CS M151B HW1

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1 1.5

1.1 a

Instructions per second is $\frac{frequency}{CPI}$
For P1 is $\frac{3G}{1.5}$
For P2 is $\frac{2.5G}{1.0}$
For P3 is $\frac{4.0G}{2.2}$
So instructions per second: P2 > P1 > P3
P2 has the highest performance.

1.2 b

Number of cycles:
P1: 10*3*$10^9 = 3 * 10^{10}$
P2: 10*2.5*$10^9 = 2.5 * 10^{10}$
P3: 10*4.0*$10^9 = 4 * 10^{10}$
Number of instructions:
P1: $3 * 10^{10}/1.5 = 2 * 10^{10}$
P2: $2.5 * 10^{10}/1.0 = 2.5 * 10^{10}$
P3: $4 * 10^{10}/2.2 = 1.8 * 10^{10}$

1.3 c

0.7/1.2 = 0.583
So the clock rate should be increased to 1/0.583 = 171.4% of before.
P1: 5.14GHz
P2: 4.29GHz
P3: 6.86GHz

2 1.6

2.1 a

P1: CPI = 0.1*1+0.2*2+0.5*3+0.2*3 = 2.6
P2: CPI = 0.1*2+0.2*2+0.5*2+0.2*2 = 2

2.2 b

P1: cycles = 2.6*1.0 $* 10^6 = 2.6 * 10^6$
P2: cycles = 2*1.0 $* 10^6 = 2 * 10^6$

3 1.7

3.1 a

A: number of cycles = $1.1s/1ns = 1.1 * 10^9$. CPI = $\frac{1.1*10^9}{1*10^9} = 1.1$
B: number of cycles = $1.5s/1ns = 1.5 * 10^9$. CPI = $\frac{1.5*10^9}{1.2*10^9} = 1.25$

3.2 b

Number of cycles for A/ number of cycles for B = 1.1/1.5 = 0.733
The clock of processor running code compiler by A is faster by 1/0.733-1 = 36.36%.

3.3 c

The number of cycles using new compiler is $6.0 * 10^8 * 1.1 = 6.6 * 10^8$.
Compared with using A: $\frac{1}{\frac{6.6*10^8}{1.1*10^9}}$ -1 = 66.7%
Compared with using B: $\frac{1}{\frac{6.6*10^8}{1.5*10^9}}$ -1 = 127.2%

4 1.13

4.1 1.13.1

The total reduced time is 70*0.2 = 14s.
So the new total time is 250-14=236s.

4.2 1.13.2

The total reduced time is 250*0.2=50s.
The time for INT operation is 250-70-85-40=55s.

So INT operation needs to reduce 50/55 = 90.9%.

4.3 1.13.3

Branch instruction takes 40/250 = 16% of time.
It is less than 20%, so by Amdahl's law, the total time cannot be reduced by 20% by reducing only branch instruction time.