CS113

Assignment 3 Key

#1.

M_1 — 900 MHz vs. M_2 — 800 MHz

prog1 — $CPU_{exe} = 20$ sec, $IC = 500M$ | prog1 — $CPU_{exe} = 15$ sec, $IC = 400M$

Compute CPI

$$CPU_{exe} = IC * CPI * CCT$$

$$\Rightarrow CPI = \frac{CPU_{exe}}{IC * CCT} = \frac{CPU_{exe} * rate}{IC}$$

for prog1,

$$\text{CPI on } M_1 = \frac{20 * 900M}{500M} = 36$$

$$\text{CPI on } M_2 = \frac{15 * 800M}{400M} = 30$$

#2. given

M_1: prog2 — $CPI = 36$, $CPU_{exe} = 8$ sec

M_2: prog2 — $CPI = 30$, $CPU_{exe} = 10$ sec

Compute IC

$$IC = \frac{CPU_{exe} * rate}{CPI}$$

for prog2,

$$\text{IC on } M_1 = \frac{8\text{ sec} * 900M}{36} = 200M$$

$$\text{IC on } M_2 = \frac{10\text{ sec} * 800M}{30} = 266.66\ldots M$$

#3.

$$MIPS = \frac{IC}{CPU_{exe} * M} = \frac{rate}{CPI * M}$$

for the peak (max) MIPS rate, CPI should be minimal.

$$M_1: \frac{800M}{1 * M} = 800\text{ MIPS}$$ — // all instr's in IC are type A.

$$M_2: \frac{900M}{2 * M} = 450\text{ MIPS}$$ — // all instr's in IC are type ~~B~~ D

#4.

type		CPI(M1)	CPI(M2)
A	25%	1	3
B	25%	2	2
C	25%	3	4
D	25%	4	2

Compute cpuexe and compare

$$CPU_{-M1} = IC * CPI * CCT$$

$$= \frac{IC * [(0.25*1)+(0.25*2)+(0.25*3)+(0.25*4)}{800M}$$

$$= \frac{IC*2.5}{800M}$$

vs.

$$CPU_{-M2} = \frac{IC * [(0.25*3)+(0.25*2)+(0.25*4)+(0.25*2)}{900M}$$

$$= \frac{IC*2.75}{900M}$$

$$\Rightarrow M_2 \text{ is } \frac{\left(\frac{IC*2.5}{800M}\right)}{\left(\frac{IC*2.75}{900M}\right)} = \frac{\frac{2.5}{800}}{\frac{2.75}{900}} = 1.0227\ldots \times$$

faster.

#5. from #4, $\frac{IC*2.5}{X} = \frac{IC*2.75}{900M}$

Solve for X. $\Rightarrow X = \frac{(IC*2.5)*900M}{IC*2.75} = 818.1818\ldots MHz.$

#6. $rate\_C_2 = \frac{clock\ cycles\_C_2}{CPUexe\_C_2} = \frac{1.5 * clock\ cycles\_C_1}{7.5\ sec}$

double performance from 15 sec.

$clock\ cycles\_C_1 = CPUexe\_C_1 * rate\ C_1$

$= 15\ sec * 2.5\ GHz = 37.5 * 10^9$

$$\Rightarrow rate\ C_2 = \frac{1.5 * 37.5 * 10^9}{7.5\ sec} = 7.5\ GHz$$