

# NWEN242 Homework Assignment

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## Question 1

### Part A

If you improved the run time of divide by three times in, a  $100ms$  total time execution of the program given that the divide take 20% of that time thus  $20ms$ . The improvement would yield:

$$20ms \div 3 = 6\frac{2}{3}ms$$

A decrease in time for the division from  $20ms$  to  $6\frac{2}{3}ms$  making a total improvement of 1.15 (rounded 2.d.p) times faster than before.

$$\frac{100ms}{80ms + 6\frac{2}{3}ms} = 1.1538...$$

If you improved the run time of divide by three times in, a  $100ms$  total time execution of the program given that the divide take 50% of that time thus  $50ms$ . The improvement would yield:

$$\frac{50ms}{8} = 6.25ms$$

A decrease in time for the division from  $50ms$  to  $6.25ms$  making a total improvement of 1.78 (rounded 2.d.p) times faster than before.

$$\frac{100ms}{50ms + 6.25ms} = 1\frac{7}{9}$$

This shows that the target of a 1.4 times faster program is possible. But to get 1.4 time exactly the multiply operation would have to be below the maximum improvement of 8 times better:

Let  $x$  be the target time for multiply needs to make the total execution time 1.4 times faster

$$\begin{aligned} 1.4 &= \frac{100ms}{50ms + x} \\ 70ms + 1.4x &= 100ms \\ 1.4x &= 30ms \\ x &= \frac{150}{7}ms \end{aligned}$$

Let  $t$  be the target improvement to multiple needed to achieve the target time  $x$

$$\begin{aligned} \frac{50}{t} &= x \\ x * t &= 50 \\ t &= \frac{50}{x} \\ t &= 50 \div \frac{150}{7} \\ t &= \frac{7}{3} = 2.33(2.d.p) \end{aligned}$$

To make the improvements Management wants it would take a 2.33 times improvement to the multiply operation to achieve the overall goal of 1.4 times faster program.

## Part B

Applying both the 8 times and 3 time improvements for the multiply and divide operations respectfully would get:

$$\frac{100ms}{30ms + 6.25ms + 6\frac{2}{3}ms} = 2.33(2.d.p)$$

A 2.33 times improvement relative to the original machine in total execution time.

## Question 2

### Part A

$$IPS_{P_1} = \frac{3GHz}{1.5} = 2,000,00$$

$$IPS_{P_2} = \frac{2.5GHz}{1.0} = 2,5000,00$$

$$IPS_{P_3} = \frac{4GHz}{2.2} = 1,818,181$$

Processor  $P_2$  has the highest instructions per second

$$Total\ Instructions_{P_1} = 10 * IPS_{P_1} = 10 * 2,000,00 = 20,000,000$$

$$Total\ Instructions_{P_2} = 10 * IPS_{P_2} = 10 * 2,5000,00 = 25,000,000$$

$$Total\ Instructions_{P_3} = 10 * IPS_{P_3} = 10 * 1,818,181 = 18,1818,18$$