Linnéuniversitetet
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Report

Performance Engineering Assignment

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Table of Contents

1 Using operational law to calculate service time

Use the operational laws to calculate the service time S_k of the SofwareSearchEngine, the SoftwareUploadManager, and Database; and to calculate the average number of iterations that the SoftwareUploadManager needs to execute to serve a request of a contributor.

Calculations:

Table 1. The service centres and related service time S_k

	SofwareSearchEngine	***SoftwareUploadManage***	***Database***
S_k	0.2	0.4	0.25

Sofware Search Engine:

$$C_k = 129600 \times 0.85 = 110160$$

$$U_k = 8.5\% = 0.085$$

$$\frac{B_k}{259200} = 0.085$$

$$B_k = 22032$$

$$S_k = \frac{22032}{110160} \approx 0.2$$

Software Upload Manager:

$$X_k = \frac{C_k}{T} = \frac{0.1754}{0.4677} \approx 0.38$$

$$U_k = \frac{B_k}{T} = \frac{38900}{259200} \approx 0.15$$

$$S_k = \frac{U_k}{X_k} = \frac{0.15}{0.37} \approx 0.4$$

Database:

$$D_k = V_k \cdot S_k$$

$$S_k = \frac{D_k}{V_k} = \frac{2}{8} = 0.25$$

Software Upload Manager (Average Iterations):

$$C_k = \frac{B_k}{S_k} = \frac{38900}{0.4} = 97250$$

$$C_k = C \times \text{Iterations} \times 15\% \Longrightarrow \text{Iterations} = \frac{97250}{129600 \times 15\%} \approx 5$$

2 Model the system using queueing networks

Model the system using queueing networks (in JMT or in your preferred Queueing Network simulation engine). Add screenshots of: the structure of the network and about all the information you add to each component (service times, routing probabilities, etc.). Simulate the model to calculate the System Response time, the Utilization and Throughput of each of the five components in the system and show screenshots of the results.

2.1 Model

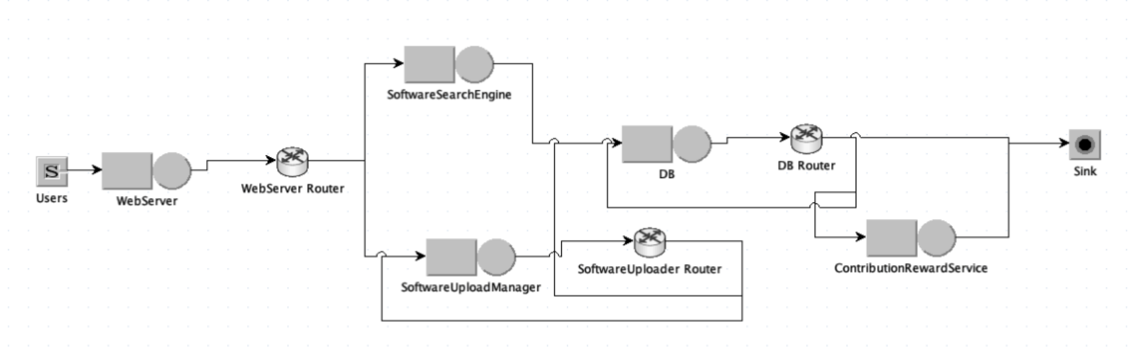
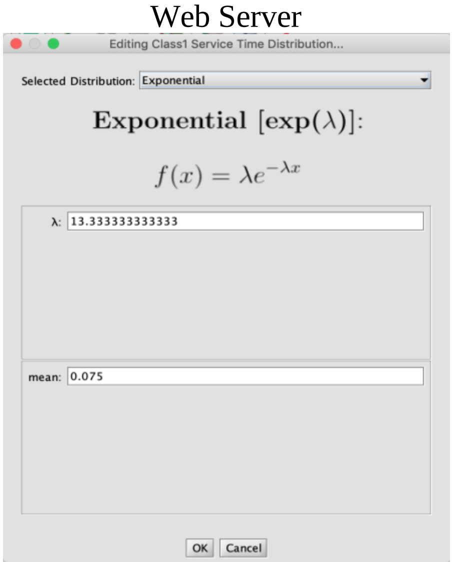


