Processing Data

The Difference between Data and Information

Data	Information
Data is unprocessed raw facts about a particular entity.	Information is processed form of data.
Data is used as input in the computer.	Information is the output of the computer.
Data is not meaningful.	Information is meaningful.
Data is normally huge in its volume.	Information is normally short in its volume.
Data is used rarely	Information is used frequently.
Data is an independent entity.	Information depends on data.
Data is not used in decision-making	Information is very important for decision-making.
Data is difficult or even impossible to reproduce. For examples, if Government lose the data of census, if will be almost impossible to reproduce it.	Information is easier to reproduce if lost. For example, if the list of illiterate citizens is lost, it can be reproduced easily because the data is still stored.

How Computers Represent Data

Computer does not understand human language. Any data, viz., letters, symbols, pictures, audio, videos, etc., fed to computer should be converted to machine language first. Computers represent data in the following three forms –

- Number System
- Bits and Bytes
- Text Code

Number System

We are introduced to concept of numbers from a very early age. To a computer, everything is a number, i.e., alphabets, pictures, sounds, etc., are numbers. Number system is categorized into four types −

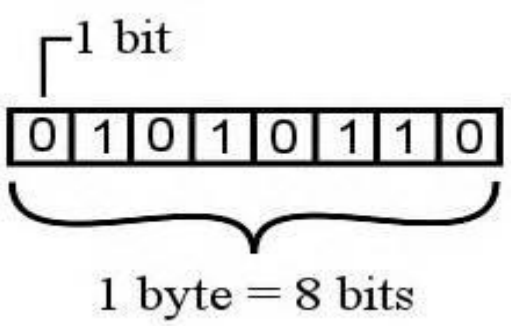
- **Binary number system** consists of only two values, either 0 or 1
- **Octal number system** represents values in 8 digits.
- **Decimal number system** represents values in 10 digits.
- **Hexadecimal number system** represents values in 16 digits

Number Systems		
System	Base	Digits
Binary	2	0 1
Octal	8	0 1 2 3 4 5 6 7
Decimal	10	0 1 2 3 4 5 6 7 8 9
Hexadecimal	16	0 1 2 3 4 5 6 7 8 9 A B C D E F

Bits and Bytes

Bits − A bit is a smallest possible unit of data that a computer can recognize or use. Computer usually uses bits in groups.

Bytes − group of eight bits is called a byte. Half a byte is called a nibble.



The following table shows conversion of Bits and Bytes −

Byte Value	Bit Value
1 Byte	8 Bits
1024 Bytes	1 Kilobyte
1024 Kilobytes	1 Megabyte
1024 Megabytes	1 Gigabyte
1024 Gigabytes	1 Terabyte
1024 Terabytes	1 Petabyte
1024 Petabytes	1 Exabyte
1024 Exabytes	1 Zettabyte
1024 Zettabytes	1 Yottabyte
1024 Yottabytes	1 Brontobyte
1024 Brontobytes	1 Geopbytes

The Difference between Bit and Byte

Parameters of Comparison	Bit	Byte
Size of Unit	In computers, a bit is the smallest unit of data that can be represented.	A byte is made up of 8 bits.
Values	A maximum of two values may be expressed using a bit.	A byte may hold 256 distinct values.
Represented	Lowercase b.	Uppercase B.
Storage	Only 1's and 0's are stored in the computer's memory.	The alphabet and additional special characters are all covered.
Different Sizes	A kilobit (kb), megabit (Mb), gigabit (Gb), terabit (Tb)	A kilobyte (KB), megabyte(MB), gigabyte (GB), terabyte (TB)

Text Code

Text code is format used commonly to represent alphabets, punctuation marks and other symbols. Four most popular text code systems are −

- EBCDIC
- ASCII
- Extended ASCII
- Unicode

EBCDIC

Extended Binary Coded Decimal Interchange Code is an 8-bit code that defines 256 symbols. It is used in IBM mainframe and midrange systems, but it is rarely encountered in personal computers. Given below is the EBCDIC Tabular column;

