COMP9334 Revision Problems – Week 4

This problem set consists of 2 questions.

Revision problem #1

Consider a hypothetical call centre with 1 receptionist and 2 technical staff. Customers make calls to this call centre to receive technical support. Calls arrive at this call centre with a mean inter-arrival time of 10 minutes, exponentially distributed.

An incoming call is first directed to the receptionist. If a call arrives at the call centre when the receptionist is idle, the call will be answered; otherwise the call is dropped.

After a call has been processed by the receptionist, it will be sent to a technical staff for further processing. The rules are:

- If both technical staff are busy, the call is dropped
- If a technical staff is available, the call will be directed to this staff.
- If both technical staff are available, the receptionist picks one of the staff with equal probability.

A customer will only be satisfied if their call is processed by both the receptionist and a technical staff, otherwise the customer is unsatisfied.

Assuming that the mean processing time required by the receptionist is 3 minutes, and that of each technical staff is 15 minutes; all distributions are exponentially distributed.

Answer the following questions:

- Draw the appropriate Markov model. Label all arcs.
- In steady state, what are the probabilities of being in each state?
- Find the probability that a technical staff is busy
- What is the probability that an arriving call is dropped by the receptionist?
- What is the "good" throughput of the call centre (i.e. the rate of which satisfied customers leave the call centre) ?

Revision problem #2

On pages 18-31 of the lecture notes, we discuss an example of analysing a database server with one CPU and 2 disks using a Markov chain. (Note: The material is based on Chapter 10 of Menasce et al "Performance Analysis".) In the example, we find that with the current workload and hardware specifications of the system, the response time is 0.7372 minutes per transaction. The engineer in charge of the system would like to improve the response time of the system by using a faster CPU. Assuming:

- The workload remains the same as before.
- There are always 2 users in the system.
- The service time for the disks remains as before.
- The service time for the CPU is inversely proportional to the speed of the CPU.

If the engineer would like to achieve a mean response time of 0.65 minutes per transactions, by how many times must the engineer speed up the CPU?

Is speeding up the CPU a good choice? Explain.

Hint: Assuming that you speed the CPU up by k times. You will need to build a Markov chain in terms of k. Once you have done it, you can then write a computer program whose input is the numerical value of k and whose output is the response time for the given speed up factor k. The computer program will need to solve the Markov chain. Once you have this program, you can plot a graph on how response time depends on k. You can then determine the value of k from this graph.