15

CSE 340

ASSIGNMENT

1

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Section: 07

Answer to the ques. No-1

Given that,

For Playstation,

A, B, C, D are the classes in which instructions are devided.

Clock rate = 2.7 GHz,

CPI of A = 7

" " B = 2

" " C = 3

" " D = 6

For Xbox,

Clock rate = 3.0 GHz

CPI of A = 5

" " B = 4

" " C = 2

" " D = 1

Instruction Count = 1.0×10^6

Instruction count of class A = $1.0 \times 10^6 \times \frac{30}{100} = 3 \times 10^5$

" " " " B = $1.0 \times 10^6 \times \frac{50}{100} = 5 \times 10^5$

" " " " C = $1.0 \times 10^6 \times \frac{10}{100} = 1 \times 10^5$

" " " " D = $1.0 \times 10^6 \times \frac{10}{100} = 1 \times 10^5$

(1)

Total clock cycle for play station:

$$\text{Clock cycles} = (7\times3\times10^5) + (5\times2\times10^5) + (3\times10^5) + (6\times10^5)$$

$$= 40\times10^5$$

Total clock cycle for Xbox:

$$\text{clock cycles} = (5\times3\times10^5) + (4\times5\times10^5) + (2\times10^5) + (1\times10^5)$$

$$= 38\times10^5$$

$$\text{AVG. } CPI_p = \frac{40\times10^5}{1\times10^6} = 4 \quad \text{[For playstation]}$$

$$\text{AVG } CPI_x = \frac{38\times10^5}{1\times10^6} = 3.8 \quad \text{[For Xbox]}$$

Now,

Playstation takes more clock cycles per instruction on average compared to xbox. The ~~amount~~ amount is:

$$\text{AVG. } CPI_p - \text{AVG. } CPI_x$$

$$\Rightarrow 4 - 3.8$$

$$= 0.2$$

Ans: 0.2

Play station:

$$\text{Execution time}_p = \frac{\text{CPU Clock Cycles}}{\text{Clock rate}}$$

$$= \frac{40 \times 10^5}{2.7 \times 10^9}$$

$$= 1.482 \text{ ms.}$$

CPU Clock cycle $= 40 \times 10^5$

Clock rate $= 2.7$ GHz $= 2.7 \times 10^9$ Hz

Xbox:

$$\text{Execution time}_x = \frac{\text{CPU clock cycle}}{\text{clock rate}}$$

$$= \frac{38 \times 10^5}{3 \times 10^9}$$

$$= 1.267 \times 10^{-3}$$

$$= 1.267 \text{ ms.}$$

CPU clock cycle $= 38 \times 10^5$

Clock rate $= 3$ GHz $= 3 \times 10^9$ Hz

Now, Difference between the execution time:

$$\text{Execution time}_p - \text{Execution time}_x$$

$$= (1.482 - 1.267)$$

$$= 0.215 \text{ ms}$$

(Ans)

3

Given that,

reference time = 120 ms

Playstation:

$$\text{SPECRatio} = \frac{\text{Reference time}}{\text{Execution time}}$$

Execution time of Playstation: 1.482 ms

$$= \cancel{\frac{120}{0.215}} \; \frac{120}{1.482}$$

$$= 80.972 \text{ ms.}$$

(Ans)

4

Performance Measurement: Performance of a device is measured ~~with~~ based on a parameter. For measuring the performance of a CPU, the parameter is Response time. Response time is basically how long it takes for the device to do a task.

So, the time CPU takes to execute a instruction, we call it response time or CPU time or execution time.

Performance of a CPU can be affected by:

1. Algorithm
2. Programming language
3. Compiler
4. ISA.

The less the CPU time is, the better.

For algorithm:

To do a task we can choose various types of algoriths, which do the same ~~take~~ tasks. But depending on the algorithm, instruction count of the task changes. It is possible that CPI has also changed. So, if instruction count is more than normal it will negatively affect the performance.

For compiler:

Depending on the compiler instruction count and CPI of a task changes. Any changes on instruction count or CPI will result in bad CPU time, bad overall performance.

For ISA:

ISA also afffects Instruction Count and CPI

So, any changes in ISA, ~~result~~ in bring changes on overall perfformance of the CPU.

So, CPU perfformance can varied depending on algorithm, ISA, compiler or programming language.

Ans. to the ques. No- 2

Given that,

CPU time = 540 s

Instruction Count = 1.35×10^{12}

Reference time = 1394 s

(1)

Given that,

Clock cycle time = 0.22 ns

$= 0.22 \times 10^{-9}$ s

We know,

CPU time = Instruction Count x CPI x Clock cycle time

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

$\Rightarrow CPI = 1.82$

So, CPI = 1.82

(Ans.)

(2) Now,

Instruction count is increased by 12%

So, Instruction Count = $1.35 \times 10^{12} + \left(1.35 \times 10^{12} \times \frac{12}{100}\right)$

$= 1.512 \times 10^{12}$

CPI is increased by 6%

So, CPI = $1.82 + \left(1.82 \times \frac{6}{100}\right) = 1.9292$

Clock cycle time = 0.22×10^{-9} s

~~SPECRatio =~~

New CPU time = $1.512 \times 10^{12} \times 1.9292 \times 0.22 \times 10^{-9}$

$= 641.729$ s

New SPECRatio = $\frac{\text{Reference time}}{\text{CPU time}}$

$= \frac{1394}{641.729}$

$= 2.172$ s

(Ans)

Ans. to the ques. No:- 3

Given that,

CPU time = 2100 s

Password Generation takes 90% of the ~~ti~~ total run time.

Need to improve by a factor of 5.
(Whole program's performance)

n = improvement factor

1. We know,

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

$$\Rightarrow \frac{2100}{5} = \frac{2100 \times \frac{90}{100}}{n} + \left(2100 \times \frac{10}{100}\right)$$

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

$$\Rightarrow n = 9$$

We need to improve the password generation operation by a factor of 9.

(2)

From previous ques. we get that,

if we improve the password generation by a factor of ~~8~~ 9, we would improve the whole program's performance by a factor of 5.

Now,

New time of the program taken by generation operation is:

$$\frac{2100 \times \frac{90}{100}}{9}$$

$= 210\text{ s}$

The new time has been reduced a lot. ~~Pea~~

Previously, the ~~ta~~ time taken by the operation was: $2100 \times \frac{90}{100} = 1890\text{ s}$

Now it is 210 s

<u>Ans:</u> 210 seconds.