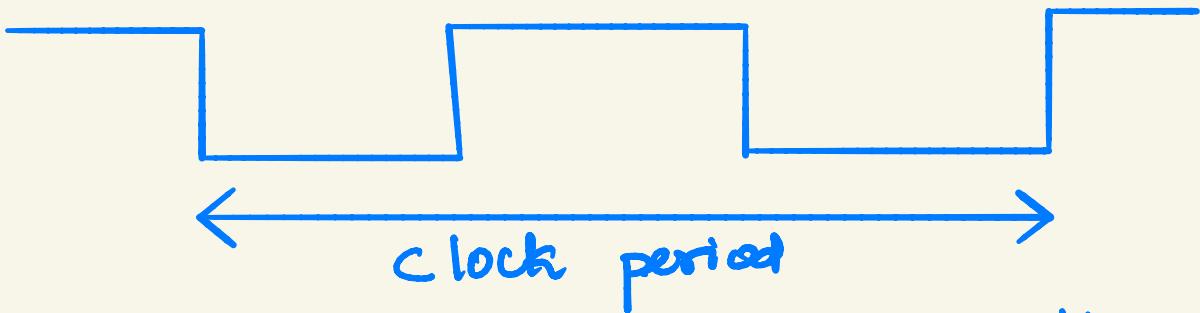



Performance of processor.

- Execution time
- Throughput
- CPU time
- MIPS - million instruction per sec
- MFLOPS - millions of floating point operations per sec

CLOCK



clock time \Rightarrow amount of time
that the clock period elapses

clock rate \Rightarrow inverse of clock time

eg., Clock Time = 5 ns

$$\text{Clock rate} = \frac{1}{5 \times 10^{-9}} =$$

Clock cycle time = seconds/cycle

Clock rate = cycles/second

CPI = Clock Cycles per Instruction

$$\text{CPI} = \frac{\text{cycles/second} \times \text{Instruction count}}{\text{Total number of instructions}}$$

Eg., Consider Processor A, its clock runs at 200 MHz.

Instruction type	Frequency	Cycles
Load & Store	30%	6 cycles
Arithmetic instructions	50%	4 cycles
All other	20%	3 cycles

Assumption: processor only executes one instruction at a time.

Calculate the CPI

Consider there are 100 instructions,
then 30 instructions - Load/Store
50 instructions - Arithmetic
20 instructions - Others.

$$\begin{aligned}
 CPI &= \frac{(6 \times 30) + (4 \times 50) + (3 \times 20)}{100} \\
 &= \frac{440 \text{ cycles}}{100 \text{ Instructions}} \\
 &= 4.4 \text{ cycles per Instruction.}
 \end{aligned}$$

$$\text{Execution time} = \frac{\text{Instruction count} \times CPI \times \text{clock cycle time}}$$

$$\text{Execution time} = \frac{\text{Instruction count} \times CPI}{\text{clock rate}}$$

$$\text{MIPS} = \frac{\text{Instruction Count}}{\text{Execution time} \times 10^6}$$

$$= \frac{\text{Instruction count}}{\text{Instructions count} \times \text{CPI} \times \text{clock cycle time} \times 10^6}$$

$$\boxed{\text{MIPS} = \frac{1}{\text{CPI} \times \text{clock cycle time} \times 10^6}}$$

$$\boxed{\text{MIPS} = \frac{\text{Clock rate}}{\text{CPI} \times 10^6}}$$

$$\boxed{\text{Performance} = \frac{1}{\text{Execution time}}}$$

Eg:- Machine A runs instruction set in 100 seconds, machine B runs the same instruction set in 125 seconds

$$\text{speed up factor} = \frac{125}{100}$$

$$= 1.25$$

performance of machine A is 1.25 times faster than performance of machine B.

Eg:- Two processor A and B have clock frequencies of 400 MHz and 900 MHz respectively. Suppose A can execute with an average of 3 steps and B can execute with an average 5 steps. for the execution of same instruction which processor is faster?

Consider only one instruction is
executed in both the processors
(same instruction)

$$\text{Execution time (A)} = \frac{1 \times 3}{700 \times 10^6} =$$

$$\text{Execution time (B)} = \frac{1 \times 5}{900 \times 10^6} =$$
