Computer Architecture Hw1

A. Exercise 1.3

a. 1.3.1:
P3(0.83) > P1(0.75) > P2(0.66), thus, P2 has the best performance.

b. 1.3.2:
P1: $2 \times 10^{10}[cycles], 1.33 \times 10^{10}[instrutions]$
P2: $1.5 \times 10^{10}[cycles], 1.5 \times 10^{10}[instrutions]$
P3: $3 \times 10^{10}[cycles], 1.2 \times 10^{10}[instrutions]$

c. 1.3.3:
$(1 + 0.2) \div (1 - 0.3) = 1.71[times]$

d. 1.3.4:

$$\text{P1} = \frac{20 \times 10^9}{2 \times 10^9 \times 7} = 1.43[IPC]$$

$$\text{P2} = \frac{30 \times 10^9}{1.5 \times 10^9 \times 10} = 2.00[IPC]$$

$$\text{P3} = \frac{90 \times 10^9}{3 \times 10^9 \times 9} = 3.33[IPC]$$

e. 1.3.5:
$1.5 \times 10 \div 7 = 2.14[GHz]$

f. 1.3.6:
$30 \times 10^9 \times 0.9 = 27 \times 10^9[No.instructions]$

B. Exercise 1.16

a. 1.16.1:
#2: $20 + 80 + 10 + 70 + 5 = 185[ms], (20 + 10 + 5) * 0.15 = 5.25[ms]$
#10: $4 + 14 + 2 + 12 + 2 = 34[ms], (4 + 2 + 2) * 0.15 = 1.2[ms]$

b. 1.16.2:
#2: $80 \times 0.1 = 8[ms]$
#10: $14 \times 0.1 = 1.4[ms]$

c. 1.16.3:
#2: $70 \times 0.1 = 7[ms]$
#10: $12 \times 0.1 = 1.2[ms]$

d. 1.16.4:

$\#2 \rightarrow \#4: 0.55[computing\ time\ ratio], 1.18[routing\ time\ ratio]$
$\#4 \rightarrow \#8: 0.51[computing\ time\ ratio], 1.31[routing\ time\ ratio]$
$\#8 \rightarrow \#16: 0.61[computing\ time\ ratio], 1.29[routing\ time\ ratio]$
$\#16 \rightarrow \#32: 0.47[computing\ time\ ratio], 1.06[routing\ time\ ratio]$
$\#32 \rightarrow \#64: 0.46[computing\ time\ ratio], 1.13[routing\ time\ ratio]$

e. 1.16.5:

$$(0.55 \times 0.51 \times 0.61 \times 0.47 \times 0.46)^{\frac{1}{5}} = 0.52$$

$(0.55 \times 0.51 \times 0.61 \times 0.47 \times 0.46)^{\frac{1}{5}} = 0.52\ [G.M.of\ computing\ time]$

$(1.18 \times 1.31 \times 1.29 \times 1.06 \times 1.13)^{\frac{1}{5}} = 1.19\ [G.M.of\ routing\ time]$

$6.5 \times 0.52 = 3.38[computing\ time], 26 \times 1.19 = 30.94[routing\ time]$

f. 1.16.6:

$176 \div 0.52 = 338.46[computing\ time], 0[routing\ time]$ (because of single processor)

C. Exercise 2.4

a. 2.4.1:

1. lw $t0, 16($s7)
   add $s0, $s1, $s2
   add $s0, $s0, $t0
2. lw $t0, 16($s7)
   sll $t0, $t0, 2
   add $t1, $s6, $t0
   and $t0, 0($s6)
   add $s0, $s1, $t0

b. 2.4.2:

1. $3[instructions]$
2. $5[instructions]$

c. 2.4.3:

1. $5[registers]$
2. $6[registers]$

d. 2.4.4:

1. f = f + g + h + i + j
2. f = A[1]

e. 2.4.5: It is impossible for both situations to reduce number of instructions.

f. 2.4.6:

1. $5[registers]$
2. $2[registers]$

D. Exercise 2.13

a. 2.13.1:

1. 0x57755778
2. 0xFEFFFEDE

b. 2.13.2:

1. 0x55555550
2. 0xEADFFED0

c. 2.13.3:

1. 0xAAAA
2. 0xBFCD

d. 2.13.4:

1. 0x15B5A
2. 0xD0

e. 2.13.5:

1. 0xEFEF0000
2. 0x0

f. 2.13.6:

1. 0xEFEFFFFF
2. 0xF0