Figure 1. System Queueing Network Model

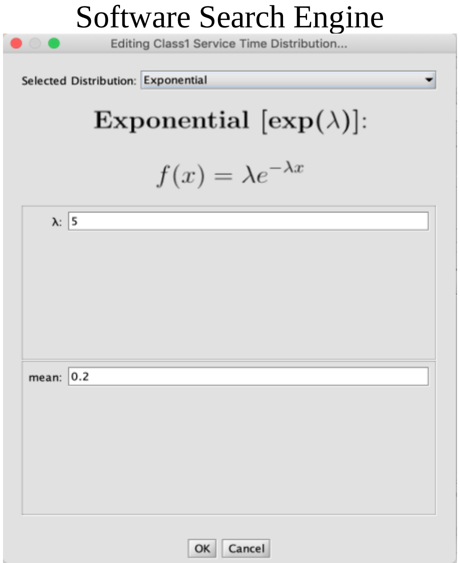
2.2 Service time

In this section, the screenshots for different service components regarding service will be presented.

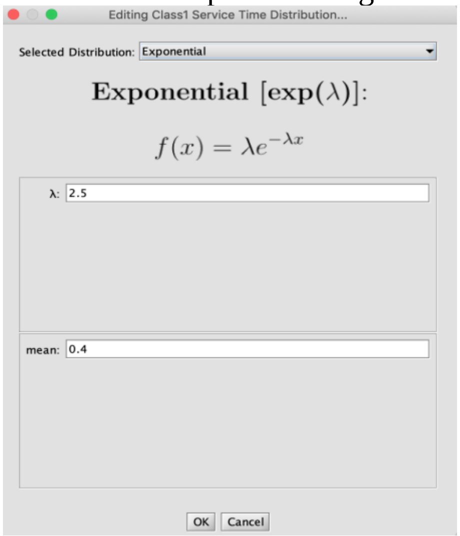
Web Server



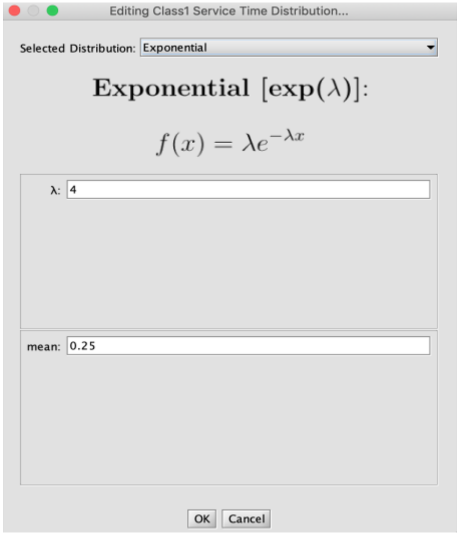
Software Search Engine



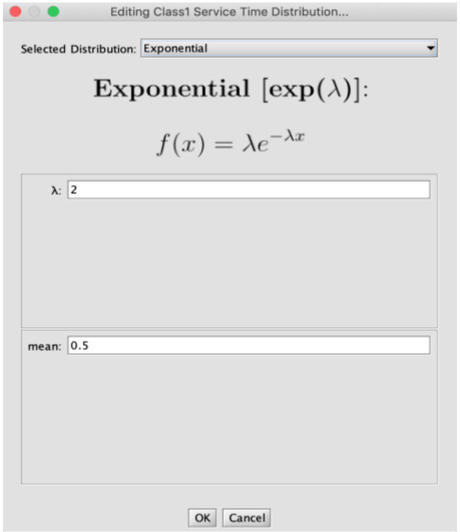
Software Upload Manager



Database



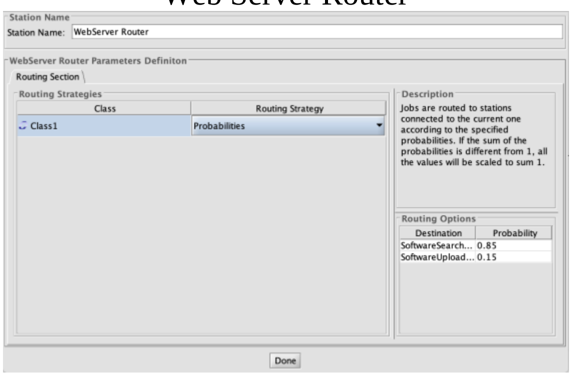
Contribution Reward Service



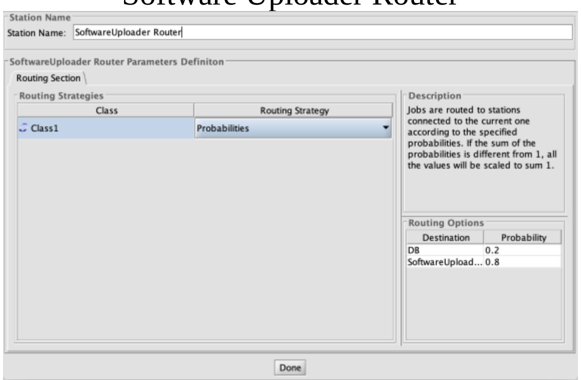
2.3 Routing

In this section, the screenshots of routers and the corresponding probabilities will be presented.

