Computer System Modelling And Analysis

Laboratory #4
Oct. 31st/Nov. 2nd and Nov. 7th/9th, 2000

Assignment

Starting with the baseline model you validated in the preparation, use analytical modelling with MAP to answer the questions below.

1. Current Workload

(a). Assume that the service level objectives (SLO's) with the current workload are:

$$\begin{aligned} X_{DSN} &\geq .007 \\ R_{ACC} &\leq 30.0 \\ R_{MNT} &\leq 50.0 \end{aligned}$$

Evaluate and compare the three different ways suggested below for modifying the system so the service level objectives are satisfied.

(i). Adjust the *avg_mpl* of the DSN class.

(ii). Modify the priorities of the various classes at the cpu, in addition to adjusting the *avg_mpl*.

(iii). Upgrade the SPARK cpu to a different model.

Given the results of the experiments indicated above, make a recommendation for the most cost-effective change to make to the system in order to make sure that the SLO's of all three classes are satisfied.

(b). Starting again from the validated model of the base current system, assume now a *different* set of SLO's:

$$\begin{aligned} X_{DSN} &\geq .004 \\ R_{ACC} &\leq 30.0 \\ R_{MNT} &\leq 30.0 \end{aligned}$$

Evaluate and compare the three different ways suggested below for modifying the system so the service level objectives are satisfied.

(i). Add memory to the system (32MB per domain slot), and adjust the capacity of the memory domain (*limited_mpl*).

(ii). Starting again with the baseline system, upgrade one or more of the BRONZE disks to different model(s).

(iii). Starting again with the baseline system, adjust the class priority levels at the cpu.

Given the results of the experiments indicated above, and using your knowledge and intuition about how expensive each change would be, make a recommendation for the most cost-effective way of modifying the system so that the SLO's are all satisfied.

2. Capacity Planning Problem for a Future Workload

Start again with the baseline model that you validated in the preparation. Given assumptions about how the workload is expected to evolve in the future, make recommendations for specific cost-effective system upgrades to support the anticipated workload satisfying the performance level objectives specified for the system. The cost of upgrades are measured in Computer Engineering Monetary Units (or CEMU's).

The projected future workload, the system performance level objectives, and the list of possible upgrades to consider along with their costs are given below. Present your recommendations for upgrades and justify them with performance results from your MAP model. You should include one recommendation for a system in which all SLO's are met at at least the "acceptable" level, and another for a system where all three SLO's are satisfied (or very nearly satisfied) at the "desirable" level.

Future Workload

Corporate projections indicate that, in the next year, the workload will change in the following ways:

- The transaction rate for *accounting* will increase from .10 to .18.
- The number of active users in the *maintenance* class will increase from 12 to 15 (with the think time remaining at 100 seconds).
- The throughput requirement for the *design* class will increase to at least .008.

System Service Level Objectives

The performance objectives for the three classes are as follows:

class	desirable	acceptable
design	$X_{dsn} > .010$	$X_{dsn} > .008$
accounting	$R_{acc} < 12.0$	$R_{acc} < 15.0$
maintenance	$R_{mnt} < 25.0$	$R_{mnt} < 30.0$

Alternative System Upgrades

Here are a number of possible upgrades that can be applied to the system, along with their associated costs in CEMU's:

1. Change the scheduling priorities of the classes at the processor [0 CEMU's].
2. Change the admission priorities of the classes to the memory domain [0 CEMU's].
3. Change the batch activation level (i.e., *avg_mpl*) for class *design* [0 CEMU's].
4. Rearrange the files of one class among the available disks [2 CEMU's per class].
5. Upgrade the processor from a SPARK to a FLAME [10 CEMU's], BLAZE [30 CEMU's], TWIN [20 CEMU's], or QUAD [40 CEMU's].
6. Upgrade the disks from BRONZE to SILVER [4 CEMU's per disk] or GOLD [8 CEMU's per disk].
7. Add additional disks (of some model) and shift some fraction of the files to them [where CEMU's per disk is 4, 8 and 12 for BRONZE, SILVER, and GOLD models, respectively].
8. Add additional memory in order to allow the domain capacity (*limited_mpl*) to be increased. Assume that each additional 32 MB allows an increase of one in the *limited_mpl*, an costs 5 CEMU's.

Hints:

(1). There *is* a *better* way to find the right solutions than to simply try out out all combinations as see what looks best. Try to examine MAP's various performance reports to get guidance as to what (combination of) changes to try next.

(2). Map is case sensitive, so model names (such as SPARK or BRONZE, etc.) must be written all in capital letters in order to be recognized by MAP.

(3). It is *critical* that *setsystem* be *on* when doing such things as changing models of processors or disks, or moving loadings from one center to another, or changing the size of memory. Otherwise, MAP will not be able to make the intended adjustments.

(4). For the purpose of this assignment, when you change the memory size with the *memsize* command, always answer "no" to the prompt about automatically adjusting avg_mpl, and instead manually adjust the limited_mpl of the domain.

(5). There are several warnings that you may see from MAP that you can safely ignore. These include:

- warnings of adjustments done during "setsystem" (as long as you see "setsystem successful" at the end)
- warnings of memory sizes above 128MB being "too big"