

Essential Computing (BPM-119)

Introduction to Computer

What's the root of the word computer?

The word 'compute' comes from the Latin word *computare*, meaning "arithmetic, accounting, reckoning". Clearly, its meaning has been extended to include non-numerical "reckoning".

The Latin word *computare* itself comes from:

- Latin *com*, meaning "with", and
- Latin *putare*, meaning "to settle, clear up, reckon".

So, in ancient Rome at least, to "compute" seems to have meant, more or less, something like:

- "to settle things together" or maybe "to reckon with (something)".

The derivative "computer" was coined in the mid-17th century, and originally meant simply 'person who computes'; the modern meaning developed via 'device for calculating' at the end of the 19th century and 'electronic brain' by the 1940s.

What is a Computer?

According to oxford living dictionaries, computer is "an electronic device for storing and processing data, typically in binary form, according to instructions given to it in a variable program."

Paul Deitel said: "Computer can perform calculations and make logical decisions phenomenally faster than human being can. Many of today's personal computer can perform billions of calculations in once second – more than a human can perform in a lifetime. Supercomputer are already performing thousands of trillions (quadrillions) of instructions per second! China's National University of Defense Technology's Tianhe-2 supercomputer can perform over 33 quadrillion calculations per second (33.86 petaflops)! To put that in perspective, the Tianhe-2 supercomputer can perform in one second about 3 million calculations for every person on the planet! And these supercomputing "upper limits" are growing quickly."

John V. Guttag of Massachusetts Institute of Technology (MIT) said "a computer does two things, and two things only: it performs calculations and it remembers the results of those calculations. But it does those two things extremely well. The typical computer that sits on a desk or in a briefcase performs a billion or so calculations a second. It's hard to image how truly fast that is. Think about holding a ball a meter above the floor, and letting it go. By the time it reaches the floor, your computer could have executed over a billion instructions. As for memory,

a typical computer might have hundreds of gigabytes of storage. How big is that? If a byte (the number of bits, typically eight, required to represent one character) weighed one ounce (which it doesn't), 100 gigabytes would weigh more than 3,000,000 tons. For comparison, that's roughly the weight of all the coal produced in a year in the U.S.”

Definition of Computer

According to Peter Norton:

A computer is an electronic device that process **data**, converting it into **information** that is useful for people.

To understand the definition clearly we need to know more about data and information:

Data consists of individual facts or pieces of information that by themselves may not make much sense to a person. Data are essentially raw, unorganized facts. Almost any kind of fact or set of facts can become computer data: a letter, text and pictures, a budget, a colorful graph etc. Data can exist in many forms. Common types of data for computer: text, graphics, audio and the video data.

Information is data that has been processed in such a way as to be meaningful to the person who receives it.

All the information is data but all the data is not information. The difference between data and information lies in the word *meaningful*.

Information is a relative term; it identifies something that has significance to a specific person in a specific situation.

So, one must not assume that there is always a clear distinction between data and information.

We don't need a computer to process data. Anyone can go through an employee file and make a list of people earning a certain salary. But this would take a lot of time. (if there is 1000 employee!). Conversion of data into information is called *information processing*.

Analog data is real world stuff like sounds, electrical currents, paintings, temperatures, time. It has no precisely measurable or discrete value - we measure to the accuracy of our recording instruments. A range of values made data.

Digital data, on the other hand is discrete. When sounds are digitized they must be stored as discrete values representing the pitch, volume, duration and other qualities of the sound.

Computers can only work with digital data. To convert analog data to digital data, the analog data has to be sampled and then converted to an approximate value.

Processes, Procedures, and Computers

A process is a sequence of steps. Each step changes the state of the world in some small way, and the result of all the steps produces some goal state. For example, baking a cake, mailing a letter, and planting a tree are all processes.

A procedure is a description of a process. A simple process can be described just by listing the steps. The list of steps is the procedure; the act of following them is the process.

A procedure that can be followed without any thought is called a mechanical procedure. An algorithm is a mechanical procedure that is guaranteed to eventually finish.

