

COSE Computer Architecture  
Assignment #2

1. a) configuration 1:  $640 * 480 * 3 = 921,600$  bytes per frame  
configuration 2:  $1280 * 1024 * 3 = 3,932,160$  bytes per frame  
b) configuration 1:  $1024 * 768 * 3 = 2,359,296$  bytes per frame  
configuration 2:  $2560 * 1600 * 3 = 12,288,000$  bytes per frame
2. a) configuration 1:  $2\text{GB}/921600$  bytes  
 $= 2 * (2^{30}) / 921600$   
 $= 2330$  frames  
configuration 2:  $4\text{GB}/3932160$  bytes  
 $= 4 * (2^{30}) / 3932160$   
 $= 1092$  frames  
b) configuration 1:  $2\text{GB}/2359296$  bytes  
 $= 2 * (2^{30}) / 2359296$   
 $= 910$  frames  
configuration 2:  $4\text{GB}/12288000$   
 $= 4 * (2^{30}) / 12288000$   
 $= 349$  frames
3. a) configuration 1:  $256\text{Kbytes} / 100\text{Mbit per sec}$   
 $= 256 * (2^{10}) / (100 * (10^6) / 8)$   
 $= 0.02097152$  s  
 $= 20.97152$  ms  
configuration 2:  $256\text{Kbytes} / 1\text{Gbit per sec}$   
 $= 256 * (2^{10}) / (1 * (10^9) / 8)$   
 $= 0.002097152$  s  
 $= 2.097152$  ms
4. a) P2 has the highest performance expressed in instruction per second  
P1:  $3 / 1.5 = 2$   
P2:  $2.5 / 1.0 = 2.5$   
P3:  $4 / 2.2 = 1.8$   
b) P2 has the highest performance expressed in instruction per second  
P1:  $2 / 1.2 = 1.7$   
P2:  $3 / 0.8 = 3.75$   
P3:  $4 / 2 = 2$
5. a)  
P1: cycles =  $10 \text{ sec} * 3 \text{ GHz} = 10 * 3 * 10^9 = 30 * 10^9$  cycles  
instructions =  $30 * 10^9 / 1.5 = 20 * 10^9$   
P2: cycles =  $10 \text{ sec} * 2.5 \text{ GHz} = 10 * 2.5 * 10^9 = 25 * 10^9$  cycles  
instructions =  $25 * 10^9 / 1.0 = 25 * 10^9$   
P3: cycles =  $10 \text{ sec} * 4 \text{ GHz} = 10 * 4 * 10^9 = 40 * 10^9$  cycles  
instructions =  $40 * 10^9 / 2.2 = 18.2 * 10^9$   
b)  
P1: cycles =  $10 \text{ sec} * 2 \text{ GHz} = 10 * 2 * 10^9 = 20 * 10^9$  cycles  
instructions =  $20 * 10^9 / 1.2 = 16.7 * 10^9$   
P2: cycles =  $10 \text{ sec} * 3 \text{ GHz} = 10 * 3 * 10^9 = 30 * 10^9$  cycles  
instructions =  $30 * 10^9 / 0.8 = 37.5 * 10^9$

P3: cycles = 10 sec x 4 GHz =  $10^4 \cdot 10^9 = 40 \cdot 10^9$  cycles  
 instructions =  $40 \cdot 10^9 / 2.0 = 20 \cdot 10^9$

