

CS 150: Project I

Due: 11:55pm, Friday October 12, 2018

Introduction

Project Description

A popular coffee shop chain is opening a new coffee shop on College Hill. You are hired as a consultant to decide how many cashiers to hire in order to optimize the profit. The following conditions are known.

1. The shop opens at 6 am and closed at 10 pm. Use second as the unit of time in this project.
2. There are s cashier counters staffed in the shop. When a customer arrives at the shop, he or she joins a single queue waiting to be served by the first available cashier. However, if the length of the queue is more than $8s$, the customer is turned away as an “overflow.” Any customer arrives at or before 10:00 pm will be queued and served.
3. The estimated profit of serving each customer is p dollars.
4. The cost of staffing a cashier counter for a whole day is c dollars.
5. The average time required by a cashier to serve a customer is t seconds.
6. The daily net profit of the shop is the total daily profit minus the daily cost of cashiers.

Input Specification

You are given a file “input.txt” containing the following information.

- The first line is a real number p , $0.00 < p < 10.00$, the estimated profit of serving each customer.
- The second line is a real number c , $0.00 < c < 1000.00$, the cost of staffing a cashier counter per day.
- The third line is an integer t , $30 < t < 300$, the average time for a cashier to serve a customer in seconds.
- From the fourth line to the last line is the arrival times of the customers. Each line contains a string in the format of “hh:mm:ss am” or “hh:mm:ss pm”.

Assignments

As a consultant, your assignments are:

1. Write a program that can compute, for the give data file and an integer parameter s ($s > 0$ is the number of cashier counters staffed) read from the standard input, the amount of daily net profit, the rate of “overflow”, the average and maximum waiting time of all customers served.
2. Plot the net daily profit as a function of the number of cashiers s and find the optimal number of cashiers s that maximizes the profit.

Guidelines

1. You should use the appropriate data structures and algorithms. Specifically, the following data structures are used in this project: ArrayList, LinkedList, Queue, PriorityQueue.
2. The simulation is “event-driven”, that is, the simulation processes events such as customer arrivals and departures in order of time. Specifically, the customer arrivals are stored in a priority queue in order of time. When a customer is served, the customer’s departure time is computed, and the departure event is inserted into the priority queue. In each iteration of the simulation, the event in the head of the priority queue is removed and processed. Refer to the textbook, section 13.32, for more information.
3. Your conclusions and analysis should be supported by data from your simulation.

Report

The guideline for wiring the project report is here: <http://www.cs.lafayette.edu/~gexia/cs150/writeup-guidelines.pdf>

Grading

The project is to be completed individually. Unless otherwise approved by the instructor, the only person you can consult is the instructor. Your project will be graded on the following criteria (assuming the program compiles and runs):

1. correctness of the program
2. documentation (methods and classes) including javadoc
3. unit testing
4. object oriented design
5. quality of the simulation and analysis
6. quality of the project report