Homework 1

Name: Yiqiao Jin

UID: 305107551

1.5

a. We know that:

CPU time (s) = Instruction Count (i) × CPI (clock/i) / Clock rate (c/s)

P1: $\frac{3GHz}{1.5} = 2 \times 10^9$

P2: $\frac{2.5GHz}{1.0} = 2.5 \times 10^9$

P3: $\frac{4GHz}{2.2} = 1.82 \times 10^9$

So P2 has the highest performance expressed in instructions per second

b. Number of cycles:

P1: $3GHz \times 10sec = 3 \times 10^{10}$

P2: $2.5GHz \times 10sec = 2.5 \times 10^{10}$

P3: $4GHz \times 10sec = 4 \times 10^{10}$

Number of instructions:

P1: $2 \times 10^9 \times 10sec = 2 \times 10^{10}$

P2: $2.5 \times 10^9 \times 10sec = 2.5 \times 10^{10}$

P3: $1.82 \times 10^9 \times 10sec = 1.82 \times 10^{10}$

c. The ratio of the new clock rates wrt the old one is $\frac{1.2}{0.7} = 1.714$

Multiply the clock rates by this ratio, the clock rates for P1-P3 becomes 5.14GHz, 4.29GHz, 6.86GHz

1.6

a.

P1: CPI = $1 \times 0.1 + 2 \times 0.2 + 3 \times 0.5 + 3 \times 0.2 = 2.6\ clocks/i$

P2: CPI = 2 clock/i

b.

According to the CPIs,

P1 needs 2.6×10^6 cycles;

P2 needs 2×10^6 cycles;

Time taken:

P1: $2.6 \times 10^6/(2.5GHz) = 1.04 \times 10^{-3}s$

P2: $2 \times 10^6/(3.0GHz) = 0.66 \times 10^{-3}s$

So P2 is faster than P1.

1.7

a.

CPU time (s) = Instruction Count (i) $\times$ CPI (clock/i) / Clock rate (c/s)

OR

CPI (clock/i) = CPU time (s) $\times$ Clock rate (c/s) / Instruction Count

Clock cycle time = 1ns means a clock rate of 10^9 clocks/s, or executing 10^9 cycles per second.

A: CPI $= 1.1s \times 10^9/10^9 = 1.1$

B: CPI $= 1.5s \times 10^9/1.2 \times 10^9 = 1.25$

b.

ratio: $\frac{F_B}{F_A}$ = $(1.2 \times 10^9 \times 1.25)/(10^9 \times 1.1) = 1.37$

So 37% faster

c.

Speedups:

A: $(10^9 \times 1.1)/(6 \times 10^8 \times 1.1) = 1.67$, or 67% speedups

B: $(1.2 \times 10^9 \times 1.25)/(6 \times 10^8 \times 1.1) = 2.27$, or 127% speedups

1.13

a.

The reduction is $70 - 70 \times 0.8 = 14s$

The reduction time takes 14/250 = 5.6%

b.

$250 \times 0.8 = 200 = 70 + 85 + 40 + T$

$T = 5s$

Thus the time for INT must be reduced by $(55 - 5)/55$ = 90.9%

c.

No, since $T_{branch} = 40s < 0.2 \times T_{total} = 50s$