Special characters	EBCDIC
<	01001011
(	01001100
+	01001101
/	01001110
&	01010000
:	01111011
#	01111011
@	01111100
‘	01111101
=	01111110
“	01111111
,	01101011
%	01101100
-	01101101
>	01101110

Alphabetic	EBCDIC
A	11000001
B	11000010
C	11000011
D	11000100
E	11000101
F	11000110
G	11000111
H	11001000
I	11001001
J	11010001
K	11010010
L	11010011
M	11010100
N	11010101
O	11010110
P	11010111

ASCII

ASCII (pronounced AS-key) stands for the American Standard Code for Information Interchange is an 8-bit code that specifies character values from 0 to 127. It is commonly used in computers of all types.

ASCII Code	Decimal Value	Character
0000 0000	0	Null prompt
0000 0001	1	Start of heading
0000 0010	2	Start of text
0000 0011	3	End of text
0000 0100	4	End of transmit
0000 0101	5	Enquiry
0000 0110	6	Acknowledge
0000 0111	7	Audible bell
0000 1000	8	Backspace
0000 1001	9	Horizontal tab
0000 1010	10	Line Feed

Extended ASCII

Extended ASCII is an eight-bit code that specifies the characters for values from 128 to 255. The first 40 symbols represent pronunciation and special punctuation and the remaining symbols are graphic symbols.

Unicode

Unicode is a universal character encoding standard that assigns a code to every character and symbol in every language in the world. Since no other encoding standard supports all languages, Unicode is the only encoding standard that ensures that you can retrieve or combine data using any combination of languages.

Features of Unicode

- Provides a consistent way of encoding multilingual plain text
- Defines codes for characters used in all major languages of the world
- Defines codes for special characters, mathematical symbols, technical symbols, and diacritics
- Capacity to encode as many as a million characters
- Assigns each character a unique numeric value and name
- Reserves a part of the code space for private use
- Affords simplicity and consistency of ASCII, even corresponding characters have same code
- Specifies an algorithm for the presentation of text with bi-directional behavior

How Computers Process Data

Two components that are located on a computer's motherboard handle data processing in a computer;

- Central processing unit, or CPU
- Memory.

Central Processing Unit (CPU)

- It is also called Central Processing Unit.
- It is the brain of computer.
- It is also called processor.
- It is the most important component of the computer.
- Computer can't work without CPU.
- It is located on the mother board.
- It carries out most of the work of a computer.
- There are two parts of CPU.
  - ✓ Arithmetic Logic Unit (ALU)
  - ✓ Control Unit (CU)

Arithmetic Logic Unit (ALU)

In the computer system, ALU is a main component of the central processing unit, which stands for arithmetic logic unit and performs arithmetic and logic operations. It is also known as an integer unit (IU) that is an integrated circuit within a CPU or GPU, which is the last component to perform calculations in the processor. It has the ability to perform all processes related to arithmetic and logic operations such as addition, subtraction, and shifting operations, including Boolean comparisons (XOR, OR, AND, and NOT operations). The operations performed by ALU are:

Logical Operations: The logical operations consist of NOR, NOT, AND, NAND, OR, XOR, and more.

Arithmetic Operations: Although it performs multiplication and division, this refers to bit addition and subtraction. But multiplication and division operations are more costly to make. In the place of multiplication, addition can be used as a substitute and subtraction for division.

Control Unit (CU)

The control unit of the central processing unit regulates and integrates the operations of the computer. It receives the input signal/information/instruction from the user and converts into control signals for the execution in the CPU. It controls and directs the main memory, arithmetic & logic unit (ALU), input and output devices, and also responsible for the instructions that are sent to the CPU of a computer. It acts as the central nervous system of a computer system.

Functions

The **functions of the control unit** include the following.

