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CSIS 2810

T R 8:00-9:50 class

**Complete Exercises 1.5 and 1.6 (p. 55)**

**1.5 Compare the following 3 processors:**

P1: 3 GHz clock rate CPI of 1.5

P2: 2.5 GHz clock rate CPI of 1.0

P3: 4.0 GHz clock rate CPI of 4.0

**a. Which processor has the highest performance in instructions per second?**

Clock rate = cycles/second

CPI = cycles/instruction

Seconds = (instructions \* CPI)/(Clock rate) => seconds/instructions = CPI/Clock rate

=> instructions/second = clock rate/CPI

P1 = 3GHz / 1.5 = 2\*109

P2 = 2.5GHz/1.0 = 2.5\*109

P3 = 4GHz/4/0 = 109

So P2 has the highest performance in instructions per second.

**b. Each processor executes a program in 10 seconds find the number of cycles and instructions.**

P1 clock cycles = 10 \* 3\* 109 = 30\*109

P1 instructions = (30 \* 109)/1.2 = 25\*109

P2 clock cycles = 10 \* 2.5\* 109 = 25\*109

P2 instructions = (25 \* 109)/1.0 = 25\*109

P3 clock cycles = 10 \* 4\* 109 = 40\*109

P3 instructions = (40 \* 109)/4.0 = 10\*109

**c. Reducing the execution time by 30% increases the CPI by 20%. What clock rate should we have to get this time reduction?**

P1 CPI = 1.8

P1 time = 7

P1 clock rate = (25\*109 \* 1.8)/7 ≈ 6.42857\*109 or about 6.4 GHz

P2 CPI = 1.2

P2 time = 7

P2 clock rate = (25\*109 \* 1.2)/7 ≈ 4.2857\*109 or about 4.3 GHz

P3 CPI = 4.8

P3 time = 7

P3 clock rate = (10\*109 \* 4.8)/7 ≈ 6.857\*109 or about 6.9 GHz

**1.6 Compare the following implementations of instruction set architecture:**

P1: 2.5 GHz CPIs A,B,C and D are 1,2,3 and 3.

P2: 3 GHz CPIs A,B,C and D are 2,2,2 and 2.

Given program has instruction count of 1\*106

Instructions are divided into classes as follows:

A = 10%; B = 20%; C = 50%; D = 20%

A = 1\*105; B = 2\*105; C = 5\*105;D = 2\*105

**Which implementation is faster?**

P1 time = [(1\*105\*1)+(2\*105\*2)+(5\*105\*3)+(2\*105\*3)]/(2.5\*109)

= (105+4\*105+15\*105+6\*105)/(2.5\*109) = (2.6\*106)/ (2.5\*109)

= 1.04 \* 10-3 seconds

P2 time = [(1\*105\*2)+(2\*105\*2)+(5\*105\*2)+(2\*105\*2)]/3\*109

= (2\* 105+4\*105+10\*105+4\*105)/(3\*109) = (2\*106)/ (3\*109)

= 0.667 \* 10-3 seconds

The implementation on P2 is about 1/3 faster than the implementation on P1

**a. What is the global CPI for each implementation?**

CPI1 = (2.5\*109)/(106\*1.04\*103) = 2.5/1.04 ≈ 2.4

CPI2 = (3\*109)/(106\*0.667\*103) = 3/0.667 ≈ 4.5

**b. Find the clock cycles required in both cases.**

P1 clock cycles = 2.4\*106

P2 instruction count = 4.5\*106