CCSI 3171 Assignment #2

Due date: June 23rd, 11:59pm.
Late submissions accepted until June 25th, 11:59pm. (5% off per day)

Hand in: Fill out the assignment cover sheet and attach to your assignment. Submit a hardcopy of your assignment in the 3171 assignment box (*the cabinet near the ladies washroom on the second floor*). Any programming must **also** be submitted using the *submit* software that is described on the webpage.

Notes: Show your calculations for all questions.

Read the programming style guidelines on the course webpage.

Read the Dalhousie Policy on Plagiarism.

Assignment Weight in Course = 9%

(i) **[20 marks]:** At Cheap-O-Burger take-out restaurant there is a single teenager who serves the luckless customers. All customers that arrive at the restaurant go into a single queue. Inter-arrival times and service times for these customers follow an exponential probability. Answer the following questions about the fast food traffic and remember to explain all your answers.

a. Suppose there is just one door through which all customers arrive. And suppose that the restaurant has infinite space for its queue. How many customers are expected to be in the restaurant and in the queue? What is the expected time for a customer in the restaurant and in the queue? Assume that the mean customer service time is 10 seconds and inter-arrival time of customers through this door is 14 seconds.

b. Suppose that we now re-configure the restaurant in part a, so that there are *x* doors through which customers are arriving instead of just one. Each has the same arrival rate as the single door in part a. To compensate, we also increase the teenager speed by a factor of *y*. We do this by raising his salary by 12 cents an hour. What are the new expected number of customers in the restaurant and the expected time for a customer in the queue?

c. In the configuration of part a, assume we now have a limited queue size. Lets say that the restaurant has only 100 feet of space for its queue. Assume that every customer in the queue uses 4 feet. What mean customer arrival rate can the restaurant handle if we don't want the queue space usage to exceed an average of 80% of its capacity?

(ii) **[50 marks]:** Design and implement a event-driven simulation for an M/M/1 queue in Java. The queuing discipline is FIFO. Assume an infinite queue buffer and exponential distributions for the arrival and service rates. The values of λ and μ are user defined parameters that you read in from the command-line. The number of events that are simulated is also a user parameter. You can use the Java random number generator but you need to do more in order to generate exponential arrival and service rates.

Your program must collect statistics. The statistics will are N and N_Q. Also compute the same values analytically from formulas. You program will print out a comparison of the simulated numbers with the analytic numbers. The statistics print out will look something like this (but with different values, because I used different arrival and service rates) :

```
--------------------------------------------------------
Simulated N      = 1.1973563
Analytic  N      = 1.2
--------------------------------------------------------
Simulated NQ = 0.65493315
Analytic  NQ     = 0.6545455169677763
--------------------------------------------------------
```

For the printout enter $\lambda = 6.5$ and $\mu = 8$. Run the program for 1,000,000 events. Don't worry about reaching a steady state before you start collecting your statistics. We are running so many events that the initial stage of the simulation becomes a very minor effect.

Also, printout the last 25 events in your simulation, like this:

```
--------------------------------------------------------

Arrival at Time = 7124.2354

  ... current # users in system = 3
  ... current # users in queue  = 2

Arrival at Time = 7124.236

  ... current # users in system = 4
  ... current # users in queue  = 3

Service End Time = 7124.2407
Service Start Time = 7124.2407

  ... current # users in system = 3
  ... current # users in queue  = 2

etc…

--------------------------------------------------------
```

See the programming guidelines and provide a short explanation for each of your objects and methods. Use good object-oriented programming style for full marks.

(iii) [10 marks]: Two HTTP request methods are GET and POST. Are there any other methods in HTTP/1.0? If so, what are they used for? Are there other methods in HTTP/1.1? If so, what are they used for? You will have to find the relevant RFCs to answer these questions.

(iv) [10 marks]: Consider an HTTP client that wants to retrieve a Web document at a given URL. The IP address of the HTTP server is initially unknown. The Web document at the URL has one embedded GIF image that resides at the same server as the original document. What transport and application layer protocols besides HTTP are needed in this scenario?

(v) [10 marks]: Suppose within your Web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS look-up is necessary to obtain the IP address. Suppose that *n* DNS servers are visited before your host receives the IP address from DNS; the successive visits incur an RTT of RTT_1, … RTT_n. Further suppose that the Web page is an HTML text file and four additional objects. Let RTT_0 denote a RTT between the local host and the server containing the object. Assuming zero transmission time of the object, how much time elapses from when the client clicks on the link until the client receives the entire Web page? Assume a non-persistent HTTP protocol with no parallel TCP connections.