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Homework 1

CS 382
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Problem 1

a.
P1. $3.2GHz \div 1.5 = 2.13 \times 10^9$ instructions per second
P2. $2.0GHz \div 1.0 = 2.0 \times 10^9$ instructions per second
P3. $4.0GHz \div 2.3 = 1.74 \times 10^9$ instructions per second

b.
P1.
$3.2GHz \times 10s = 3.2 \times 10^10$ cycles
$3.2GHz \div 1.5 = 2.13 \times 10^10$ instructions

P2.
$3.2GHz \times 10s = 2.0 \times 10^10$ cycles
$2.0GHz \div 1.0 = 2.0 \times 10^9$ instructions

P3.
$4.0GHz \times 10s = 1.74 \times 10^10$ cycles
$4.0GHz \div 2.3 = 1.74 \times 10^9$ instructions

c.
execution time = (number of instructions $\times$ CPI) $\div$ clockrate
new clockrate = 1.71 $\times clockrate$
$P1$:3.2 $\times 1.71 = 5.47GHz$
P2: $2.0 \times 1.71 = 3.42GHz$
P3: $4.0 \times 1.71 = 6.84GHz$

Problem 2

a.
A = $(1 \times 10^6) \times 30\% = 3 \times 10^5$
B = $(1 \times 10^6) \times 20\% = 2 \times 10^5$
C = $(1 \times 10^6) \times 30\% = 3 \times 10^5$

P1 = $2.2 \times 10^6 \div 1 \times 10^6 = 2.2$
P2 = $2.0 \times 10^6 \div 1 \times 10^6 = 2.0$

b.
P1 = $(1 \times 3 \times 10^5) + (2 \times 2 \times 10^5) + (3 \times 2 \times 10^5) = 2.2 \times 10^6$
P1 = $(2 \times 3 \times 10^5) + (2 \times 2 \times 10^5) + (2 \times 2 \times 10^5) = 2.0 \times 10^6$

c.
P1: $(2.2 \times 10^6) \div 2.5 \times 10^9 = .88ms$
P2: $(2.0 \times 10^6) \div 3 \times 10^9 = .88ms$

Problem 3

a.
A = $1.2 \div (109 \times 109) = 1.2$
B = $1.5 \div (1.2 \times 109 \times 109) = 1.25$

b.
Clock speed A = $(109 \times 1.2 \times ClockspeedB) \div (1.2 \times 109 \times 1.25)$
$ClockspeedA = .8 \times ClockspeedB$
$A's Clockspeed is 20\% slower than B's$

c.
$C : 6.0 \times 1.1 \times 108 \times 109 = .66s$
$A : 1.2 \times A = .66 \times C$
$1.82 \times A = C$
$C is 1.82 times faster than A$
$B : 1.5 \times B = .66 \times C$
$2.27 \times B = C$
$C is 2.27 times faster than B$

Problem 4

a.
Yield of Wafer 1 = $1 \div (1 + .022 \times .5 \times 2.10)^2 = .959$
Yield of Wafer 2 = $1 \div (1 + .031 \times .5 \times \pi)^2 = .909$

b)
Cost of Wafer 1 = $12 \div (84 \times .959) = \$.15$
$Cost of Wafer 2 = 15 \div (100 \times .909) = \$.16$

c)
$Area of Wafer 1 = 2.10 \div (1.1 \times 84) = 1.91 \text{cm}^2$
Yield of Wafer 1 = $1 \div (1 + 1.15 \times .022 \times .5 \times 1.91)^2 = .957$

Area of Wafer 2 = $\pi \div (1.1 \times 100) = 2.86cm^2$
Yield of Wafer 2 = $1 \div (1 + 1.15 \times .031 \times .5 \times 2.86)^2 = .905$

Problem 5

a.
$(50 \times 10^6 \times .6 \times 2) + (100 \times 10^6 \times .6 \times 2) + (80 \times 10^6 \times .7 \times 8) + (16 \times 10^6 \times .7 \times 4) \div 2GHz = 336.4 \times 10^6$
$336.4 \times 10^6 \div 502 \times 10^6 = .67$
33% faster execution time

b.
$.95 \times 502 \times 10^6 = ((50 \times 10^6 \times$ new CPI$) + (100 \times 10^6 \times 2) + (80 \times 10^6 \times 8) + (16 \times 10^6 \times 4)) \div$ 2GHz
new CPI = .996

c. $.70 \times 502 \times 10^6 = ((50 \times 10^6 \times 2) + (100 \times 10^6 \times 2) + (80 \times 10^6 \times$ new CPI$) + (16 \times 10^6 \times 4)) \div$ 2GHz
new CPI must be improved 4.235 for the program to be 30% faster