

## 2.2: Tour of a Digital Device

We will begin with personal computers, which consist of these essential basic components:

- Central Processing Unit (CPU)
- Motherboard (circuit board)
- Random Access Memory (RAM)
- Video Card
- Power Supply
- Hard Drive (HDD)
- Solid-State Drive (SSD)
- Optical Drive (DVD/CD drive)
- Card Reader (SD/SDHC, CF, etc.)

It also turns out that almost every digital device uses three of components, so examining the personal computer will give us insight into the structure of various digital devices. So let's take a "tour" of a personal computer and see what makes them function.

### 2.2.1: Central Processing Unit: The CPU

As stated in the previous section, most computing devices have a similar architecture. The core of this architecture is the central processing unit or CPU. The CPU can be thought of as the "brain" of the device or main processor. Its main functions are to fetch data and instructions, decode the instructions, execute, and store the output. The CPU was made up of hundreds of wires that carried information. These wires carried out the commands sent to them by the software and returned results to be acted upon. The earliest CPUs were large circuit boards with limited functionality. Today, a CPU is generally on one chip and can perform a large variety of functions. There are two primary manufacturers of CPUs for personal computers: Intel and Advanced Micro Devices (AMD).

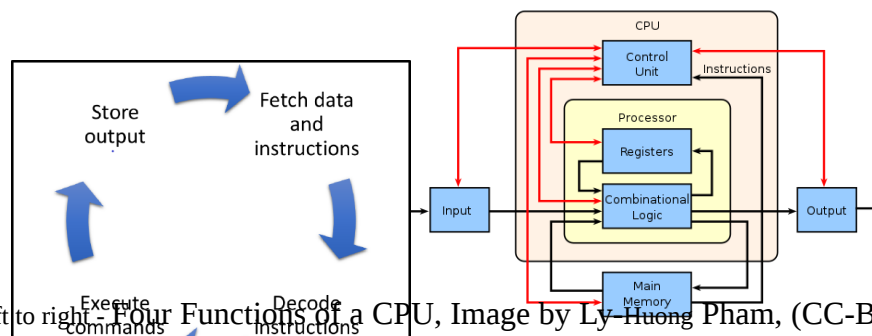


Figure 2.2.1: From left to right - Four Functions of a CPU, Image by Ly-Huong Pham, (CC-BY-NC, 2022); Block diagram of a basic computer with one processor CPU. Black lines indicate data flow, whereas red lines indicate control flow. Arrows indicate the direction of flow, by Surachit is licensed under [CC BY-SA 4.0](https://creativecommons.org/licenses/by-sa/4.0/).

A CPU's speed ("clock time") regulates the instruction rate and executes and synchronizes the various computer components. The faster the clock, the quicker the CPU can execute instructions per second. The clock is measured in hertz. A hertz is defined as one cycle per second. Using the binary prefixes mentioned above, we can see that a kilohertz (abbreviated kHz) is one thousand cycles per second, a megahertz (MHz) is one million cycles per second, and a gigahertz (GHz) is one billion cycles per second. The CPU's processing power increases amazingly (see the sidebar about Moore's Law). Besides a faster clock time, many CPU chips now contain multiple processors per chip. A multi-core processor is a single integrated circuit that contains multiple chips. These chips are commonly known as cores. The multi-core runs and reads

instructions simultaneously, increasing the speed. A computer with two processors is known as dual-core, or quad-core (four processors), increasing the processing power of a computer by providing multiple CPUs' capability.

When computers run with multiple cores, additional heat is generated and why companies add fans on top of the CPU. Macs have built-in a fail-safe that the computer will shut down to avoid damage when the temperature builds too rapidly. Smartphones may warn users if the temperatures get too hot. As our devices get smaller, we have many parts placed in a compact area, and in turn, devices will generate more heat. Running many apps on your phone simultaneously is another way to increase the phone's heat; this is why it is essential to close applications after use.



Figure 2.2.2 Left to right: Processor side of an Intel Core i9-10900K microprocessor showing the lid and markings for the processor. Image by [Locke Cole](#) is licensed under [CC BY-SA 4.0](#). The back of the Intel Core i9-9900K. Image by [PantheraLeo1359531](#) is licensed under [CC BY-SA 4.0](#).

A graphics processing unit (GPU) is an electronic circuit designed to rapidly manipulate and alter memory to accelerate the creation of images in a frame buffer for output. Devices that use GPUs are personal computers, smartphones, and game consoles. Nvidia is one of the powerhouse companies that manufacture HD graphics cards. Nvidia has been a leader in GPU's chips, one of the most popular chips is the Nvidia GeForce, which is integrated with laptops, PCs, and virtual reality processors. Nvidia has also worked with many companies expanding its GPU chip market. Some notable companies that Nvidia works with are Tesla, Quadro, and GRID.

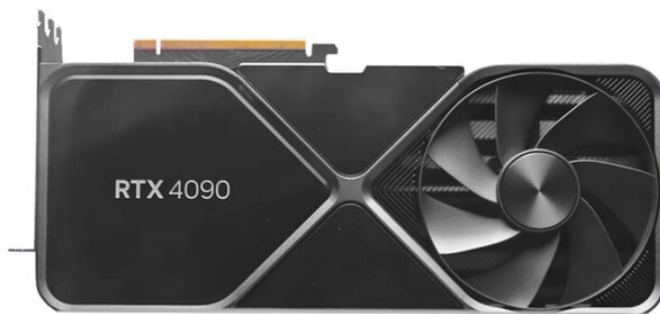


Figure 2.2.3 NVIDIA GeForce 40 series Image by [GalaxyNite](#) is licensed under [CC-BY-3.0](#)

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