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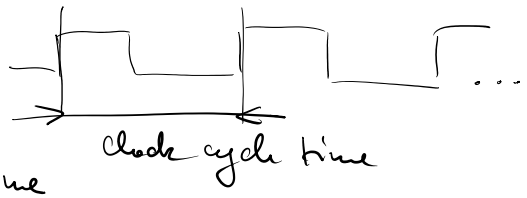
2.4 The Processor Performance Equation

- Clock cycle time, clock frequency



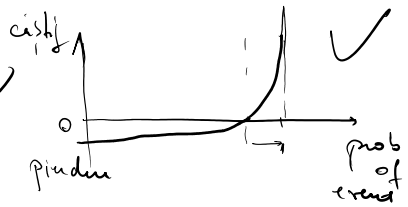
CPU_{time} = CPU clocks for a program × clock cycle time

$$CPU\ time = \frac{CPU\ clocks\ for\ a\ program}{Clock\ frequency}$$

IC – Instruction Count
CPI – Clock Cycles Per Instruction

$$CPU\ time = Instruction\ Count \times Clock\ cycles\ per\ instruction \times Clock\ Cycle\ Time = IC \times CPI \times clock\ cycle\ time$$

$$\frac{Instructions}{Program} \times \frac{clock\ cycles}{Instruction} \times \frac{Time}{Clock\ cycle} = \frac{Time}{Program}$$



Clock cycle time ⟶ hardware technology & organization
CPI ⟶ Computer Organization & instruction set architecture (RISC)
IC ⟶ Instruction set architecture & compiler technology

$$CPU\ clock\ cycles = IC \times CPI = \sum_{i=1}^{n} IC_i \times CPI_i$$

i - instruction subset

IC_i – the number of times instruction i is executed in a program
CPI_i – the average no. of clocks per instruction type i

$$CPI = \frac{\sum_{i=1}^{n} IC_i \times CPI_i}{IC} = \sum_{i=1}^{n} \frac{IC_i}{IC} \times CPI_i$$

→ fraction of instructions (type) i from the IC