Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Autumn Term 2016

Advanced Systems Lab Exercises
Queuing Exercises

Exercise 1

Instrumentation on a network gateway indicates that on average it receives 125 packets per second. The gateway takes 2ms to forward each packet. Compute (show your working and how you model the problem):

a) Service time

b) Server utilization

c) Average number of packets in gateway

d) Mean waiting time

e) Mean response time

Exercise 2

A disk has an average response time of 50ms. What is the maximum rate of I/O operations that the disk can support?

Exercise 3

Assume a server can be modeled as a queue. If the maximum response time allowed is 2 seconds and the server has enough memory to hold 10 jobs, including the one being processed, what is the maximum request rate that can be supported?

Exercise 4

Prove that the average number of jobs in the service of a general queue equals the offered load.

Exercise 5

You want to send an e-mail message. You observe that the e-mail server has at any point in time about 100 messages waiting to be sent. The number of messages to be sent arriving at the server is about 5 per millisecond. About how long will it take for your e-mail to be sent? Show your working.

Exercise 6

If the offered load on that e-mail server (Exercise 5) is 40%, how long does it take to process each e-mail message and how long is the message actually waiting to be processed? Show your working

Exercise 7

For a queuing system M/M/1/B, compute the number of jobs in the system as a function of the traffic intensity.

Exercise 8

Assume a device with an arrival rate of 10 jobs per second and the ability to process up to 5 jobs in parallel with an average service time of 0.1 seconds for each server. Show that the system has better performance if implemented as M/M/5 than as five distinct M/M/1 systems and that we can uniformly distribute the jobs across the 5 systems.

Exercise 9

Show algebraically that the traffic intensity in an M/M/m system is the same as the traffic intensity of each ones of the queues if we model the same system as m M/M/1 queues.

M/M/m Arrival rate/(m x Service rate) M/M/1 (Arrival rate/m) / Service rate

Exercise 10

During an observation period of 5 seconds, a device processed 2000 requests. The device can process 500 requests per second. What was the utilization of the device?

Exercise 11

We can choose the speed at which we can clock a digital device so that it can process between 200 and 800 request per second depending on the clock rate. To avoid overheating, the device can only operate at a maximum utilization of 50%. What is the throughput range that can be achieved with such a device?