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CSE340 – Computer Architecture

Assignment 1

Name: Mehnaz Ara Fazal

ID: 20301295 Sec: 12

Q1.

Class	A	B	C	D
PS	7	2	3	6
Xbox	5	4	2	1

} CPIs

a)

Instruction Count for A = $1 \times 10^6 \times \frac{30}{100}$ = 300 000

" " " B = $1 \times 10^6 \times \frac{50}{100}$ = 500 000

" " " C = $1 \times 10^6 \times \frac{10}{100}$ = 100 000

" " " D = $1 \times 10^6 \times \frac{10}{100}$ = 100000

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Average CPI For PS:

$$\text{Clock cycles} = \sum_{i=1}^{n} (CPI_i \times \text{Instruction Count})$$

$$= (300000 \times 7) + (500000 \times 2) + (100000 \times 3) + (100000 \times 6)$$

$$= 4000000$$

$$\text{Average CPI} = \frac{\text{Total clock cycles}}{\text{Total IC}} = \frac{4000000}{1 \times 10^6} = 4$$

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For Xboxx:

Clock cycles = $(300000 \times 5) + (500000 \times 4) + (100000 \times 2) + (100000 \times 1)$
= 3800000

Average CPI = $\frac{3800000}{1 \times 10^6} = 3.8$

∴ CPI difference = $4 - 3.8 = 0.2$ (Ans)
(between PS & Xboxx)

b) Execution Time = CPU Time

Execution Time for PS : $\frac{IC \times CPI \text{ (Average CPI)}}{\text{Clock rate}}$

$= \frac{1 \times 10^6 \times 4}{2.7 \times 10^9} = 1.481 \text{ ms}$

For Xbox: $\frac{1 \times 10^6 \times 3.8}{3 \times 10^9} = 1.267 \text{ ms}$

Difference between Execution Time = $1.481 - 1.267$
$= 0.214 \text{ ms}$ (Ans)

a) Reference Time = 120ms

SPEC Ratio = $\frac{\text{Reference Time}}{\text{Execution Time}} = \frac{120}{1.481} = 81.026$ (Ans)

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d) Algorithm determines the number of operations executed and the compiler and ISA determines the number of machine instructions executed per operation. Hence if an algorithm has less operations and the compiler and ISA have less number of instructions per operation then the performance will be better or faster.

Q2. a) Execution Time = CPU Time = 540s

IC = 1.35×10^{12}

Clock cycle Time = 0.22ns

CPU Time = IC × CPI × Clock cycle Time

=> $540 = 1.35 \times 10^{12} \times CPI \times 0.22 \times 10^{-9}$

$$CPI = \frac{540}{1.35 \times 10^{12} \times 0.22 \times 10^{-9}} = 1.818$$

b) New IC = $1.35 \times 10^{12} \times \frac{112}{100}$ (112%) = 1.512×10^{12}

New CPI = $1.818 \times \frac{106}{100}$ (106%) = 1.927

New CPU Time = $1.512 \times 10^{12} \times 1.927 \times 0.22 \times 10^{-9}$

= 640.997s

SPEC Ratio = $\frac{\text{Reference Time}}{\text{Execution Time}} = \frac{1394}{640.997} = 2.175$ (Ans)

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Q3. a) Execution Time = 2100s

$T_{affected} = 2100 \times \frac{90}{100} = 1890s$

$T_{unaffected} = 2100 - 1890 = 210s$

n = ?

According to Amdahl's Law,

$T_{improved} = \frac{T_{affected}}{n} + T_{unaffected}$

$\Rightarrow 420 = \frac{1890}{n} + 210$

$\Rightarrow 420n = 1890 + 210n$

$\Rightarrow 210n = 1890$

$n = \frac{1890}{210} = 9$ (Ans)

b) New time for generation operation = $\frac{1890}{9}$

= 210s (Ans).

$T_{improved} = \frac{2100}{5}$

= 420s