計算機架構\_CH1\_HW1

**資工三 B0329044 蔡宛芝**

1.5

Consider three different processors P1, P2, P3 executing the same instruction set.

|  |  |  |
| --- | --- | --- |
|  | clock rate(GHz) | CPI |
| P1 | 3.0 | 1.5 |
| P2 | 2.5 | 1.0 |
| P3 | 4.0 | 2.2 |

1. Which processor has the highest performance expressed in instruction per second?

**Instruction per second:**

**P1: 3.0 GHz / 1.5 = 2.0 \* 109**

**P2: 2.5 GHz / 1.0 = 2.5 \* 109**

**P3: 4.0 GHz / 2.2 = 1.8 \* 109**

**P2 > P1 > P3 #**

1. If the processors each execute a program in 10 seconds, find the number of cycles and the number of instruction.

**Number of cycles:**

**P1: 10 sec \* 3.0 GHz = 3.0 \* 1010**

**P2: 10 sec \* 2.5 GHz = 2.5 \* 1010**

**P3: 10 sec \* 4.0 GHz = 4.0 \* 1010 #**

**Number of instruction:**

**P1: 10 sec \* (2.0 \* 109) = 2.0 \* 1010**

**P2: 10 sec \* (2.5 \* 109) = 1.0 \* 1010**

**P3: 10 sec \* (1.8 \* 109) = 1.8 \* 1010 #**

1. We are trying to reduce the execution time by 30% but this leads to an increase of 20% in the CPI. What clock rate should we have to get this time reduction?

**Execution time \* 0.7 = (Number of instructions \* CPI \* 1.2) / (New Clock rate)**

**New Clock rate = 1.71 \* Clock rate**

**New Clock rate for each processor:**

**P1: 3.0GHz \* 1.71 = 5.13 GHz**

**P2: 2.5GHz \* 1.71 = 4.27 GHz**

**P3: 4.0GHz \* 1.71 = 6.84 GHz #**

1.14

Assume a program requires the execution of 50 x 106 FP instructions, 110 x 106 INT instructions, 80 x 106 L/S instructions, and 16 x 106 branch instructions. The CPI for each type of instruction is 1, 1, 4, and 2, respectively. Assume that the processor has a 2GHz clock rate.

1.14.1

By how much must we improve the CPI of FP instructions if we want the program to run two times faster?

**Total clock cycles**

**= (50 \* 106 \*1) + (110 \* 106 \* 1) + (80 \* 106 \*4) + (16 \* 106 \*2)**

**= 5.12 \* 108**

**Then,**

**(50 \* 106 \* CPI improved FP) + (110 \* 106 \* 1) + (80 \* 106 \*4) + (16 \* 106 \*2)**

**= Total clock cycles / 2 = 5.12 \* 108 / 2**

**CPI improved FP = -4.12 ---> not possible #**

1.41.2

By how much must we improve the CPI of L/S instructions if we want the program to run two times faster?

**(50 \* 106 \*1) + (110 \* 106 \*1) + (80 \* 106 \* CPI improved L/S) + (16 \* 106 \*2)**

**= Total clock cycles / 2 = 5.12 \* 108 / 2**

**CPI improved L/S = 0.8 #**

1.14.3

By how much is the execution time of the program improved if the CPI of INT and FP instructions is reduced by 40% and the CPI of L/S and Branch is reduced by 30%?

**CPU time**

**= clock cycles / clock rate**

**= (50 \* 106 \* 1 \* 0.6) + (110 \* 106 \* 1 \* 0.6) + (80 \* 106 \* 4 \*0.7) + (16 \* 106 \*2 \* 0.7) / 2 \* 109**

**=0.1712 #**