C O Tutorial 4

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Sol-1

Program	time on M_1	time on M_2
1	2.0	1.5
2	5.0	10 sec

(1) For program 1

$$(\text{performance of } M_1) = \frac{1}{2.0} = 0.5$$

$$\text{performance of } M_2 = \frac{1}{1.5} = 0.666$$

M_2 is faster to M_1 by n

$$n = \frac{\text{execution times } M_1}{\text{execution times } M_2} = \frac{2}{1.5} = 1.33$$

(2) ~~for~~ M_1 is faster by n

$$n = \frac{\text{execution time } M_2}{\text{execution time } M_1}$$

$$= \frac{10}{5} = 2.0$$

Sol-2 ① CPU execute time A

$$= \frac{\text{cpu clock cycle A}}{\text{clock rate A}}$$

$$= 12 \text{ sec} = \frac{\text{cpu clock cycles}}{5 \text{ GHz}}$$

CPU clock cycles A = 60 G Cycles

② CPU execute time B

$$= 1.2 \times \frac{\text{CPU clock cycles A}}{\text{clock rate B}}$$

$$\Rightarrow 10 \text{ sec} = \frac{1.2 \times 60 \text{ G Cycles}}{\text{clock rate B}}$$

$$\text{CPU rate B} = \frac{72}{10} = 7.2 \text{ GHz}$$

so desired rate is 7.2 GHz

Scanned with CamScanner

Sol-3 Comp A → 250 ps clock cycle time
CPI 3.0 for some program

Comp B → 500 ps clock cycle time
CPI 2.2 for same program

I = no. of instructions for program

CPU clock $cycles_A$ = I × 3.0

CPU clock $cycles_B$ = I × 2.2

Now we can compute CPU time for each computer

CPU $time_A$ = CPU clock $cycles_A$ × clock cycle time

= I × 3.0 × 250 ps = 750 × I ps

Illy for B

CPU $time_B$ = I × 2.2 × 500 = 1100 I ps

Clearly A is faster. The amound faster is given by ratio of execution times.

$$\frac{\text{CPU performance}_A}{\text{CPU performance}_B} = \frac{\text{Execution time}_B}{\text{Execution time}_A}$$

$$= \frac{1100 \text{ I ps}}{750 \text{ I ps}} = 1.466$$

A is 1.466 time faster than B

Sol-4:— CPU clock cycles $= \sum_{i=1}^{n} (CPI_i \times \text{Instruction count})$

$(\text{CPU clock cycles})_1 = (6\times2 + 1\times1 + 2\times4)\times10^9$
$= (12+1+8)\times10^9$
$= 21\times10^9$

$(\text{CPU clock cycles})_2 = (12\times2 + 2\times1 + 1\times4)\times10^9$
$= (24+2+4)\times10^9$
$= 30\times10^9$

$\text{Execution time} = \dfrac{\text{CPU clock cycle}}{\text{clock rate}}$

$(\text{Ex. time})_1 = \dfrac{21\times10^9}{700\times10^6} = 30 \text{ sec}$

$(\text{Ex. time})_2 = \dfrac{30\times10^9}{700\times10^6} = 42.85 \text{ sec}$

compiler 1 generates faster program

$\text{MIPS} = \dfrac{\text{Instruction count}}{\text{Execution time}\times10^6}$

$(\text{MIPS})_1 = \dfrac{(6+1+2)\times10^9}{30\times10^6} = 300$

$(\text{MIPS})_2 = \dfrac{(12 \cancel{*} 2+1)\times10^9}{42.85\times10^6} = 350.05$

thus Compiler 2 or ~~MIPS~~$_2$ has higher MIPS rating but compiler 1 runs faster

(5) Amdahl's law:

It is named after computer scientist Gene Amdahl (IBM). also known as Amdahl's argument. It is formula which gives the theoretical speedup in latency of the execution of a task at a fixed workload that can be expected of a system whose resources are improved. Its formula for finding maximum improvement possible by just improving particular part of system.

$$\text{speedup} : \frac{\text{Pe (Performance with enhancement)}}{\text{Pw (Performance without enhancement)}}$$

$$= \frac{\text{Ew (execution without enhancement)}}{E_E \text{ (execution with enhancement)}}$$

$$S = \frac{1}{\left((1 - \text{Fenhanced}) + \frac{\text{Fraction enhanced}}{\text{Speedup enhancement}} \right.}$$

$$S = \frac{1}{1 - f + \frac{f}{F}}$$

examples:- (1) FP Instruction improved to run 2x as fast but only 10 % of all executed instruction order

$$S = \frac{1}{1 - 0.1 + \frac{0.1}{2}} = 1.053$$

(2) we want overall speedup of 2, FP instruction by 4x find FP instruction fraction

$$S = \frac{1}{1 - f + \frac{f}{F}} = 2 = \frac{1}{1 - f + \frac{f}{4}} \Rightarrow \boxed{f = 0.667}$$