A computer is a machine that can:

1. Accept input. Input could be entered by a human typing at a keyboard, received over a network, or provided automatically by sensors attached to the computer.
2. Execute a mechanical procedure, that is, a procedure where each step can be executed without any thought.
3. Produce output. Output could be data displayed to a human, but it could also be anything that effects the world outside the computer such as electrical signals that control how a device operates.

Information Systems

An information system is a complete interconnected environment in which raw data — quantifiable facts and figures — is turned into useful information. An information system includes the following parts: people, hardware, software, procedures, and data.

People: People are the computer operators, also known as users. It can be argued that some computer systems are complete without a person's involvement; however, no computer is totally autonomous. The only reason computers exist is to help people accomplish their goals. Therefore when planning an information system, it's critical to understand what the people hope to get out of it. The first step in planning an information system is to analyze the requirements of the people.

Hardware: When most people think of computers, they immediately think of hardware, the physical parts of the computer system. The mechanical devices that make up the computer are called hardware. The hardware includes circuit boards with silicon chips and transistors mounted on them, input devices like the keyboard and mouse, and output devices like printers and monitors.

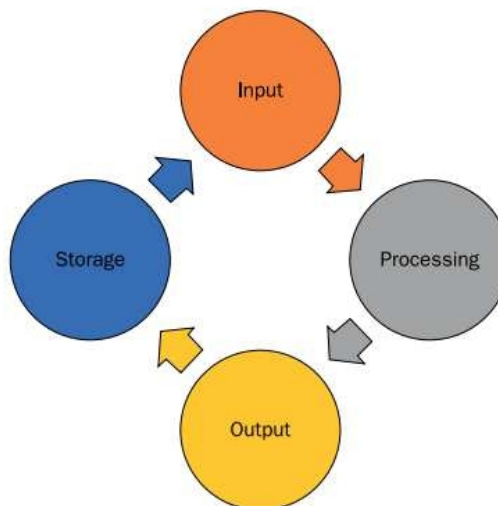
Software: Software is a set of instructions that makes the computer perform tasks. In other words, software tells the computer what to do. Computer hardware just sits there idle unless it has software. There are many different levels of software, including the operating system (like Windows or Mac OS) and applications (like a word processing or accounting program).

Procedures: The software doesn't run itself (usually). People must interact with the computer to tell it what software to run. We can learn procedures from the online Help system in the application, from a printed user manual, from a training class, or by trial and error.

Data: Data consist of individual facts or pieces of information that by themselves may not make much sense to a person. Computer programs operate upon the data they receive. A computer's primary job is to process these tiny pieces of data in various ways, converting them into useful information.

Computer System Components

Every computer system is made up of multiple electronic components. These components fall into four broad categories that serve different purposes in the information processing cycle, shown in Figure below. Information processing cycle is the four-step process that data moves through as it is processed by a computer consists of input, processing, output, and storage.



The information processing cycle.

Input: Components that help humans put data into the computer. Examples include a keyboard, mouse, and touch screen.

Processing: Components that move and process the data inside the computer. The motherboard and its processor and memory chips fall into this category.

Output: Components that provide the results of the processing to humans. The monitor is the primary output device; other examples include printers and speakers.

Storage: Components that store software and data until it is needed. Storage components include hard drives, USB flash drives, and DVDs.

Types of Computer

Computers exist in a wide range of forms, and thousands of computers are hidden in devices we use every day but don't think of as computers such as cars, phones, TVs, microwave ovens, and access cards.

Personal computer

A personal computer, or PC is designed for only one person to use at a time. Personal computers fall into several categories that are differentiated from one another by their sizes. The most common sizes are:

Desktop PC: A computer designed to be used at a desk, and seldom moved. This type of computer consists of a large metal box called a system unit that contains most of the essential components, with a separate monitor, keyboard, and mouse that all plug into the system unit.

Notebook PC: A portable computer designed to fold up like a notebook for carrying. The cover opens up to reveal a built-in screen, keyboard, and pointing device, which substitutes for a mouse. This type of computer is sometimes called a laptop. A smaller version of a notebook PC is sometimes referred to as a netbook, which is short for Internet book, implying that this type of computer is primarily for accessing the Internet rather than running applications.