- It directs the flow of data sequence between the processor and other devices.
- It can interpret the instructions and controls the flow of data in the processor.
- It generates the sequence of control signals from the received instructions or commands from the instruction register.
- It has the responsibility to control the execution units such as ALU, data buffers, and registers in the CPU of a computer.
- It has the ability to fetch, decode, handle the execution, and store results.
- It cannot process and store the data

- To transfer the data, it communicates with the input and output devices and controls all the units of the computer.

Memory

The CPU contains the basic instructions needed to operate the computer, but it cannot store entire programs or large sets of data permanently. The CPU needs to have millions (or even trillions, in some computers) of bytes of space where it can quickly read or write programs and data while they are being used. This area is called memory, and it consists of chips either on the motherboard or on a small circuit board attached to the motherboard. This electronic memory allows the CPU to store and retrieve data quickly. There are two types of built-in memory:

- Permanent or Non-volatile Memory
- Nonpermanent or Volatile Memory

Nonvolatile Memory

Nonvolatile chips hold data even when the computer is unplugged. In fact, putting data permanently into this kind of memory is called "burning in the data," and it is usually done at the factory. During normal use, the data in these chips is only read and used-not changed-so the memory is called read-only memory (ROM). Specifically, chips that cannot be changed are called programmable read only memory (PROM). PROM chips are often found on hard drives and printers. They contain the instructions that power the devices. These instructions, once set, never need to be changed. When a computer is turned on, it must know how to start. ROM contains a set of start-up instructions called the basic input output system (BIOS) for a computer. In addition to booting the machine, BIOS contains another set of routines, which ensure that the system is functioning properly and all expected hardware devices are present. This routine is called the power on self-test (POST). Flash memory is a special type of nonvolatile memory. It is often used in portable digital devices for storage. Digital cameras, portable MP3 players, USB "keychain" storage devices, and game consoles all use flash memory.

Volatile Memory

Volatile memory is a type of storage whose contents are erased when the system's power is turned off or interrupted. An example of volatile memory is RAM (random access memory). When a computer boots up, it loads the operating system into RAM. Similarly, when you open an application on your computer or mobile device, it is loaded into RAM. Loading the operating system and active applications into RAM allows them to run much faster. When you are working on a document, it is kept in RAM. If the computer you're using is disconnected from power, your work is lost because it was not stored in permanent (non-volatile) memory.

The Difference between Volatile Memory & Non-Volatile Memory

SL	Volatile Memory	Non-Volatile Memory
1.	Volatile memory is the type of memory in which data is lost as it is powered-off.	Non-volatile memory is the type of memory in which data remains stored even if it is powered-off.
2.	Contents of Volatile memory is stored temporarily.	Contents of Non-volatile memory is stored permanently.
3.	It is faster than non-volatile memory.	It is slower than volatile memory.
4.	RAM (Random Access Memory) is an example of volatile memory.	ROM (Read Only Memory) is an example of non-volatile memory.
5.	In volatile memory, data can be easily transferred in comparison to non-volatile memory.	In non-volatile memory, data cannot be easily transferred in comparison to volatile memory.
6.	In Volatile memory, process can read and write.	In Non-volatile memory, process can only read.
7.	Volatile memory generally has less storage capacity.	Non-volatile memory generally has more storage capacity than volatile memory.

SL	Volatile Memory	Non-Volatile Memory
8.	In volatile memory, the program's data are stored which are currently in process by the CPU.	In non-volatile memory, any kind of data which has to be saved permanently are stored.
9.	Volatile memory is more costly per unit size.	Non-volatile memory is less costly per unit size.
10.	Volatile memory has a huge impact on the system's performance.	Non-volatile memory has a huge impact on a system's storage capacity.
11.	In volatile memory, processor has direct access to data.	In non-volatile memory, processor has no direct access to data.
12.	Volatile memory chips are generally kept on the memory slot.	Non-volatile memory chips are embedded on the motherboard.