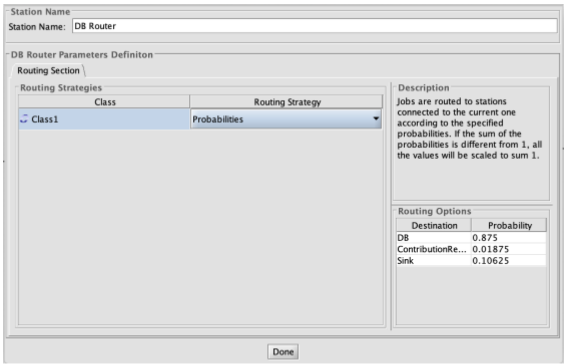
Web Server Router



Software Uploader Router



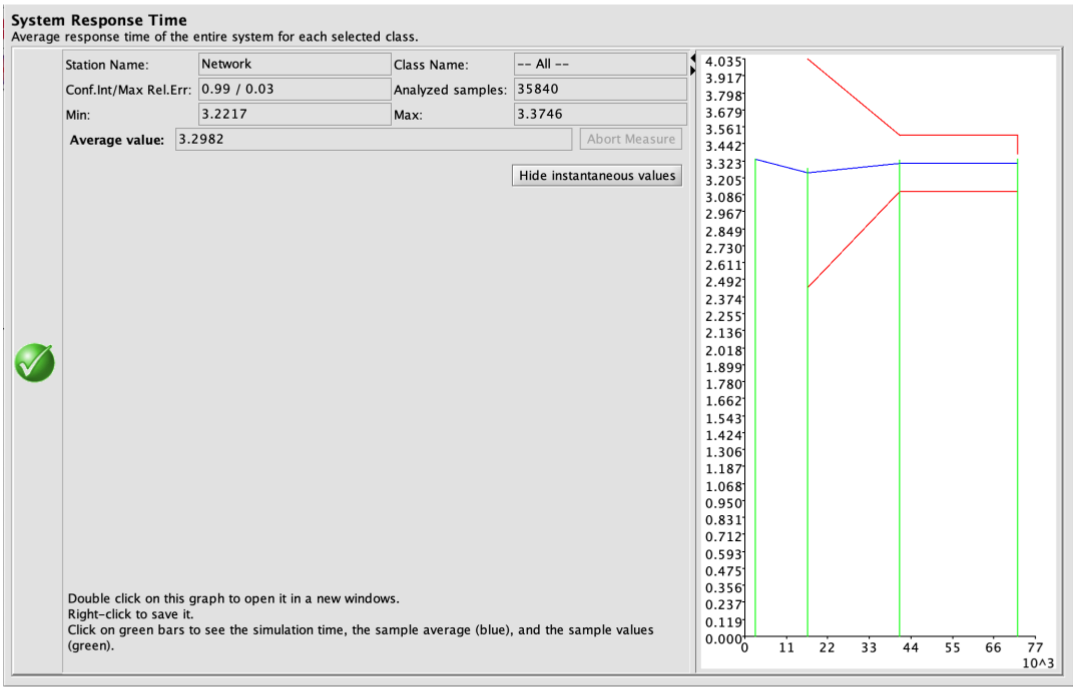
Database Router



2.4 System simulation

In this part, the simulation regarding the system response time, the utilization and throughput of each of the five components will be presented.

2.4.1 System response time



2.4.2 Utilization

2.4.3 Throughput

3 System upgrade

Suppose that some of our software has become popular by university students in one of their courses. It means that, by the date of the utilization of the software in the course, there will be a huge increment in the requests from users to download that software, and an increment in the new versions of that software that are uploaded to the system. Concretely, we expect that: 1) the workload increases x18, that is, it passes from an average of 30 requests per minute to 30x18=540 requests per minute; 2) the proportion of contributor uses *increases from 15% to 25%.*

3.1 Analysis

Under the new scenario, the service components need to be re-calculated in order to fulfill the service demands, the analysis process can be found as following.

3.1.1 Workload

The total amount of workload increases 18 times which means now the total user sessions are 18×129600=2332800.

