Assignment – 02

You Must Mention Your Name, ID And Section In The Script And Write The Answers In The Provided Space.

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Section A (8 Marks)

Suppose, you are a developer of a software company named 'HackerMan'. Your supervisor asked you to develop a password program, for MIPS architecture, that can both generate passwords and break them. After building the program, you observed that the program was taking **X milliseconds** to execute and the password generation was taking **90%** of the total execution time (*Here X is your BRACU ID. For example, if your ID is 12456789 then the time is 12456789 milliseconds*).

After reporting to your boss fearfully, he said it was unacceptable and threatened to fire you unless you can increase the whole program's performance by a factor of **5** by optimizing the password generation.

Now, your job's future rests in your optimization skills and the results of your analysis. Let's start with the analysis.

Question 1: You need to improve the password generation operation by a factor of what, to meet the requirements? Is it even possible to meet the requirements? If not then why? *[4 Marks]*

In the meantime, you are thinking if you can decrease the execution time of the password breaking operation. You thought of a slight optimization of that operation and made some rough calculations: the optimized algorithm would have an average CPI of **Y** and instruction count of **Y*10^{7}** (*Here Y is the third digit of your BRACU ID. For example, if your ID is 12456789 then instruction count will be 4**10^{7}). Now answer the following question.

Question 2: How much processing speed would you require for running the optimized algorithm? [*4 Marks*]

ANSWER OF SECTION A:

1.

My BRACU ID = 17301108

Execution time = 17301108 milliseconds

Password generation time = 17301108 * 0.90 = 15570997.2 milliseconds

Factor of 5 (Execution time) = 17301108/5 = 3460221.6 milliseconds

now,

3460221.6 = 15570997.2/n +1730110.8

=> 15570997.2 / n = 3460221.6 – 1730110.8

=> n = 15570997.2 / 1730110.8

=> n = 9

here the value of n is 9, so it is possible to meet the requirement of improvement.

2.

Here CPU time = 17301108 milliseconds = 17301.108 seconds

3rd digit of my BRACU ID, 17301108 = 3

Average CPI = 3

Instruction count = 3*10^7

Total CPU clock cycle = Average CPI*Instruction count = 3*10^7*3

= 9*10^7

Clock rate = CPU clock cycle / CPU time = 9*10^7 / 17301.108

= 5201.978972 Hz

Section B [7 Marks]

Suppose you are running the SPEC CINT2006 benchmarking program and the program ran three separate programs listed below:

Program Name	**Instruction Count ($x10^9$)**	**Clock Rate (GHz)**	**CPI**	**Execution Time**	**Reference Time**	**SPEC Ratio**
BFG	P+1	2.4	2.5	?	86	?
Vega	Q+1	2.4	2.0	?	12	?
Checker	R+1	2.4	3.0	?	15	?

Here P, Q, R are the 6^{th}, $7^{th}$and 8^{th} digit of your BRACU ID.

1. **Now determine the execution time and SPEC ratio for BFG, Vega and Checker programs. [*4 Marks*]**
2. **Calculate the Geometric Mean. [*3 Marks*]**

ANSWER OF SECTION B:

1.

My BRACU ID = 17301108

P = 1

Q = 0

R = 8

Program Name	**Instruction Count ($x10^9$)**	**Clock Rate (GHz)**	**CPI**	**Execution Time**	**Reference Time**	**SPEC Ratio**
BFG	P+1 =1+1= 2	2.4	2.5	?	86	?
Vega	Q+1 =0+1= 1	2.4	2.0	?	12	?
Checker	R+1 =8+1= 9	2.4	3.0	?	15	?

Execution time for **BFG** = (Instruction count *CPI) / Clock rate = (2*2.5)/2.4

= 2.083333333

SPEC ratio for **BFG** = Reference time/Execution time = 86/2.083333333

= 41.28000001

Execution time for **VEGA** = (Instruction count CPI) / Clock rate = (1*2.0)/2.4

= 0.833333333

SPEC ratio for **VEGA** = Reference time/Execution time = 12/0.833333333

= 14.40

Execution time for **Checker** = (Instruction count CPI)/Clock rate=(9*3.0) /2.4

= 11.25

SPEC ratio for **Checker** = Reference time/Execution time = 15/11.25

= 1.33333333

Program Name	**Instruction Count (x10^9)**	**Clock Rate (GHz)**	**CPI**	**Execution Time**	**Reference Time**	**SPEC Ratio**
BFG	P+1 =1+1= 2	2.4	2.5	2.083333333	86	41.280
Vega	Q+1 =0+1= 1	2.4	2.0	0.833333333	12	14.40
Checker	R+1 =8+1= 9	2.4	3.0	11.25	15	1.3333

2.

now

Geometric Mean = $\sqrt[3]{41.280 \times 14.40 \times 1.333}$

= 9.253601153