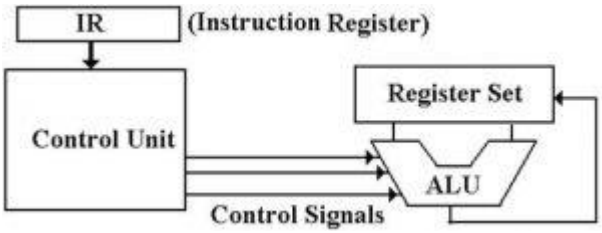
Factors Affecting Processing Speed

In the modern day's competitive world, quick result is the most. We are moving so fast in our day to day life that we want to get results quickly. We use computer to perform various certain task quickly & accurately so that we can get our work done. But there are many factors that could affect the computer system & give us very poor result beyond our expectation. Some of the Factor that can affect our computer system are discussed below:

- Registers
- RAM
- The System Clock
- The Bus
- Cache Memory

1. Registers

- The CPU contains of small memory areas called registers, which store data and instructions while the CPU processes them.
- The size of the registers determines the amount of data with which the computer can work at a one time.



Graph; Computer Registers effect on the processing speed of a computer system

- The register's capacity is in bytes. A register can be of one, two, four, or eight bytes.
- Today most PC`s have 32-bit registers, mean the CPU can process four bytes data at one time. Register sizes are rapidly growing to 64 bits. The bigger size of the register increases the performance of the computer.

2. RAM

- The amount of RAM in a PC has a direct effect on the system`s speed.
- The more RAM a PC has the more program instructions and data can be held in memory, which is faster than storage on disk.
- If a PC does not have enough memory to run a program, it must move data between RAM and the hard disk frequently. This process called swapping, can greatly slow a PC`s performance.

3. The System Clock

- The computer`s system clock sets the pace the CPU by using a vibrating quartz crystal.
- A single "tick" of the clock is the time required to turn a transistor off and back on. This is called a clock cycle.
- Clock cycles are measured in Hertz (Hz), a measure of cycles per second. If a computer has a clock speed of 300 MHz, then its system clock "ticks" 300 million times every seconds.

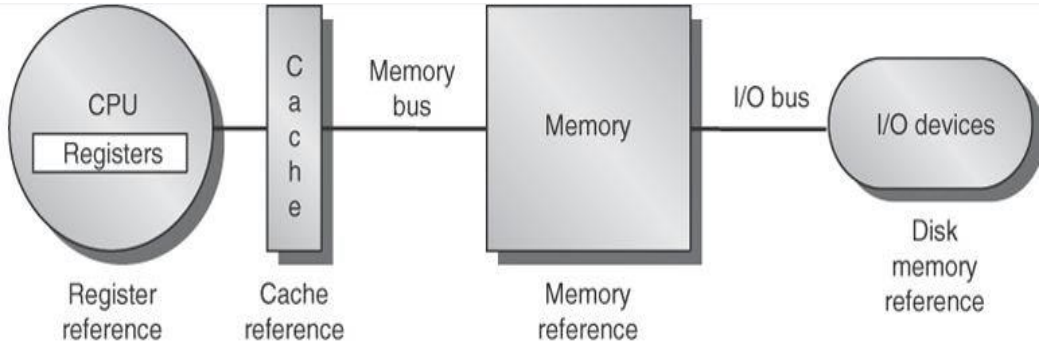
- The faster a PCs clock runs, the more instructions the PC can execute each second.

4. The Bus

- A bus is a path between the components of a computer. Data and instructions travel along these paths.
- The data bus width determines how many bits can be transmitted between the CPU and other devices.
- A higher bus width means that the user can carry more data. It increases the performance of the computer.
- The address bus runs only between the CPU and RAM, and carries nothing but memory addresses for the CPU to use.
- Peripheral devices are connected to the CPU by an expansion bus.

5. Cache Memory

- Cache (pronounced "cash") memory is high-speed memory that holds the most recent data and instructions that have been loaded by the CPU.
- Cache is located directly on the CPU or between the CPU and RAM, making it faster than normal RAM.



- CPU-resident cache is called Level-1 (L1) cache. External cache is called Level-2 (L2) cache.
- The amount of cache memory has a tremendous impact on the computer`s speed.