6. # of instructions \* CPI / CPU time

a) P1:  $2 \cdot 10^{10} \cdot 1.2 \cdot 1.5 / (0.7 \cdot 10) = 5.14$  GHz

P2:  $2.5 \cdot 10^{10} \cdot 1.2 \cdot 1.0 / (0.7 \cdot 10) = 4.28$  GHz

P3:  $1.82 \cdot 10^{10} \cdot 1.2 \cdot 2.2 / (0.7 \cdot 10) = 6.86$  GHz

b) P1:  $1.67 \cdot 10^{10} \cdot 1.2 \cdot 1.2 / (0.7 \cdot 10) = 3.43$  GHz

P2:  $3.75 \cdot 10^{10} \cdot 1.2 \cdot 0.8 / (0.7 \cdot 10) = 5.14$  GHz

P3:  $2 \cdot 10^{10} \cdot 1.2 \cdot 2.0 / (0.7 \cdot 10) = 6.85$  GHz

7. a) P1:  $2 \cdot 10^{10} / (7 \text{ sec} \cdot 3\text{GHz}) = 0.95$

P2:  $3 \cdot 10^{10} / (10 \text{ sec} \cdot 2.5\text{GHz}) = 1.2$

P3:  $9 \cdot 10^{10} / (9 \text{ sec} \cdot 4\text{GHz}) = 2.5$

b) P1:  $2 \cdot 10^{10} / (5 \text{ sec} \cdot 2\text{GHz}) = 2$

P2:  $3 \cdot 10^{10} / (8 \text{ sec} \cdot 3\text{GHz}) = 1.25$

P3:  $2.5 \cdot 10^{10} / (7 \text{ sec} \cdot 4\text{GHz}) = 0.89$

8. a)  $2.5 \text{ GHz} / (7/10) = 3.57 \text{ GHz}$

b)  $3\text{GHz} / (5/8) = 4.8 \text{ GHz}$

9. a)  $3 \cdot 10^{10} \cdot 9/10 = 27 \cdot 10^9$

b)  $3 \cdot 10^{10} \cdot 7/8 = 26.25 \cdot 10^9$

10. a) P2

P1: CPU time =  $(10^6 \cdot 0.1 \cdot 1 + 10^6 \cdot 0.2 \cdot 2 + 10^6 \cdot 0.5 \cdot 3 + 10^6 \cdot 0.2 \cdot 3) / (2.5 \cdot 10^9)$   
 = 0.00104 sec

P2: CPU time =  $(10^6 \cdot 0.1 \cdot 2 + 10^6 \cdot 0.2 \cdot 2 + 10^6 \cdot 0.5 \cdot 2 + 10^6 \cdot 0.2 \cdot 2) / (3 \cdot 10^9)$   
 = 0.00066 sec

b) P2

P1: CPU time =  $(10^6 \cdot 0.1 \cdot 2 + 10^6 \cdot 0.2 \cdot 1.5 + 10^6 \cdot 0.5 \cdot 2 + 10^6 \cdot 0.2 \cdot 1) / (2.5 \cdot 10^9)$   
 = 0.00068 sec

P2: CPU time =  $(10^6 \cdot 0.1 \cdot 1 + 10^6 \cdot 0.2 \cdot 2 + 10^6 \cdot 0.5 \cdot 1 + 10^6 \cdot 0.2 \cdot 1) / (3 \cdot 10^9)$   
 = 0.0004 sec

11. a)

P1: CPI =  $0.00104 \text{ sec} \cdot 2.5 \text{ GHz} / 10^6 = 0.00104 \cdot 2.5 \cdot 10^9 / 10^6$   
 = 2.6

P2: CPI =  $0.00066 \text{ sec} \cdot 3 \text{ GHz} / 10^6 = 0.00066 \cdot 3 \cdot 10^9 / 10^6$   
 = 1.98

b)

P1: CPI =  $0.00068 \text{ sec} \cdot 2.5 \text{ GHz} / 10^6 = 0.00068 \cdot 2.5 \cdot 10^9 / 10^6$   
 = 1.7

P2: CPI =  $0.0004 \text{ sec} \cdot 3 \text{ GHz} / 10^6 = 0.0004 \cdot 3 \cdot 10^9 / 10^6$   
 = 1.2

12. a)

P1: #clock cycles =  $2.6 \cdot 10^6 = 2600000$

P2: #clock cycles =  $1.98 \cdot 10^6 = 1980000$

b)

P1: #clock cycles =  $1.7 \cdot 10^6 = 1700000$

P2: #clock cycles =  $1.2 \cdot 10^6 = 1200000$