CS 2250 **Data Structures and Problem Solving**
Assignment # 5 Due Date: April 24, 2007

Queues

Create a directory `${USER}.5` in your home. Keep all programs and datafiles for this assignment in this directory. Do each of the assigned programs in a separate directory within this directory. After you are done with the assignment, remove the executables, and execute the following commands on admiral:

```
% cd
% ~sanjiv/bin/handin cs2250 5
```

This program is meant to exercise the queues where each element is dynamically allocated as needed. You must use the queue ADT as given in the class using the dynamic memory allocation with pointers.

In this program, you are required to perform a simulation of the grocery store checkout lanes and compare the performance of two different queueing methods for checkout. The program will be made up of two separate programs for simulation and one for generating the times of arrival and departure in the queue. Upon analysis, it is seen that we are more interested in the actual time spent by a customer in the queue than the time of departure. Therefore, we'll keep two parameters of each customer: time of arrival and the service time requirement.

1. Program to generate the time parameters for the customer

   - Write a program to generate random numbers to be associated with the time of arrival and the service time requirement for the customer. The time is a logical entity and can be expressed as a float, instead of the usual HH:MM:SS format. The arrival time will increase linearly with every customer (assuming that a customer arrives, on an average, every 5 seconds). Each customer will require between 100 and 400 seconds of service time.

     This program will generate a list of two fields (as specified above) and write them to a file named `customers`.

2. In the second phase, you will write two programs to simulate the grocery store checkout using the file `customer`. Each program will take its input from this file and produce a report to specify the following:

   - Number of customers serviced
   - Number of customers remaining
   - Average time spent by each customer in the line
   - Average waiting time for each customer
   - Average idle time for the checkout clerks

   Assume that there are 10 checkout counters, and all of them are available for checkout when you start. You have to write the programs to show the results from two different strategies:

(a) Simulate the grocery store checkout lanes as you see them. A customer arrives and goes to the lane which has the minimum number of waiting customers. You will have to have a queue corresponding to each checkout counter in this case. This can be easily simulated by an array of ten queues.

(b) Simulate the grocery store checkout where we still have ten checkout clerks but all the customers enter a single queue. Whenever a checkout clerk is done with the current customer, she waves the next customer in the queue to step to her counter and performs the service. This is like a bakery where you have to take a number for service and your number is called when the clerk is available.

Use top-down design to design and code the implementation. Use good documentation.