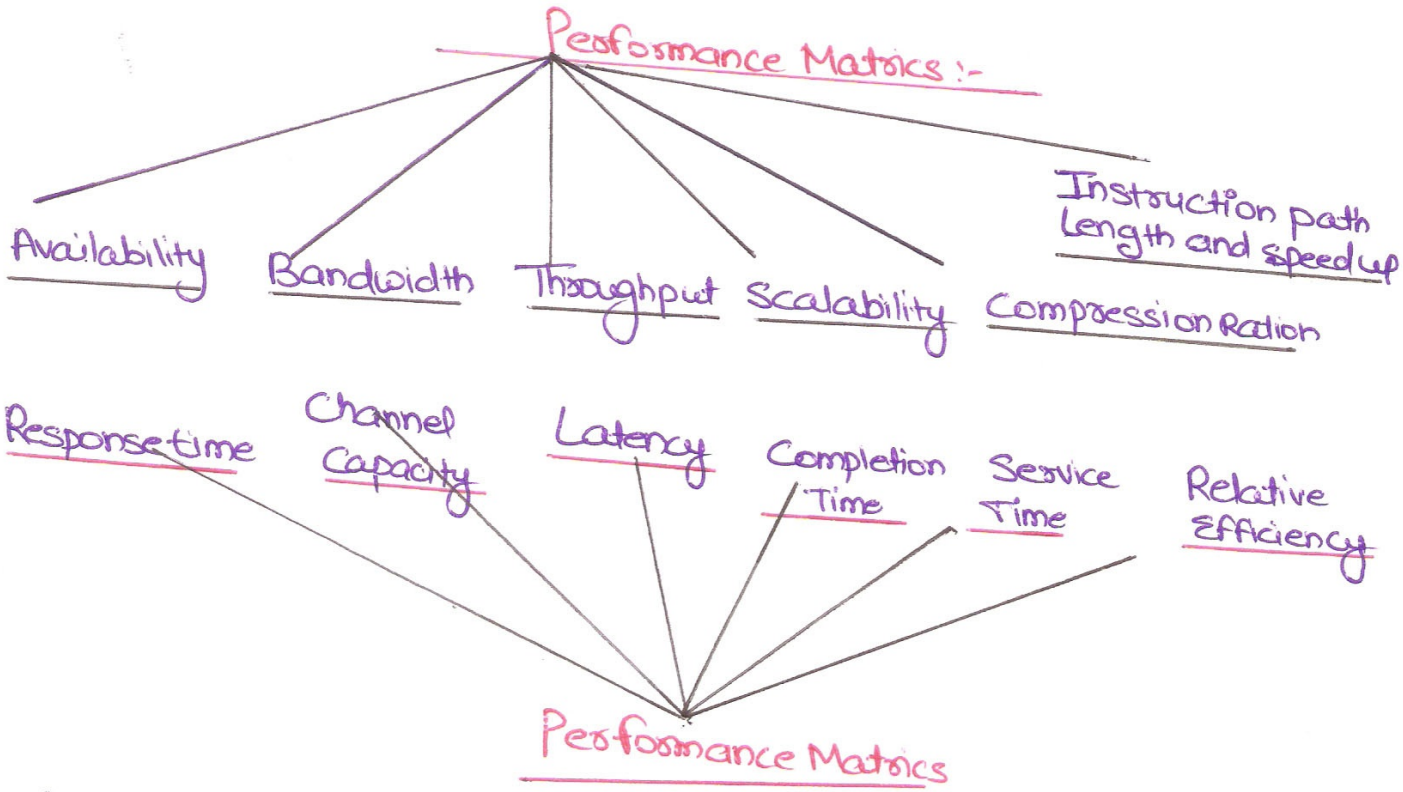
Performance Matrics :-

It is a way by which we measure CPU performance

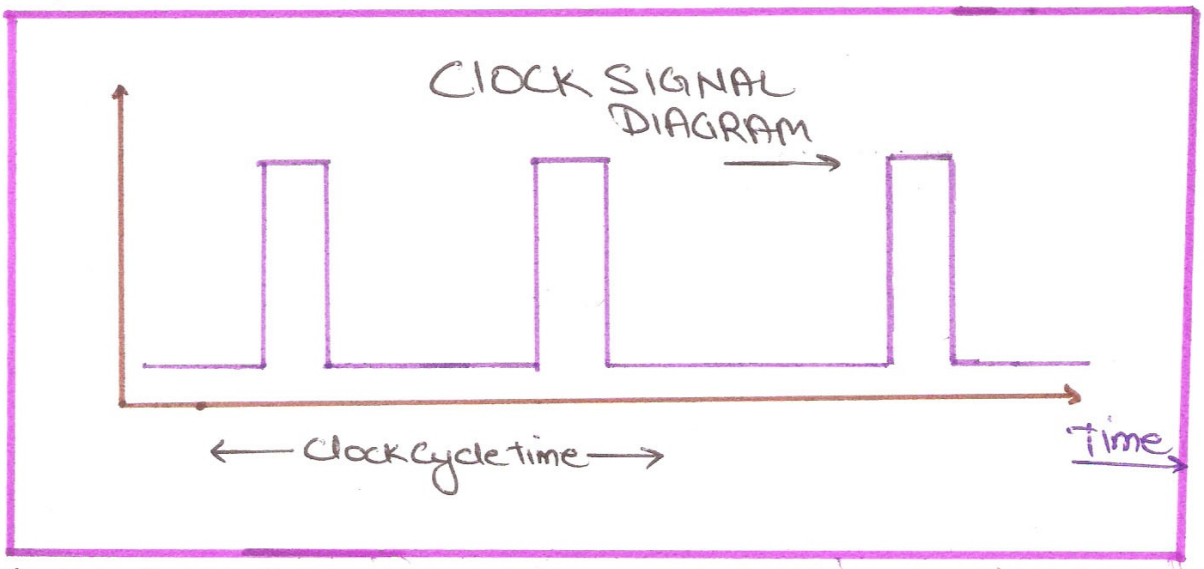


Performance Analysis should help answering question such as how fast can a program be executed using a given computer? for this we need to determine the time taken by a Computer to execute a given job.

We define the clock Cycle time as the time between two Consecutive rising (trailing) edges of a periodic clock Signal.

Clock cycles allow counting unit computations, because the storage of computation results is synchronized with rising (trailing) clock edges.

The no. of CPU clock cycles for executing a job to be the cycle count (CC), the cycle time (CT), and the clock frequency by $f = 1/CT$.



Time taken by CPU to execute a job

$$\text{CPU time} = CC \times CT = CC/f$$

It may be easier to count the number of instructions executed in a given program as compared to counting the number of CPU clock cycles needed for executing that program.

∴ the average no. of clock cycles per instruction (CPI) has been used as an alternate performance measure.

$$CPI = \frac{\text{CPU clock cycle for program}}{\text{Instruction Count}}$$

$$\text{CPU time} = \text{Instruction Count} \times \text{CPI} \times \text{Clock Cycle time}$$

$$= \frac{\text{Instruction Count} \times \text{CPI}}{\text{Clock rate}}$$

It is known that the instruction set of a given machine consists of a no. of instruction categories :- ALU (Simple assignment and arithematic and logic instructions), load, store, branch and so on

In the case that the CPI for each Instruction Category is known, the over all CPI can be computed as

$$CPI = \frac{\sum_{i=1}^{n} CPI_i \times I_i}{\text{Instruction Count}}$$

Where I_i is the no. of times an instruction of type i is executed in the program CPI_i is the average no. of clock cycles needed to execute such instruction.

Example :- CPI for a machine A. Assume CPU's clock rate 200MHz

Instruction Category	Percentage of occurrence	No. of Cycles Per instruction
ALU	38	1
Load & Store	15	3
Branch	42	4
Others	5	5

Assuming the execution of 100 instructions, the overall CPI can be computed as:-

$$CPI_a = \frac{\sum_{i=1}^{n} CPI_i \times I_i}{\text{Inst}^n \text{ Count}} = \frac{38\times1 + 15\times3 + 42\times4 + 5\times5}{100} = 2.76$$

→ CPI Reflects the organization and the instruction set Architecture of the processor and

→ Instruction Count reflects the instruction set Architecture and Compiler technology used.