

Computer Anatomy 101

Hardware, Software, and Networks

AP Computer Science

Module 09

Computer Anatomy 101: Hardware

Thinking like an object-oriented programmer, mentioning the word computer probably brings to mind an abstract image that represents many objects of a particular type.

Can you list a set of attributes that computers have in common? Your list probably describes the hardware of a computer “system” and not necessarily the small chip hidden inside the case that actually is the computer. The CPU is like the queen bee—all the other pieces of equipment just exist to serve the needs of the CPU!

But computers are not confined to laptops and desktops, they come in many [shapes and sizes](#). You find them in cars, appliances, games, cell phones, MP3 players, and even in clothing.

“Hardware is the part of the computer you can kick.”

Anonymous

Computer Anatomy 101: Hardware

Motherboard: The main circuit board of the computer.

A circuit board is a secure mounting surface for the computer's electronic parts (e.g. integrated circuits) and provides the electrically conductive pathway to carry signals between components (e.g. circuit board).



Circuit Board
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Computer Mother Board
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Electronic components found on the motherboard include the central processing unit and primary memory chips.

The motherboard also provides connectors for peripheral devices such a mouse, printer, and monitor.

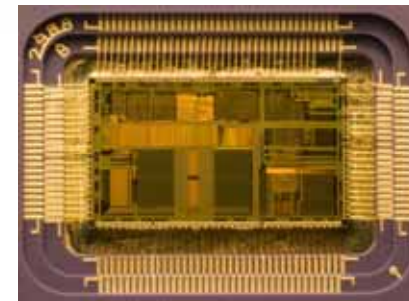
Expansion slots are available for graphics cards and additional memory.

[How Motherboards Work](#)

Computer Anatomy 101: Hardware

Processing Units

- **CPU: Central Processing Unit:** Controls the operation of a computer by executing program instructions and performing arithmetic and logical operations. The CPU consists of hundreds of thousands of transistors and circuits embedded in a silicon integrated circuit chip.
- **ALU: Arithmetic Logic Unit:** Performs arithmetic and logical operations. The ALU is a part of the CPU.
- **Coprocessors:** Supplement the capabilities of the CPU and improves system performance by handling some specialty functions.
 - **Math Coprocessor:** Allows arithmetic calculations to be performed faster.
 - **Graphics Coprocessor:** Speeds up the processing of graphics. Many computer games and high-end graphics programs require the installation of an additional [Graphics card](#).



Microprocessor

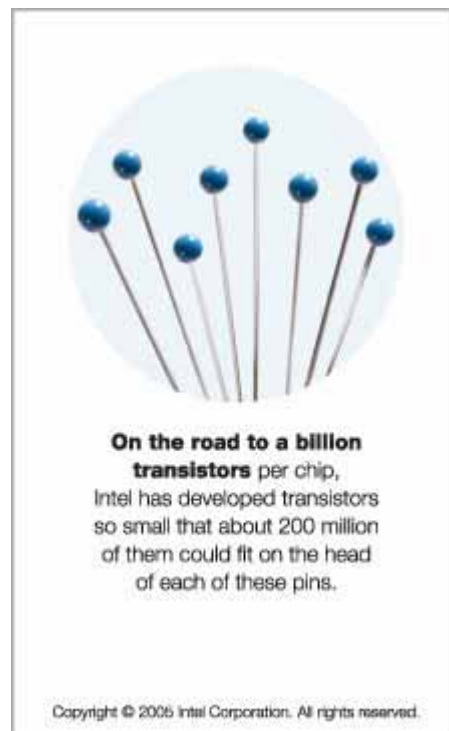
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Computer Anatomy 101: Hardware

- **Microprocessor:** An integrated circuit containing the entire CPU of a computer on a single silicon chip. The first readily available microprocessor was the Intel 8080: which cost around \$400 when first introduced in 1973. Development of the microprocessor is what made microcomputers, or home computers, available to the general public in the 1980s.
- **Moore's Law:** A prediction made in 1965 by Gordon Moore, president of Intel, that the number of transistors that could be placed on an integrated circuit chip would double every two years, continues to hold true.



8080 Microprocessor Chip
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Computer Anatomy 101: Hardware

- Computer Storage

In order to process information, a computer needs a way to store the information both internally and externally. Information is stored internally on primary storage devices such as memory chips and externally on a variety of magnetic and optical media.

- **Primary Storage:** Integrated circuits are attached to the motherboard and provide two types of primary, internal information storage:

- ROM: Read-only memory contains the permanent instructions the computer needs at start up.
- RAM: Random access memory contains temporary data and programs needed to process information.



Random Access Memory
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- **Secondary Storage:** Magnetic (e.g. disks, memory sticks) and optical (e.g. CDs) media are used to store data, information, and programs for later use.

Primary storage can be directly accessed by the CPU, secondary storage cannot.

Secondary storage is external and can be removed, primary storage is usually attached to the motherboard and is not removed except for repairs or upgrades.

Computer Anatomy 101: Hardware

Byte: The smallest unit of memory

1 byte consists of 8 bits. It takes one byte of memory to store one keyboard character.

[How Bits and Bytes Work](#)

Units of Memory

Both primary and secondary memory capacity are measured in bytes.

1 kilobyte = 1,000 bytes

1 megabyte = 1,000,000 bytes

1 gigabyte = 1,000,000,000 bytes



Computer Anatomy 101: Hardware

Peripheral Device: Any piece of hardware added to a computer to expand the system's capabilities.

Peripherals can usually be divided into three categories.