Tablet PC: A portable computer that consists of a touch-sensitive display screen mounted on a tablet-size plastic frame with a small computer inside. There is no built-in keyboard or pointing device; a software-based keyboard pops up onscreen when needed, and finger sliding on the screen serves as a pointing device.

Smartphone: A mobile phone that can run computer applications and has Internet access capability. Smartphones usually have a touch-sensitive screen, and provide voice calls, text messaging, and Internet access. Many have a variety of location-aware applications, such as a global positioning system (GPS) and mapping program and a local business guide.

Multi-User Computers

Multi-user computers are designed to serve groups of people, from a small office to a huge international enterprise. Here are some common types of multi-user computers:

1. Server
 2. Mainframe
 3. Supercomputer
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1. **Server:** A computer dedicated to serving and supporting a network, a group of network users, and/or their information needs. It performs network tasks such as managing files, printers, or email for multiple users. Many networks employ servers to provide a centrally accessible storage space for data, and share common devices like printers and scanners. A group of servers located together in a single room or facility is called a **server farm**, or server cluster. Large Internet service provider (ISP) companies maintain extensive server farms.
 2. **Mainframe:** A large and powerful computer capable of processing and storing large amounts of business data. For example, a mainframe might collect all the sales data from hundreds of cash registers in a large department store and make it available to executives. The modern mainframe unit itself is a large cabinet, or a series of cabinets, each about the size of a refrigerator. A mainframe may be stored in its own air-conditioned room in a business or school, and may have multiple employees monitoring and maintaining it.
 3. **Supercomputer:** The most powerful computers in terms of performance and data processing are the Supercomputers. These are high capacity, specialized and task specific machines with hundreds of thousands of processors that can perform trillions of operations per second. It is used for the processing of enormous volumes of data. These computers are used by large high-tech academic, governmental, and scientific research facilities. For example, NASA uses supercomputers for launching space shuttles, controlling them and for space exploration purpose. It is also used for sifting demographic marketing information and for creating film animation

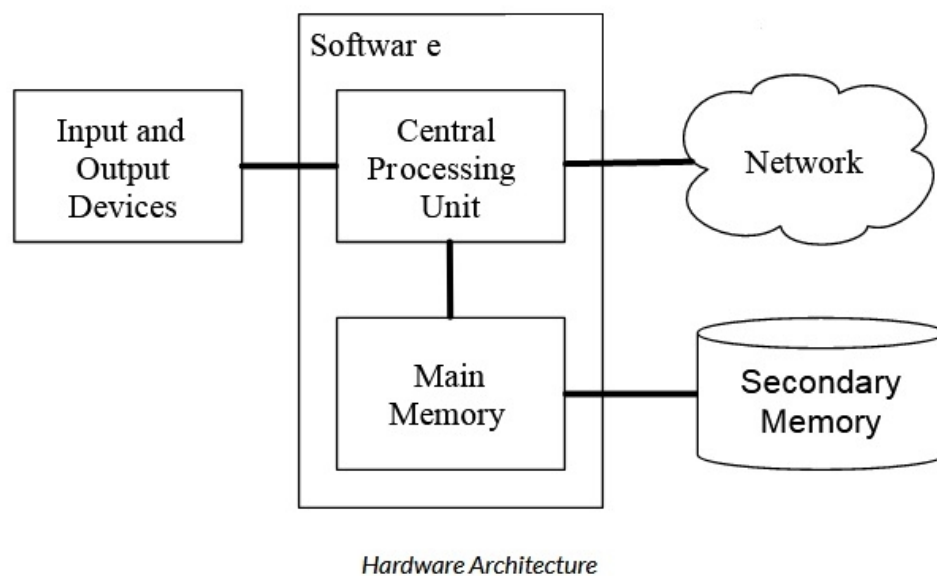
The supercomputers are very expensive and very large in size. It can be accommodated in large air-conditioned rooms; some super computers can span an entire building.

Currently (till June 2018) the fastest supercomputer in the world is IBM's Summit with a peak performance of 200 petaflops, or 200,000 trillion calculations per second.