3.1.2 Web server

$$C_k = 2332800$$
$$S_k = 0.075$$
$$X_k = \frac{2332800}{259200} = 9$$
$$U_k = X_k \times S_k = 9 \times 0.075 = 0.675$$

The U_k is lower than 1, therefore, 1 server for web server is sufficient.

3.1.3 Software search engine

$$C_k = 2332800 \times 0.75 = 1749600$$
$$S_k = 0.2$$
$$X_k = \frac{1749600}{259200} = 6.75$$
$$U_k = X_k \times S_k = 6.75 \times 0.2 = 1.35$$

Since the U_k has to be lower than 1, therefore, the number of the servers for search engine needs to be 2.

3.1.4 Software upload manager

$$C_k = 2332800 \times 0.25 = 583200$$
$$S_k = 0.4$$
$$X_k = \frac{583200}{259200} = 2.25$$
$$U_k = X_k \times S_k = 2.25 \times 0.4 \times 5 = 4.5$$

Since the U_k has to be lower than 1, therefore, the number of the servers for search engine needs to be 5.

3.1.5 Database

$$C_k = 2332800$$
$$S_k = 0.25$$

$$X_k = \frac{2332800}{259200} = 9$$
$$U_k = X_k \times S_k = 9 \times 0.25 \times 8 = 18$$

Since the U_k has to be lower than 1, therefore, the number of the servers for database needs to be 19 to keep it lower than 1.

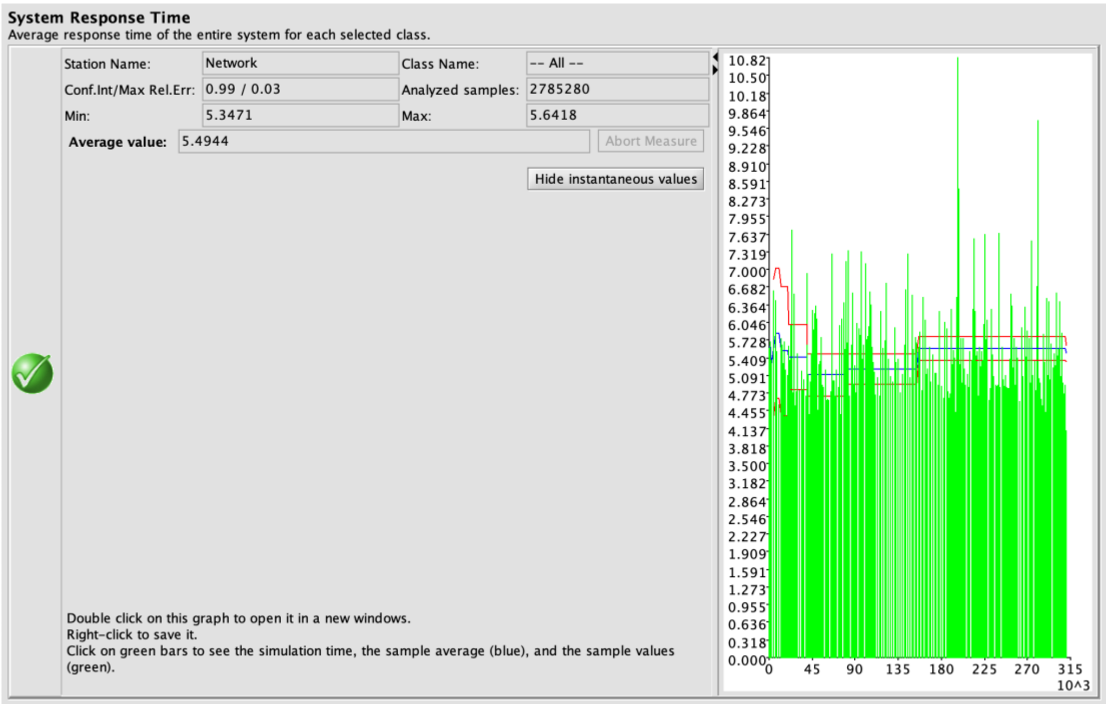
3.1.6 Contribution reward service

$$C_k = 583200$$
$$S_k = 0.5$$
$$X_k = 2.25$$
$$U_k = X_k \times S_k = 2.25 \times 0.5 = 1.125$$

Since the U_k has to be lower than 1, therefore, the number of the servers for contribution reward needs to be 2.

3.2 Simulation result

3.2.1 System response time after upgrading the system



As we can see, after the system upgrade the system response time is around 5.49 seconds.

3.2.2 Utilization after upgrading the system

3.2.3 Throughput after upgrading the system