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Question 1)

Given

|  |  |
| --- | --- |
| Processing | 20% |
| Disk access | 30% |
| Network transfer | 50% |

Base system: processor = 500MHz, 20Mbytes/sec data transfer rate, this system costs $5K and can support 10,000 average web page accesses/sec.

1. Option-1: replacing the existing disk with a disk supporting 40Mbytes/sec data transfer rate with an additional (compared to the base) cost of $1,000.

S =

S = = 1.176

Average web page acc. = 1.176\*10000 = 11760 web page/sec

Additional cost 1000

Total cost = 6000

1. Option-2: replacing the processor with a 800MHz processor with an additional (compared to the base) cost of $800

S =

S = = 1.081

Average web page acc. = 1.081\*10000 = 10810 web page/sec

Additional cost 800$

1. Option-3: using the two enhancements indicated in Option-1 & Option-2 together with an additional (compared to the base) cost of $1,500

S =

S = = 1.2903

Average web page acc. = 1.2903\*10000 = 12903 web page/sec

Additional cost 1500$

Total cost 6500$

Cost performance analysis of web page access:

1. We manage to improve it by 1760 for 1000$. 1.76 per $
2. We manage to improve it by 810 for 800$. 1.013 per $
3. We manage to improve it by 2903 for 1500$. 1.935 per $

Conclusion: even though option b is the cheapest but the enhancement is happening to small fraction (20%), so the overall speed up is negligible. Whereas in option c the enhancement is happening to half of the performance which yields better performance cost ratio.

Question 2)

(1)

**A. Option-A**: Let us assume that 𝑓𝐴, the fraction of instructions using component A, can be sped up by 10 times. However, due to the dependency of A on B, another fraction 2𝑓𝐴 will be get slowed down by 5 times.

S =

S = = =

**b. Option-B**: The instructions using component B, fraction 𝑓𝐵, can be sped up by 20 times. The dependency forces another fraction 0.5𝑓𝐵 to get slow down by 2 times.

S =

S = = =

**c. Option-C:** A fraction 𝑓𝐴 of instructions using the component A, can be sped up by a factor of 4. Unfortunately, the dependency forces another fraction 𝑓𝐴 to get slowed down by 1.8 times.

S =

S = = =

(2)

If we assume

Option a) S =

Option b) S =

Option b) S =

For the same fraction of 10% the overall speedup of option a is much higher for the same price compared to the rest so I will choose option a.

Question 3)

A)

Relative usage of Program 1 is 45%, Program 2 is 35%, and Program 3 is 20%.

Table

Description automatically generated

The fist system

execution time using iron law of performance.

0.45\*1+0.35\*10+0.2\*5 = 4.95

The second system

0.45\*2+0.35\*7+0.2\*3 = 3.95

The third system

0.45\*1.5+0.35\*5+0.2\*4 = 3.225

Performance =

Performance system 1 = = 0.202

Performance system 2 = = 0.253

Performance system 3 =

System 3 will provide the best performance for the laboratory.

B)

By doing a cost-performance analysis, indicate which one of these systems you will choose and why?

System 1: 8,000$

System 2: 5,000$

System 3: 6,500$

The cost per performance

System 1: 39603 $/performance

System 2: 19762

System 3: 20967

It depends on the budget of the laboratory if money is not an issue I would choose the one with higher performance. If money is an issue, I would choose the second one for better performance at affordable price.