

ICS3U: Introduction to Computer Science

Computer Hardware

J. Garvin



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Computers

Inside the case, a modern electronic digital computer typically contains:

- Motherboard – holds the central processing unit (CPU), read-only memory (ROM), random-access memory (RAM), and other major parts.
- Power supply – holds a transformer, voltage control, fan.
- Storage controllers (IDE, SCSI or other) – control hard disk, floppy disk, optical drive, etc. These may be on the motherboard, or on expansion cards.
- Graphics controller – produces output for the monitor.
- Hard disk – external storage.
- Optical drive – external storage.
- Interface controllers (parallel, serial, USB, Firewire) – connect to external peripherals.

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Case

Most computer components are housed in a box, simply called the *case*.

Cases come in different shapes and sizes, whether for desktop computers, laptops, netbooks, servers, etc. These different shapes are often called *form-factors*.

Many people mistakenly refer to the case as the *CPU*.

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Case



Typical desktop case

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Case

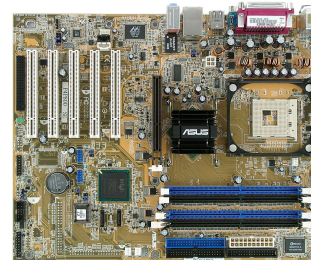
Inside of the case, you will find many components. These are all connected to a large *circuit board* called the *motherboard*.

The motherboard connects most of the internal components, including any microprocessors, integrated circuits, and on-board controllers. Motherboards typically provide connections for common *peripherals*.

Like cases, there are many different form-factors for motherboards.

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Motherboard



ASUS P4P800 Motherboard

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Central Processing Unit (CPU)

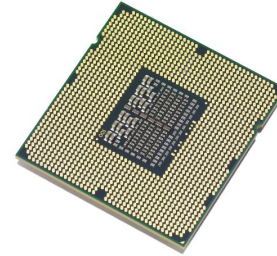
The CPU is the “brain” of the computer.

It *executes* program instructions to run a program.

The CPU is located on a single electronic component, the *microprocessor chip*.

Popular CPU vendors are Intel, AMD and ARM.

Central Processing Unit (CPU)



Intel Core 7 CPU

Central Processing Unit (CPU)

CPUs may be different sizes, and may run at different speeds.

Each CPU has a built-in clock, and the speed at which the CPU operated is called the *clock rate*.

Modern desktop computers typically have a clock rate of 1-3 gigahertz (GHz).

Some CPUs contain multiple *cores*, which allow multiple tasks to be run in parallel.

Main Memory

Memory temporarily holds data, program instructions and information.

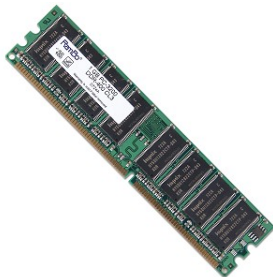
It stores program instructions or data for only as long as the program is in operation.

Main memory is *volatile* – turning the computer off will destroy the data.

The memory that most people are familiar with is Random-Access Memory (RAM).

Most modern consumer-grade computers have between 1 and 4 GB of RAM, while servers and more powerful workstations may contain more.

Main Memory



PC3200 RAM

Secondary Storage

Secondary storage includes magnetic hard drives, floppy disks, flash media, etc.

It holds information too large for storage in main memory.

Information on secondary storage can only be accessed by the CPU if it is first transferred to main memory.

Secondary storage is slow and virtually unlimited in capacity.

It is *non-volatile*, retaining information when the computer is switched off.

This is where permanent copies of programs and data are stored.

Hard Drives



Magnetic hard drive

Hard Drives

Hard drives consist of one or more metallic *platters*.

A *read/write head* magnetizes sectors to store data.

Program instructions or data are stored until it is overwritten.

Hard drive capacities are typically between 500 gigabytes (GB) and 4 terabytes (TB).

Newer hard drives may be *solid-state* drives, similar to flash memory.

Input/Output (I/O)

I/O devices allow the computer to communicate with the outside world.

The computer receives input through the keyboard or another input device. This input is transferred into memory (RAM), and then processed by calculating, comparing, or copying it.

The computer outputs the results of the processing, usually on the screen, onto a disk, or over a communications channel.

Some typical I/O devices include:

- data: floppy disk (largely obsolete), CD/DVD burner
- input: keyboard, mouse, joystick, optical scanner, light pen, touch panel, or microphone
- output: CRT monitor, LCD panel, printer, speakers
- communication: modems, network units

Input/Output (I/O)



Common input and output devices

Input/Output (I/O)

Input/output devices each have their own controller. The CPU communicates with input/output devices via this controller.

Associated with the controller is a memory area called a Buffer. Data buffering compensates for any differences in speed between the CPU or main memory when data is transferred to most peripheral devices.

All output is sent by the CPU to the buffer for re-transmission by the device controller to the device. Similarly input from devices is sent to the buffer from where the CPU can transfer it at high speed to main memory.

Sound and Video

Some computers have dedicated sound and video controllers, to display graphics and text to a monitor.

Other computers may use separate cards, which have more memory or on-board processors.

This allows for more powerful graphics or sound-processing capabilities.

Input/Output (I/O)



An nVidia graphics card, with cooling fan

Networking

To connect to other computers, or a network, most computers have some networking hardware.

Computers may use separate cards, or have network hardware integrated on the motherboard.

Some computers are wired, while some are wireless.

Networking



A standard cable modem

System Bus

All communication between the major components of the computer occurs via the system bus.

The bus is a cable that carries data or signals from one place to another.

Older computers typically used system busses that were specific to the computer, but most are now industry-standard.

Most modern Personal Computers use a Peripheral Component Interconnect (PCI) bus.

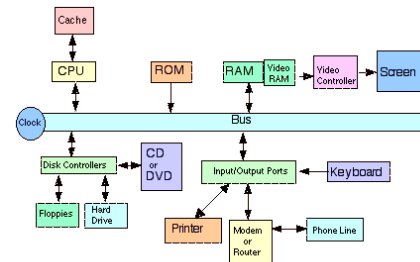
The system bus speed is important, since a slow bus may restrict the speed of the CPU.

System Bus

Possible transfers of information via the system bus include:

- Transmitting data from main memory to the CPU.
- Transmitting input data from a keyboard to main memory.
- Transmitting information from external memory to main memory.

System Bus



Components connected by the system bus