1. Input Devices: Hardware that provides input to the computer.
e.g. keyboard, mouse, scanner
2. Output Devices: Hardware that makes information available to the user.
e.g. printer, monitor, speaker
3. Input/Output Devices: A computer device that can both read and write or send and receive information.
e.g. disk drive, modem, network interface card

Computer Anatomy 101: Hardware

Input Devices

Keyboard: An input device for the input of text and numbers by hand.

- The QWERTY layout found on most computer keyboards has been in use almost since the typewriter was invented in the 1860s. This layout was designed so that keystrokes would alternate between the left and right side of the keyboard to avoid jams.
- The Dvorak layout was invented in 1936 by August Dvorak. By studying letter frequencies and the mechanics of typing, Dvorak moved the most commonly typed letters to the middle row and the least commonly typed letters to the lower row. The most frequent letters are typed with the strongest fingers and most typing is done with the right hand.



QWERTY Keyboard
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Dvorak Keyboard

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Mouse: A pointing device that can be moved in two dimensions to control the cursor on the monitor.

- Touchpad: A substitute for a mouse on a laptop computer.
- Trackball: An alternative pointing device that is basically an upside-down mouse.



Mouse
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Touchpad

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Scanner: An input device that converts a document, pictures, or objects to 2-D digital images.



Scanner
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Track Ball
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Computer Anatomy 101: Hardware

Output Device: Any device that makes information processed by the CPU available to the user.

- Monitor: Displays computer images and text on a computer screen for viewing.
 - CRT: A monitor that uses a cathode-ray tube.
 - LCD: A monitor that uses a liquid crystal display.
- Printer: Produces a hard copy of a document or image in printed form. The most common type of printer is the ink jet, which deposits tiny drops of liquid ink on paper.
- Speaker: A device that plays audio files. Speakers may be internal or external.



CRT Monitor
Public Domain



LCD Monitor
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Printer

Computer Anatomy 101: Hardware

Storage Input/Output Devices: A computer device that can both read and write information on a storage medium.



Floppy Disk
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Hard Disk
Public Domain



Compact Disk
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1. Magnetic Storage
 - Floppy Disk
 - Hard Disk
2. Optical Storage
 - CD-R
 - CD-RW
3. Solid State
 - Flash Memory



Solid State Memory
Public Domain

Computer Anatomy 101: Hardware

Communication Input/Output Devices: A computer device that can both send and receive information over a communication network.

- **Modem:** A device that translates information into a format that can be transmitted and received over a variety of communication networks including standard telephone lines, fiber optic cable, radio waves, or satellite.
 - [Dial-up](#)
 - [Cable](#)
 - [DSL](#)
 - [WiMAX](#) / [WiFi](#)
 - [Satellite](#)
- **Network Interface Card (NIC):** A device that connects a computer to a home or business local area network (LAN).



Network Interface Card

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Internal Dial-up Modem
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External Dial-up
Modem
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DSL Modem
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Cable Modem
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Computer Anatomy 101: Software

Collectively, all of the programs you use to perform computer tasks are referred to as software. Software can be categorized in many different ways, but for the purposes of this course, we will use the following divisions:

- Operating system (OS) software runs your computer and manages all of the system resources.
- Application software consists of all the programs that help you complete tasks with your computer.
- Programming languages are used to write software.



Computer Anatomy 101: Software

Operating system (OS): A set of programs that runs a computer by managing system resources including memory and disk access, accepting input, displaying output, and controlling peripheral devices.

There are three primary computer operating systems for personal computers, but Windows continues to hold the dominant market share.

90% Windows XP / Windows Vista

6% Mac OSX

3% Linux

1% Other



Computer Anatomy 101: Software

Application software is the broadest category and includes some of the following general products:

- Productivity tools include word processors, databases, spreadsheets, etc.
- Entertainment software is used for playing games, listening to music, etc.
- Communication tools are web browsers, email, blogs, podcasts, etc.
- Educational software provides instruction on various topics.

This list is not all-inclusive, so you probably could add specific products and additional categories.



Computer Anatomy 101: Software

Programming Language: An artificial language that instructs a computer to perform a task. How many programming languages are there? A conservative estimate would be over two thousand! There are two common ways to categorize programming languages: low-level vs. high-level and interpreted vs. compiled.

The earliest computers had to be programmed at the machine level by re-wiring circuits or by programming in binary code. It did not take long for assembly languages to appear; they translated simple mnemonic codes into binary code. In such low-level languages there is usually a one-to-one correspondence between the mnemonic and binary codes. Source code written in high-level languages (e.g. Java, Visual Basic, C++) use English-like statements that encompass several binary statements.

High-level languages are often categorized as interpreted or compiled. At runtime, the source code of an interpreted language (e.g. BASIC, Lisp, Scheme) is translated one line at a time into machine language. In contrast, the source code of a compiled language (e.g. C++, COBOL, Pascal) is first completely translated into machine language and then the machine code is executed.

Java is a hybrid language; the source code is compiled into bytecode and then the bytecode is interpreted. The Java Virtual Machine executes bytecode, allowing platform independence.

Computer Anatomy 101: Networking

Connectivity: Generally speaking, computers are either stand-alone or networked.

Technically, a stand-alone computer is one that is not connected to a network. This is a little ambiguous because today, most computers are connected to the Internet, the network of networks. Once you log off the Internet, then your computer in effect becomes a stand-alone, single-user machine.

Computers are often [networked](#) together in order to share hardware resources (e.g. printers and secondary storage) and information. Local area networks ([LANs](#)) cover small geographic areas such as several buildings, an office, or a home.

On a much broader scale, the [Internet](#) connects computers separated by wide geographic distances.