temporary and volatile.

➤ Types of RAM:

- DRAM (Dynamic RAM).
- DDR2 SDRAM and DDR3 SDRAM.
- SRAM (Static RAM).
- Double Data Rate Synchronous Dynamic RAM (DDR SDRAM).

Types of Memory

➤ Read only memory (ROM):

- Nonvolatile.
- Provides permanent storage for data and instructions that do not change.

➤ Cache memory:

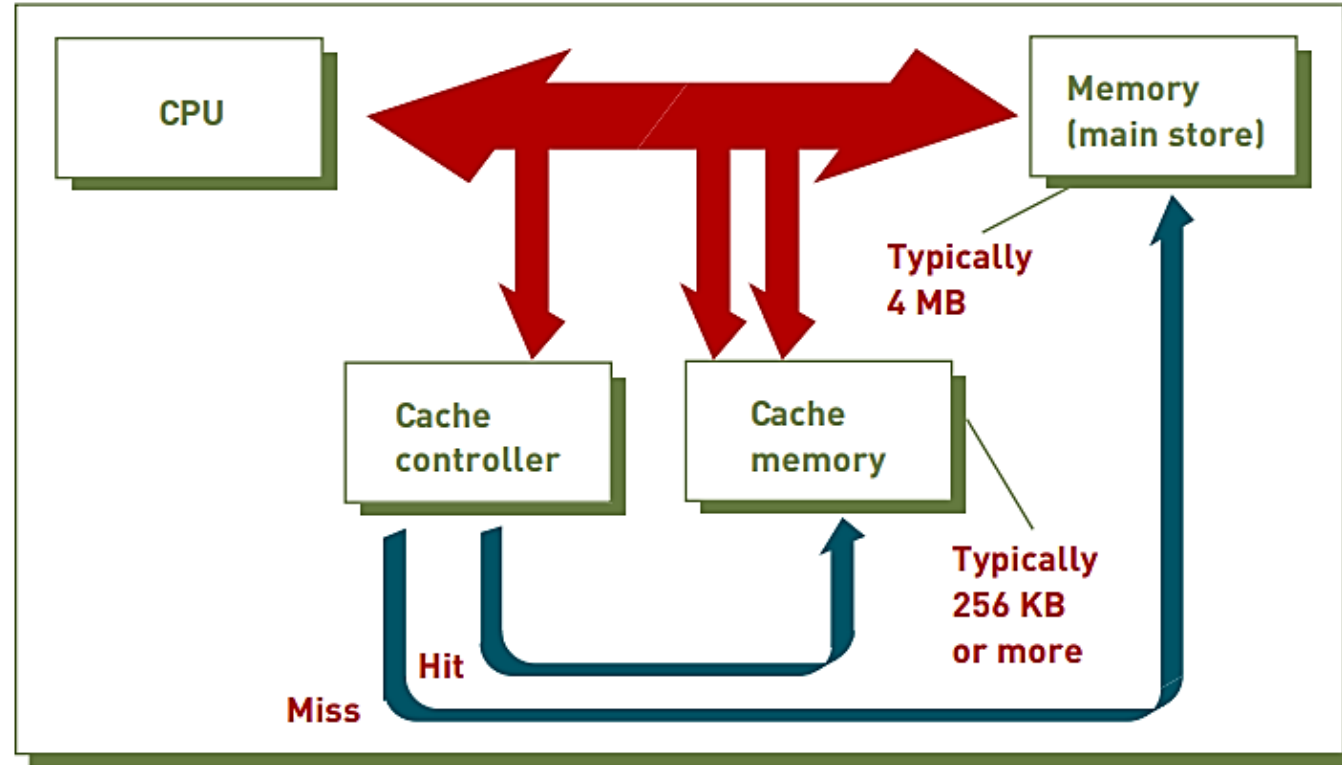
- High speed memory that a processor can access more rapidly than main memory.

Types of Memory

FIGURE 3.3

Cache memory

Processors can access this type of high-speed memory faster than main memory. Located on or near the CPU chip, cache memory works with main memory. A cache controller determines how often the data is used, transfers frequently used data to cache memory, and then deletes the data when it goes out of use.



Multiprocessing

- Multiprocessing:
 - Simultaneous execution of two or more instructions at the same time.
- Coprocessor:
 - Speeds processing.
- Multicore microprocessor:
 - Combines two or more independent processors into a single computer.

Parallel Computing

- Parallel computing:
 - Simultaneous execution of the same task on multiple processors to obtain results faster.
- Massively parallel processing:
 - Systems with thousands of such processors.
- Grid computing:
 - Use of a collection of computers to work in a coordinated manner to solve a common problem.

Parallel Computing

➤ Cloud computing:

- Uses a giant cluster of computers, that serves as a host, to run applications that require high-performance computing.
- Supports a wider variety of applications than grid computing.
- Pools computing resources so they can be managed primarily by software rather than people.

Secondary Storage

- Compared with memory, offers the advantages of nonvolatility, greater capacity, and greater economy.
- On a cost-per-megabyte basis:
 - Most forms of secondary storage are considerably less expensive than primary memory.
- Storage media that allow faster access:
 - Generally more expensive than slower media.

Access Methods

➤ Sequential access:

- Records must be retrieved in order in which it is stored.
- Devices used called sequential access storage devices (SASDs).

