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**EE488 - Computer Architecture**

**Homework Assignment #1**

**Due day: 2/5/2023**

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**Answers :**

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

1. New performance = (0.7\* 40Mb/sec) + (0.3\*500MHz) = 28 + 150 = 178 $. The enhanced system will support an average of 178\* 10,000 = 1,780,000 web page access per second.

**B**. Second Option: replacing the processor with a 800MHz processor with an additional (compared to the base) cost of $800

1. At 800MHz, the new processor will have a 60% improvement over the existing one. Since the existing disk will be used, the new performance can be calculated as below:

New performance = (0.7\* 20Mb/sec) + (0.3\*800MHz) = 14 + 240 = $ 254 . The enhanced system will support an average of 254\* 10,000 = 2,540,000 web page access per second

**C**. Third option : Using the two enhancements indicated in Option-1 & Option-2 together with an additional (compared to the base) cost of $1,500.

New performance = = (0.7\* 40Mb/sec) + (0.3\*800MHz) = 28 + 240 = $ 268 . The enhanced system will support an average of 268 \* 10,000 = 2,680,000 web page access per second.

From the cost analysis stand point, option 3 which uses both enhancement performance improvement is the highest and would be the most cost-effective option to considered. In addition, the additional $1500 is lower than using either option individually.

2. The Amdahl’s law is based on the assumption that when an enhancement is performed to some part of the system, the enhancement doesn’t have any negative impact on the non-enhanced part. However, in the real life, it could lead to negative impact on these parts. Thus, the Amdahl’s law can be modified to take care of this situation.

Consider a computer system with two components A and B which can be enhanced. There is interdependency between these components. And enhancement in one component affects the other. There exist three options for enhancement as suggested below. All options involve the same amount of cost.

* **Option-A:**

10 times speed enhancement by component A = f\_A \* 10.

5 times slowed by component A = 2f\_A \* 1/5.

Therefore, speedup= f\_A \* 10 + (1 - f\_A - f\_B) \* 1 – 2f\_A \* (1/5)

* Option-B:

20 times speed enhancement by component B = f\_B \* 20.

2 times slowed down by component B = 0.5f\_B \* 2 = f\_B

Therefore, speedup = f\_B \* 20 + (1 - f\_A - f\_B) \* 1 - 0.5 f\_B \* (1/2)

* Option-C:

4 times speed enhancement by component A = f\_A \* 4

Component A slows down by 1.8 times = f\_A \*1/ 1.8

Therefore, speedup = f\_A \* 4 + (1 - f\_A - f\_B) \* 1 – f\_A \* (1/1.8)

**Conclusion** : The component of Option-B accelerates by 20 times while the other fractions decelerate by 2 times; it is almost the same as Option-component C's but accelerates by 4 times by their single component. Option a, on the other hand, caused the fraction to increase 10 times while slowing down by five times. Consequently, as an architect, I will unquestionably choose option b to start.

3. A set of three systems are being evaluated to be used in a laboratory environment. This environment uses three types of programs with a relative usage of 45% (Program 1), 35% (Program 2), and 20% (Program 3) respectively. Each of these three programs has been benchmarked on these three systems individually and their execution times are shown as follows.

Data

|  |  |  |  |
| --- | --- | --- | --- |
| **Programs** | **System 1** | **System 2** | **System 3** |
| Programs 1 | 1.0 sec | 2.0 sec | 1.5 sec |
| Programs 2 | 10.0 sec | 7.0 sec | 5.0 sec |
| Programs 3 | 5.0 sec | 3.0 sec | 4.0 sec |

A. which of the above three systems will provide the best performance for the laboratory

* System 1: Execution time = 0.45 \* 1 + 0.35 \* 10 +0.2 \* 5 = 4.95 sec

Performance = 1/ Execution time = 1/ 4.95 = **0.202**

* System 2: Execution time = 0.45 \* 2 + 0.35 \* 7 +0.2 \* 3 = 3.95 sec

Performance = 1/ Execution time = 1/ 3.95 = **0.253**

* System 3: Execution time = 0.45 \* 1.5 + 0.35 \* 5 +0.2 \* 4 = 3.225 sec

Performance = 1/ Execution time = 1/ 3.225 = **0.310**

**Note: Based on the performance average, System 3 has the best performance.**

2. Cost-performance analysis

System 1 : $8000 \* 0.202 = $ 1616

System 2: $5000 \* 0.253 = $ 1265

System 3: $6500 \* 0.310 = $ 2015

Note: A**s the cost** analysis, System 2 can be considers as the best since it is cheaper.