CMPEN331 – Quiz 1 (January 25th, 2022)

Section: **Major:**

Name: **Email:**

1. Computer A has an overall CPI of 1.3 and can be run at a clock rate of 600MHz. Computer B has a CPI of 2.5 and can be run at a clock rate of 750 Mhz. We have a particular program we wish to run. When compiled for computer A, this program has exactly 100,000 instructions. How many instructions would the program need to have when compiled for Computer B, in order for the two computers to have exactly the same execution time for this program? **(5 points)**

$(\text{CPUTime})_A = (\text{Instruction count})_A * (\text{CPI})_A * (\text{Clock cycle Time})_A$
$= (100{,}000)*(1.3)/(600*10^6)$ ns
$(\text{CPUTime})_B = (\text{Instruction count})_B * (\text{CPI})_B * (\text{Clock cycle Time})_B$
B
$= (I)_B *(2.5)/(750*10^6)$ ns
Since $(\text{CPUTime})_A = (\text{CPUTime})_B$,

we have to solve for (I)B and get 65000

Or you can solve it that way:

$$\begin{cases} CPI_A = 1.3 \\ Instruction\ Number_A = 10^5 \rightarrow Execution\ time\ for\ A = \dfrac{CPI_A * Instruction\ Number_A}{F_A} = \dfrac{13}{6} * 10^{-4} \\ Ferequency_A = 600\ MHz \end{cases}$$

$$Execution\ Time\ A = Execution\ Time\ B \rightarrow \frac{CPI_B * Instruction\ Number_B}{F_B} = \frac{13}{6} * 10^{-4}$$

$$\rightarrow \frac{2.5 * nstruction\ Number_B}{750 * 10^6} = \frac{13}{6} * 10^{-4} \rightarrow Instruction\ Number_B = 65000$$

2. Suppose you have a machine which executes a program consisting of 50% floating point multiply, 20% floating point divide, and the remaining 30% are from other instructions. **(5 points)**

   Management wants the machine to run 4 times faster. You can make the divide run at most 3 times faster and the multiply run at most 8 times faster. Can you meet management's goal by making only one improvement, and which one?

   Amdahl's Law states:
   Execution time after improvement =
   (Execution time affected by improvement)/(Amount of Improvement) + Execution time unaffected

For running program with efficient divide time will be:

$$\text{Execution Time}_{\text{Divide}} = \frac{0.2 * \text{T}_{\text{Total}}}{3} + 0.8 * \text{T}_{\text{Total}} = 0.8\overline{6} * \text{T}_{\text{Total}} \rightarrow 1.15\text{x faster}$$

For running program with efficient multiply time will be:

$$\text{Execution Time}_{\text{Multiply}} = \frac{0.5 * \text{T}_{\text{Total}}}{8} + 0.5 * \text{T}_{\text{Total}} = 0.5625 * \text{T}_{\text{Total}} \rightarrow \quad 1.\overline{7}\text{x faster}$$

We cannot meet management's goal with only one improvement.

Another way that we will assume it is correct:

Assuming initially that the floating point multiply, floating point divide and the other instructions had the same CPI,
Execution time after Improvement with Divide = (20)/3 + (50 + 30) = 86.67
Execution time after Improvement with Multiply = (50)/8 + (20 + 30) = 56.67
The management's goal can't be met by making the improvement with Multiply alone.