Inside the System Unit

How Computers Represent Data

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

The smallest piece of data that 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.

<table>
<thead>
<tr>
<th>Binary digit</th>
<th>0</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>States</td>
<td>On</td>
<td>Off</td>
</tr>
</tbody>
</table>
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).

Because even small numbers require many digits when converted to binary, computers convert binary numbers into **hexadecimal (hex) numbers**, which use the numbers 0 through 9, followed by letters A through F.

Floating-point notation has no fixed number of digits before or after a decimal point.

Enables a computer to work speedily with very large or small numbers

Requires special processing circuitry

Characters (letters, numbers, and symbols) are translated into numbers the computer understands.

Character code performs this translation.

The three main types of character codes are:

- American Standard Code for Information Interchange (ASCII)
- Extended Binary Coded Decimal Interchange Code (EBCDIC)
- Unicode

Introducing the System Unit

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

System units come in a variety of styles and have varying footprints.

The **footprint** is the amount of room that the computer takes up on a desk.
Introducing the System Unit

- System units also come in a variety of form factors.
- The **form factor** is the manner in which the internal components of a computer are located within the system unit.

Inside the System Unit

- Main components in the system unit are:
  - Motherboard
  - CPU
  - Power supply
  - Cooling fan
  - Internal speaker
  - Drive bays
  - Expansion slots

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 defined as **integrated circuits**.
  - An **integrated circuit (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 central processing unit 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 (ALU)**.
  - 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?

- The **arithmetic logic unit** of the CPU performs calculations and **logical operations** of data item comparisons.
- When data must be temporarily stored in the CPU, it is stored in locations known as **registers**.

Factors that affect the performance of a CPU include:
- The number of existing transistors
- Data bus width and word size
- Operations per microprocessor cycle
- Use of parallel processing
- Type of chip
What's on the Motherboard?

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

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What's on the Motherboard?

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

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What's on the Motherboard?

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

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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.

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What's on the Motherboard?

- The set of chips that collectively supply the switching circuitry required by the CPU to move data throughout the computer is identified as the **chip set**.
  - The CPU and the **input/output (I/O) bus** are linked through the chip set.
  - The input/output bus provides a means to communicate with input and output devices.

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What's on the Motherboard?

Random access memory (RAM)
- Temporarily stores data and instructions to be used by the central processing unit
- Contents erased when the computer is shut off
- Permits the CPU to access or store data and instructions quickly through RAM's memory address feature
- Considered to be volatile

Read-only memory (ROM)
- Contents not erased when power to the computer is turned off
- Considered to be nonvolatile

Cache memory
- Extremely fast memory that is part of the CPU
- Faster and more expensive than random access memory
- Two types of cache:
  - Primary (level 1/L1) cache, found in the microprocessor chip
  - Secondary (level 2/L2) cache, located on a circuit board

What's on the Outside of the Box?
- The reset switch, which is used to restart the computer
- The drive activity light, which advises the user that the hard drive is retrieving data
- The power-on light, which shows whether the power is on
- The power switch, which may be used to turn the computer on or off
What's on the Outside of the Box?

- A **connector** is where the user can plug a peripheral device into the computer.
- A **port** is the interface used to send data into, and retrieve data from, the computer.

**Currently used ports:**
- USB (Universal Serial Bus) port
- 1394 (FireWire) ports
- DVI (Digital Visual Interface) port

**Currently used connectors:**
- VGA (Video Graphics Array) connector
- Phone and network connectors
- PC card slots
- Sound card connectors
- Game cards
- TV/sound capture board connectors

**Legacy technology**
- Older technology being phased out:
  - Parallel ports
  - Serial ports
  - SCSI (Small Computer System Interface) ports
  - PS/2 ports

What You’ve Learned

- Computers work with binary numbers, which include only 0s and 1s.
- The smallest piece of data that a computer can work with is known as a bit; eight bits equal a byte. Bytes are used to represent a character.

**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. The processor, memory, circuits, and other computer components are connected to it.**
What You’ve Learned

- Other elements of the system unit include the power supply, cooling fan, internal speaker, drive bays, and expansion cards.
- The central processing unit (CPU) is the “brain” of the computer.

What You’ve Learned

- The CPU is made up of the control unit and the arithmetic logic unit (ALU).
- The control unit manages the four-step machine cycle: fetch, decode, execute, and store.
- The ALU performs calculations and logical operations.

What You’ve Learned

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

What You’ve Learned

- Main memory, RAM, is volatile and temporarily holds programs, data, and instructions.
- Read-only memory (ROM), which is nonvolatile, contains prerecorded computer start-up instructions.
- Cache memory is additional CPU memory that operates at very fast speeds.

What You’ve Learned

- Most computers have USB ports, video ports, input and output audio jacks, telephone connectors, and network connectors, and some have a FireWire port.
- Legacy ports include serial ports, parallel ports, PS/2 ports, and SCSI ports.