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CS-050 (BE)

Section - B

Assignment #1: CSM

Question #1(a)

t_a = 5 cycles
t_m = 10 cycles
clock rate = 250MHz

FP add = N # FP mul = 2N
Total # FP operations = 3N

$t_1 = N(t_a + 2t_m)$
$t_1 = N(5 + 2(10))$
$t_1 = 25N$

one cycle = $\frac{1}{250MHz}$ = 4n sec

$t_1 = 25N \times 4n$
$t_1 = 100Nn$ sec

$$R_1 = \frac{\text{total}_1}{t_1} = \frac{3N}{100Nm} = 30 \text{ MFLOPS}$$

Question # 1(b)

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S=0
for (int i=1; i<=N; i++)
    if (x[i] != 0)
        S = S + x[i] * x[i] * x[i]
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Question # 1(c)

of FP add = fN , # of FP mul = 2fN

∴ f = fraction of N for which x[i] are non-zero

total_2 = # fp operations = 3fN

for Non-zero : f = 0.7

$$t_2 = N\{t_{if} + f(t_a + 2t_m)\}$$

t_{if} = time required to execute each "if" test

$$t_2 = N\{3 + 0.7(5 + 2(10))\}$$

$t_2 = 20.5N$ cycles

CPU Clock Rate = 250 MHz

Clock Period = 4n sec

$t_2 = 20.5N \times 4 nsec$

$t_2 = 82N nsec$

$R_2 = \frac{total_2}{t_2} = \frac{3fN}{82N nsec} = \frac{3(0.7)}{82 nsec} = 25.60 \text{ MFLOPS}$

Question #1 (d)

$S_{B,A} = \frac{t_1}{t_2} = \frac{100N nsec}{82N nsec}$

$S_{B,A} = 1.22$

Relative change of segment B over A

$\Delta_{B,A} = 1.22 - 1$

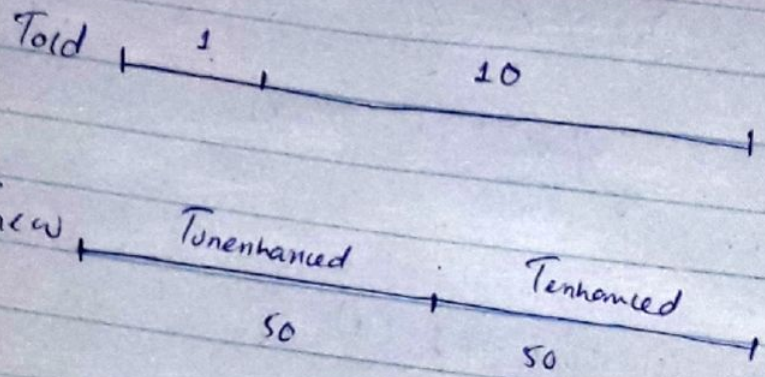
$\Delta_{B,A} = 0.22$

$\Delta_{B,A} = 22\%$

Question #1 (e)

Execution rate of system A (R_1) is 30MFlops whereas execution rate of system B (R_2) is 25.60MFLOPS which shows that system B is slower than system A. On the other hand relative change is showing system B is actualy 22% faster than system B. Therefore end-base metrics (execution time) are relacible.

Question # 2(a)



$$\text{Speed up} = \frac{T_{old}}{T_{new}}$$

$$\text{Speed up} = \frac{10+1}{1+1}$$

$$\text{Speed up} = \frac{11}{2}$$

$$\text{Speed up} = 5.5$$

Question # 2(b)

$(1-\alpha) = ?$

Using Amdahl's law

$$\text{Speedup} = \frac{1}{\frac{1}{q} + \left(1 - \frac{1}{q}\right)\alpha}$$

$$5.5 = \frac{1}{\frac{1}{10} + \left(1 - \frac{1}{10}\right)\alpha}$$

$$\frac{1}{10} + \frac{9}{10}\alpha = \frac{1}{5.5}$$

$$\frac{9}{10}\alpha = \frac{1}{5.5} - \frac{1}{10}$$

$$\frac{9}{10}\alpha = \frac{9}{110}$$

$$\alpha = \frac{1}{11}$$

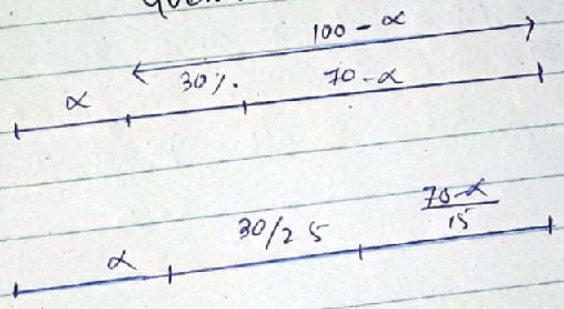
$$\alpha = 0.0909$$

$$\alpha = 0.91$$

$$1 - \alpha = 0.91$$

Therefore 91% of original execution time has been converted to fast mode.

Question # 3



$$\text{Speedup} = \frac{T_{old}}{T_{new}}$$

$$\text{Speedup} = \frac{\alpha + 100 - \alpha}{\frac{75\alpha + 90 + 350 - 5\alpha}{75}}$$

$$\text{Speedup} = \frac{100}{\frac{70\alpha + 440}{75}}$$

$$5 = \frac{100}{\frac{70\alpha + 440}{75}}$$

$$5 = \frac{7500}{70\alpha + 440}$$

$$70\alpha + 440 = \frac{7500}{5}$$

$$70\alpha = 1500 - 440$$

$$\alpha = \frac{1060}{70}$$

$$\alpha = 15.14$$

$$\alpha \simeq 15\%$$

Hence enhancement 2 must be used as $70 - \alpha = 55\%$ of the time to achieve the overall speedup of 5.