CPU Time — Response Time — Execution Time.

The actual time the CPU spends computing for a specific task is known as CPU time. It is also called CPU execution time.

CPU Time = CPU clock cycles X Clock cycle Time

$$\text{CPU Time} = \frac{\text{CPU clock cycles}}{\text{clock Rate}}$$

Problem: A program takes 1000 clock-cycles to run a processor running at 2 GHZ. What is the time spent on the CPU by the program.

↑ Clock Rate

clock cycles = 1000

Clock Rate = 2 GHZ

$= 2 \times 10^9$ HZ

CPU Time = ?

$$\text{CPU Time} = \frac{1000}{2 \times 10^9}$$

$= 0.5 \times 10^{-6}$ sec

$= 0.5$ Msec

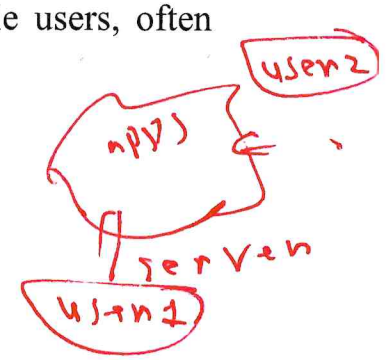
Chapter 1

Classes of Computers

Personal Computer: A **personal computer** is a general-purpose, cost-effective computer that is designed to be used by a single end-user.

Example Desktop computer
Laptop computer

Server: A computer used for running larger programs for multiple users, often simultaneously, and typically accessed only via a network.



Supercomputer: A supercomputer is a large array of small computers. A class of computers with the highest performance. It is built to solve complex problem.

→ weather forecasting
→ Large scale scientific calculations
→ Oil exploration .

Embedded Computer: An **embedded computer** is a combination of hardware and software that is designated to perform a specific task.

Example projector, printer, Television,

Personal Mobile Devices (PMDs): PMDs are small wireless device to connect to the internet. It is both portable and capable of storing, transmitting or processing electronic data or images.

smartphone.

Cloud Computing: It refers to large collections of servers that provide service over internet. Instead of buying, owning, and maintaining physical data centers and servers, you can access technology services, such as computing power, storage, and databases, on an as-needed basis from a cloud provider.

Amazon AWS.

AWS → Amazon Web Service

High Level Languages:

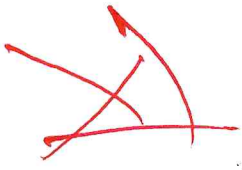
- High level languages resemble human languages in many ways.
- They are designed to be easy for human beings to write programs in and to be easy for human beings to read.

Example : C, C++, Java, Python.

X = Y + Z →

Low Level Languages

- The kind of language a computer can understand is called a low- level Language.
- This instruction may be unclear to human user. Low level languages do not resemble human languages. However, it is understood by the computer



ADD X9, X20, X21

X9 = X20 + X21

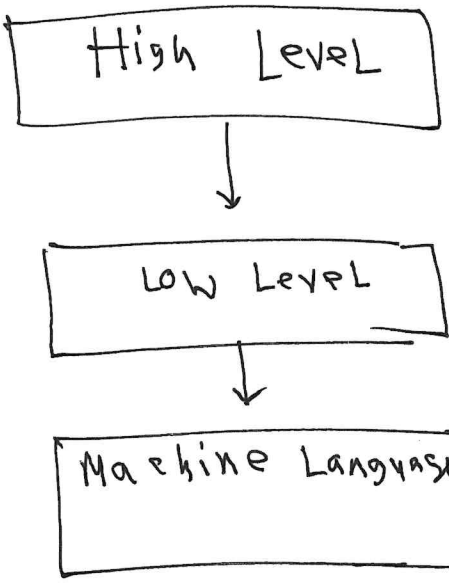
X = Y + Z

Machine Languages

- Programs written in the form of zeros and ones are called machine languages.
- Any high-level language must be translated into machine language before computer can read and understand the program.

32-bits → 0000 0000 0100 0011 1100 1101 1001 0000

High Level Language to Machine Language



X = Y + Z

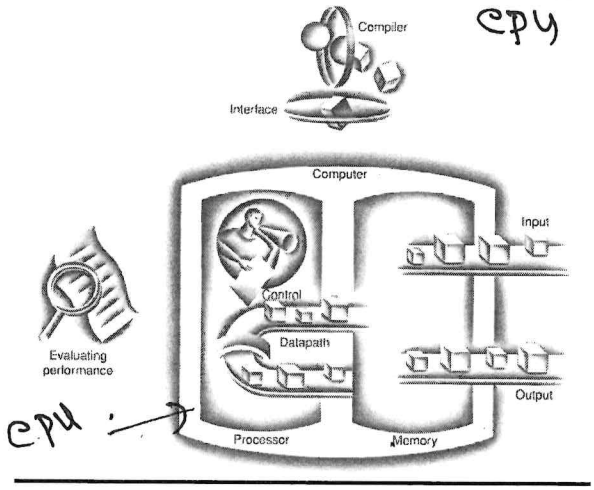
ADD X9, X20, X21

→ 0000 0000 0100 0011 1100 1101 1001 0000

Components of a Computer

Five components: Input, Output, Memory, Control, Datapath

cpu



cpu :

Input : Mouse, keyboard

Output : printer, display

Memory : Hard-disk, flash.

Define volatile and non-volatile memory?

Volatile memory : DRAM (Dynamic Random Access Memory)

Non-volatile memory : Flash drive, DVD

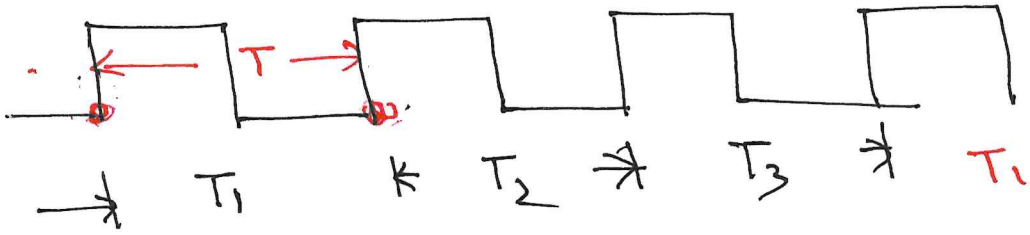
Define response time and throughput? How to improve response time and throughput?

Response Time : Time required to complete a task
Execution Time.

Throughput : Total number of work done in a given time.

→ Adding more processors
→ Adding the processor with fasten version

CPU Clocking - Clock Period or Clock cycle time (T) and Clock frequency or Clock rate (f):



$T_1 = T_2 = T_3 = T$

Clock-Period T = Duration of a clock cycle.
clock or cycle time

Clock-frequency or Clock-Rate

$$f = \frac{1}{T}$$

$$\text{Performance}_X = \frac{1}{\text{Execution Time}_X}$$

Problem: If computer A runs a program in 10 seconds and computer B runs the same program in 15 seconds, how much faster is A than B?

$$\frac{\text{Performance}_A}{\text{Performance}_B}$$

$$\text{Performance}_A = \frac{1}{\text{Execution Time}_A}$$

$$\text{Performance}_B = \frac{1}{\text{Execution Time}_B}$$

$$\frac{\text{Performance}_A}{\text{Performance}_B} = \frac{\text{Execution Time}_B}{\text{Execution Time}_A}$$

$$= \frac{15}{10}$$

$$= 1.5$$

$$\text{Performance}_A = 1.5 \times \text{performance}_B$$