The complete list of Top 500 Supercomputers in the world can be viewed from the website top500.org.

Looking Inside the Computer Systems

If we were to take apart our computer or cell phone and look deep inside, we would find the following:



So we can say computer hardware devices fall into one of four categories:

1. Processor
 2. Memory
 3. Input and output
 4. Storage (secondary memory)
- Processor is like the brain of the computer. It organizes and carries instructions that come from either the user or the software. In personal computer processor usually consists of one or more specialized chips, called microprocessor, which are slivers (splinter) of silicon or other material etched with many tiny electronic circuits. The term *Central Processing Unit* (or **CPU**) refers to a computer's processor.
 - **Memory** is one or more sets of chips that store data and/or program instructions, either temporarily or permanently. PC use several different types of memory, but the two most important are called Main Memory or RAM and ROM.

RAM: The *Main Memory* or RAM (Random Access Memory) is used to store information that the CPU needs in a hurry. RAM holds data and program instruction while CPU works with them. When a program is launched it is loaded and run from memory. As program needs data, it is loaded into the memory for fast access. The main memory is nearly as fast as the CPU. But the information stored in the main memory vanishes when the computer is turned off. That's why RAM is called volatile.

RAM has tremendous impact on the speed and power of a computer. Generally more RAM a computer has, the more it can do and the faster it can perform tasks. The most common measurement unit for describing a computer's memory is the byte – the amount of memory it takes to store a single character such as a letter or a numeral. When referring to computer's memory the numbers are often so large that it is helpful to use term such as kilobyte (KB), gigabyte (GB), and terabyte (TB) to describe the values.

ROM: Read-only Memory (ROM) stores its data permanently. It holds instructions that the computer needs to operate. Whenever the computer's power is turned on, it checks ROM for directions that help it start up, and for information about its hardware device.

- The *Secondary Memory* or storage is also used to store information, but it is much slower than the main memory. The advantage of the secondary memory is that it can store information even when there is no power to the computer. Examples of secondary memory or storage are disk drives, CDs or flash memory.

We may think storage as electronic file cabinet and RAM as an electronic worktable. When data needed computer locates it in the file cabinet and puts a copy on the table. After finishing work it is put back into file cabinet.

Comparison between storage and RAM can be made in the following ways;

- There is more in storage than in memory, just as there is more room in a file cabinet than there is on a tabletop
 - Contents are retained in storage when the computer is turned off, whereas program or the data in memory disappear when we shut down the computer.
 - Storage device operate much slower than memory chips, but storage is much cheaper than memory.
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- The *Input and Output Devices* are simply those that allow us to interact with the computer. Input devices accept data, for example: Keyboard, mouse. Output devices deliver data, for example: monitor, printer, and speaker. Some devices can both accept input and deliver output, for example: touch screens.
 - These days, most computers also have a *Network Connection* to retrieve information over a network. We can think of the network as a very slow place to store and retrieve data that might not always be "up". So in a sense, the network is a slower and at times unreliable form of *Secondary Memory*.

How Computers build Network

A **network** is a group of computers that are connected with one another and share resources (such as printers or Internet service) and/or data (such as files). Most computers today are part of one or more networks. There are many choices for making computers connect to one another.

Ethernet Networking

The most common network standard is Ethernet. Ethernet networks can be either wired or wireless (or a combination of the two), but the term Ethernet is most often applied to the wired kind of connection. Figure below shows an Ethernet port on the side of a notebook PC.



Most PCs have a network adapter, which provides network connectivity services and a port into which you can plug an Ethernet cable.

Wireless Ethernet is more often called **Wi-Fi**, or 802.11. Most portable devices such as tablets and phones use wireless connections and do not have the capability for wired networking.

In a small network, such as in a home or small business, one end of an Ethernet cable plugs into the computer, and the other end plugs into a controller box called a **router** that manages the network traffic between the connected devices. If a computer has Wi-Fi wireless router and a wireless network adapter in the computer, the computer can connect to the router via **radio frequency** (RF) waves, so no cables are required.

