Saishan Ramesh Kumar

Date:

CSCI113-Lab 3

1) $\text{CPU Time} = \frac{\text{Instruction Count} \times CPI}{\text{Clock Rate}}$

M1: Clock Rt → 900MHz, 500 million, Prog 1 = 20s

M2: Clock Rt → 800MHz, 400 million, Prog 1 = 15s

Program 1:

M1: $20 = \frac{(500\times10^6)(CPI)}{900\times10^6}$

$1.8\times10^{10} = (500\times10^6)(CPI)$

$CPI = 36$ #

M2: $15 = \frac{(400\times10^6)(CPI)}{800\times10^6}$

$1.2\times10^{10} = (400\times10^6)(CPI)$

$CPI = 30$ #

2) Program 2:

M1: Clock Rt → 900MHz, 500×10^6, Prog 2 = 8s

M2: Clock Rt → 800MHz, 400×10^6, Prog 2 = 10s

M1: $8 = \frac{(500\times10^6)(CPI)}{900\times10^6}$

$7200000000 = (500\times10^6)(CPI)$

$CPI = 14.4$ #

M2: $10 = \frac{(400\times10^6)(CPI)}{800\times10^6}$

$8000000000 = (400\times10^6)(CPI)$

$CPI = 20$ #

3) $MIPS = \frac{\text{Clock Rate}}{CPI \times 10^6}$

M1 = 800MHz, 800×10^6

M2 = 900MHz, 900×10^6

M1:

CPI_A=1 ↳ $\frac{800\times10^6}{1\times10^6} = 800$

CPI_B=2 ↳ $\frac{800\times10^6}{2\times10^6} = 400$

CPI_C=3 ↳ $\frac{800\times10^6}{3\times10^6} = 266.67$

CPI_D=4 ↳ $\frac{800\times10^6}{4\times10^6} = 200$

The peak performance for M1 would be CPI_A as it performs 800 million instructions every second. #

M2:

CPI_A=3 ↳ $\frac{900\times10^6}{3\times10^6} = 300$

CPI_B=2 ↳ $\frac{900\times10^6}{2\times10^6} = 450$

CPI_C=4 ↳ $\frac{900\times10^6}{4\times10^6} = 225$

CPI_D=2 ↳ $\frac{900\times10^6}{2\times10^6} = 450$

The peak performance of M2 would be CPI_B and CPI_D as they both perform 450 million instructions per second. #

Date:

4) Instruction = 1×10^6

So, $M1 = \dfrac{[(1\times10^6\times1)+(1\times10^6\times2)+(1\times10^6\times3)+(1\times10^6\times4)]}{800\times10^6}$

$= \dfrac{1000000+2000000+3000000+4000000}{800\times10^6} = \dfrac{1}{80} = 0.0125$ seconds #

$M2 = \dfrac{[(1\times10^6\times3)+(1\times10^6\times2)+(1\times10^6\times4)+(1\times10^6\times2)]}{800\times10^6}$

$= \dfrac{3000000+2000000+4000000+2000000}{800\times10^6} = \dfrac{11}{800} = 0.01375$ seconds #

$\therefore \dfrac{M_1}{M_2} = \dfrac{0.0125}{0.01375} = 0.909$, M1 is 0.909 times faster than M2. #

5) CPU Time = $\dfrac{\text{Instruction Count}\times\text{CPI}}{\text{Clock Rate}}$ Instruction Count: 1×10^6 Clock Rate $= x$
M2: 0.01375

$0.01375 = \dfrac{[(1\times10^6\times1)+(1\times10^6\times2)+(1\times10^6\times3)+(1\times10^6\times4)]}{\text{Clock Rate}/x}$

$0.01375x = 1000000+2000000+3000000+4000000$

$x = \dfrac{10000000}{0.01375} = 727.27\,MHz$ #

6) Performance $= \dfrac{1}{\text{Execution Time}} = \dfrac{1}{15} = 0.067$ Clock cycle = CPU Time × Clock Rate
$= 15\times2.5 = 37.5\times10^9$

M2 clock rate $= \dfrac{1.5\times\text{Clock Cycle}_{M1}}{(0.067\times2.5)}$

$= \dfrac{(1.5)(37.5\times10^9)}{(0.067\times2.5)} = 3.358\times10^{11}$

$= 33.58\times10^{10}\,GHz$ #