➤ Direct access:

- Records can be retrieved in any order.
- Devices used are called direct access storage devices (DASDs).

Devices

- Magnetic tapes
- Magnetic disks
- RAID
- Virtual tape
- Optical disks
- Digital video disk (DVD)
- Holographic versatile disk (HVD)

Enterprise Storage Options

- Attached storage
- Network-attached storage (NAS)
- Storage area network (SAN)

Enterprise Storage Options

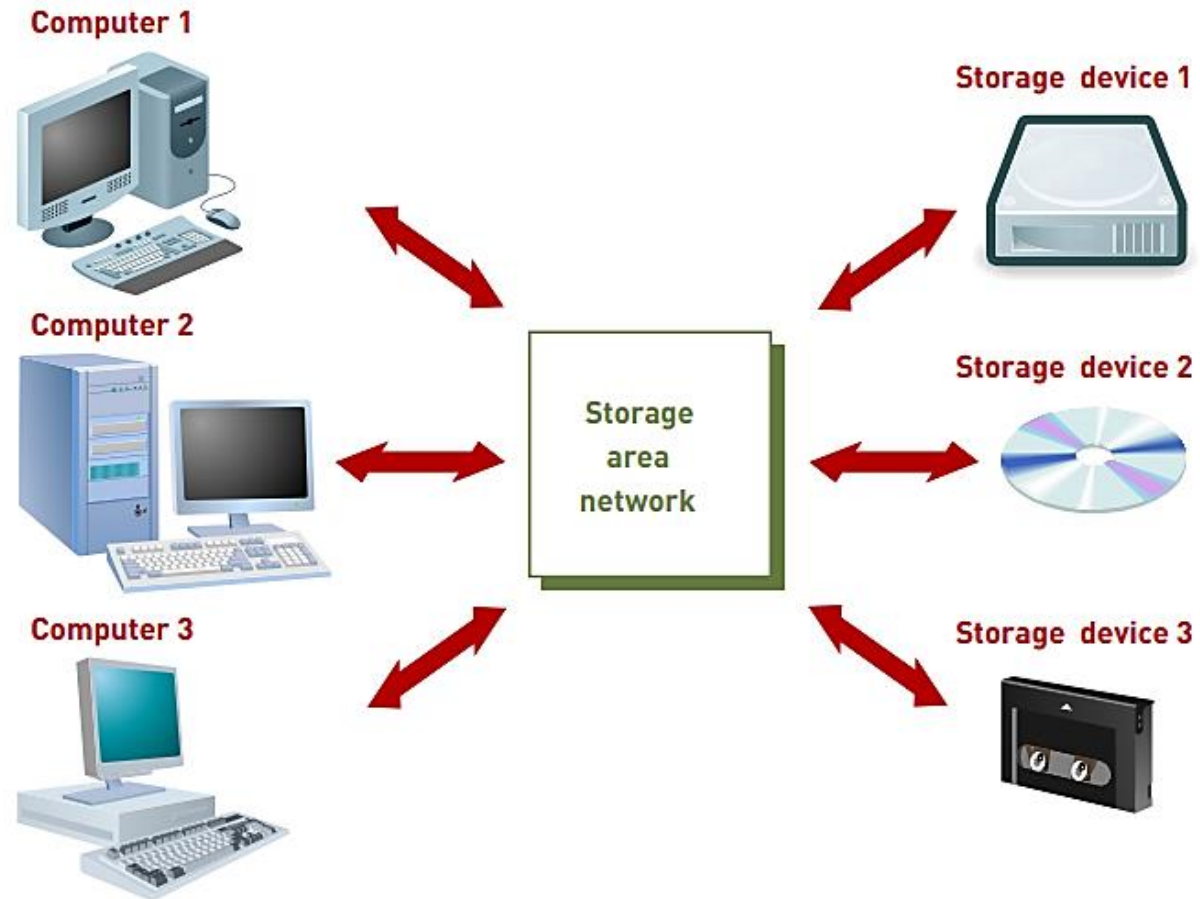


FIGURE 3.7

Storage area network

A SAN provides high-speed connections among data storage devices and computers over a network.

Input and Output Devices: The Gateway to Computer Systems

- Input and output devices:
 - Gateways to the computer system.
 - Part of a computer's user interface.
- Organizations:
 - Should keep their business goals in mind when selecting input and output devices.

Characteristics and Functionality

- Data can be human readable or machine readable .
- Data entry:
 - Converts human readable data into machine readable form.
 - Part of a computer's user interface.
- Data input:
 - Transfers machine readable data into system.
- Source data automation:
 - Capturing and editing data where the data is initially created and in a form that can be directly input to a computer.

Input Devices

- Personal computer input devices:
 - Keyboard
 - Mouse
- Speech-recognition technology.
- Digital cameras
- Terminals
- Scanning devices
- Optical data readers
- Magnetic ink character recognition (MICR) devices

Output Devices

- Display monitors
- Plasma displays
- Liquid crystal displays (LCDs)
- Organic light-emitting diodes
- Printers and plotters
- Digital audio player

Computer System Types

- Special-purpose computers:
 - Used for limited applications by military and scientific research groups such as the CIA and NASA.
- General-purpose computers:
 - Used for a wide variety of applications.
- Handheld computers
- Portable computers
- Thin client
- Desktop computers

Computer System Types

- Workstations
- Servers
- Mainframe computers
- Supercomputers