Bluetooth Networking

Bluetooth is a short-range wireless alternative to wireless Ethernet (Wi-Fi), used primarily to connect wireless devices directly to specific computers. For example, one might have a Bluetooth wireless headset for his cell phone, or a Bluetooth speaker for his MP3 player. Bluetooth's limited range (10 meters) makes it impractical as a replacement for Wi-Fi, but it provides an easy and economical way for one device to connect with another within a limited space without Ethernet hardware.

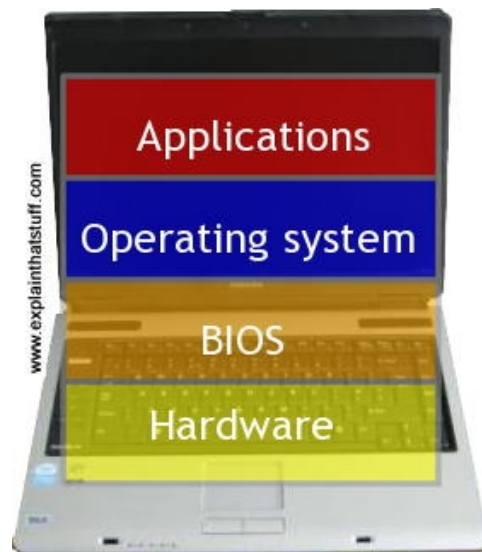
The Internet

The Internet is the world's largest network. When we use the Internet, our computer becomes a member of this giant network, and we can communicate with any other computer on the Internet, to the extent that its owner has chosen to make it available. For example, we can exchange email messages, download files, and view web pages stored anywhere in the world.

Individual computers don't connect directly to the Internet, however; they go through an Internet service provider (**ISP**), a company that provides and maintains a direct connection to the Internet and leases access to it to individuals and companies for a fee.

Software

Software can be defined as the programs that tell the computer what to do. A set of instructions that drive a computer to perform specific tasks is called a program. These instructions tell the machine's physical components what to do; without the instructions, a computer could not do anything at all. When a computer uses a particular program, it is said to be **running or executing** that program.



The following sections provide an overview of the types of software a computer might include:

BIOS

The most basic software is the Basic Input Output System (BIOS). This software is stored on a read-only memory (ROM) chip on the motherboard so that it doesn't accidentally get changed or corrupted. This important software helps the computer start up and performs some basic testing on the hardware.

Operating Systems

The operating system (OS) manages all the computer's activities after startup. The operating system serves several purposes:

- It provides the user interface that humans use to communicate commands and receive feedback.
- It runs applications, and enables humans to interact with them.
- It controls and manages the file storage system.
- It communicates with the hardware, instructing it to take action to accomplish tasks. For example, the OS tells the printer to print a document, and tells the monitor what image to display.

Microsoft Windows is the most popular operating system. Other operating systems include Mac OS and Linux for desktop and notebook PCs, UNIX for mainframes and servers, and Android for tablets and smartphones. Special versions of Windows and Mac OS also power tablets and smartphones. Each operating system has its own unique set of features, benefits, and drawbacks.

Utilities

Utilities are software that performs some useful service to the operating system, such as optimizing or correcting the file storage system, backing up files, or ensuring security or privacy. Utility software may be either provided free with the OS or added on. Utility programs assist with a wide range of system maintenance and security functions, such as checking storage disks for errors, blocking security and privacy threats, and backing up important files.

Application Software

Application software tells the computer how to accomplish a specific task, such as word processing or drawing for use. It is designed to do something productive or fun, something of interest to a human user. The OS keeps the computer running, but the applications give people a reason to use the computer.

Most computers come with some application software already installed. You can purchase additional software, and many applications are available for free. The software may be provided on a CD or DVD disc, or may be downloaded and installed via the Internet.

Productivity software helps us accomplish practical tasks such as managing our money, charting numeric data, writing documents, storing data, and sending email. Perhaps the best known example in this software category is Microsoft Office, a suite of applications that includes a word processor, a spreadsheet application, a database application, an application for creating business presentations, and an email and contact management system. A **suite** is a group of applications that are designed to work well together and that share some common interface characteristics.