



HOMEWORK - SPRING 2018

HOMEWORK 4 - due Tuesday, March 20th no later than 7:00pm

REMINDERS:

- Be sure your code follows the [coding style](#) for CSE214.
- Make sure you read the warnings about [academic dishonesty](#). *Remember, all work you submit for homework assignments MUST be entirely your own work. Also, group efforts are not allowed.*
- Login to your [grading account](#) and click "Submit Assignment" to upload and submit your assignment.
- You are allowed to use any built-in Java API Data Structure classes to implement this assignment except where noted.
- You may use Scanner, InputStreamReader, or any other class that you wish for keyboard input.

The L. I. double R. has realized that it can leverage its reputation as the absolute [worst commuter railroad in America](#) in order to extract even more undeserved money from its passengers. Following models from European trains, they've decided to change all their cars to have two classes - first and second class. They would like to know how their morning commute will be affected by this - what the average wait time will be for first and second class will be (and how many people won't get on the train at all) *there will be no standing passengers*. You will model a LIRR morning service with the following stations: Mineola, Hicksville, Syosett, and Huntington (passengers will only get off at Jamaica and Penn, so we won't worry about those). Each station will have a probability for a first class and a second class passenger arrival at any given minute. If the first class is full, the first class passengers can go to second class, but not vice versa. Trains will start at Huntington every 5 minutes, and take 5 minutes between stations (this is an idealized world where trains go fast and come often, we can multiply this by a large constant to get realistic data at a later date), and at the end of the simulation, you will print what the average wait time was for passengers at each given station for each given class, and how many passengers were served. We will pretend that there is only one train car, as we can easily multiply this by some constant to get an actual train, but it will make input and output more

manageable. We will also pretend that the train is at the station for only one minute. We will also take input for a time that passengers stop showing up for the morning commute.

Inputs:

- Train capacity 1st and 2nd class
- Probabilities for each station.
- Time passengers stop showing up (because the LIRR has lower capacity than demand most of the time)

NOTE: All exceptions explicitly thrown in Required Classes except for `IllegalArgumentException` are custom exceptions that need to be made by you.

Required Classes

Passenger

Write a fully-documented class named `Passenger` which contains an integer `id`, the arrival time, and a boolean for `isFirstClass`. This class must contain methods that allow the user to manipulate the instance variables (getters, setters, etc.)

- `int id`
- `int arrivalTime`
- `boolean isFirstClass`

PassengerQueue

Write a fully documented class called `PassengerQueue` that has all the regular queue methods. You may choose to extend a class implementing the `List<T>` interface (ie: `ArrayList` or `LinkedList`). If you choose to use api, you **must** extend. You may choose to have an `EmptyQueue` exception if you wish.

- `public void enqueue(Passenger p)`
- `public Passenger dequeue()`
- `public String toString()`
- `public Passenger peek()`
- `public boolean isEmpty()`

BooleanSource

You may copy this from the lecture slides. Basically an object is constructed with a probability `p` between 0 and 1 and then the `occurs()` method returns `true` $p \cdot 100\%$ of the time.

Station

Write a fully documented class that simulates a station. It must contain two queues, two boolean source instances - one to generate arrivals for first class, and one to generate arrivals for second class.

- `public void simulateTimestep()`
 - Handles arrival of passengers
- `private PassengerQueue firstClass;`
- `private PassengerQueue secondClass;`
- `private BooleanSource firstArrival`
- `private BooleanSource secondArrival`

Train

Write a fully documented class called `Train` to simulate trains. It will contain a queue of the stations the train has to visit (at `time%5==0`, a new station is dequeued, the list of stations is initialized to contain all the stations on the line, in order). It will also contain a method to simulate station arrival, where passengers are dequeued.

- `public void simulateTimeStep()`
 - Simulates the passing of one timestep, and dequeues passengers from stations when appropriate
- `private int firstCapacity`
- `private int secondCapacity`
- `private int time until next Arrival`

LIRRSimulator

Write a fully documented class called LIRR simulator. It should have some sort of list of stations, some list of trains currently on the line, and some global variables for number of passengers served, and other useful statistics (see sample I/O for expected end-of-run statistics).

Note on Exceptions: all exceptions should be handled gracefully - they should be caught in the main, and the user should be notified by a nice printout. Your messages will not be graded for creativity, but they should clearly indicate what the problem is (bad index, full list, negative number, etc.). The program should continue to run normally after an exception is encountered. We will not be checking Input Mismatch cases.

Pretty Printing: Here is a tutorial on how to print tables neatly using printf in java. It is highly encouraged that you print the output neatly, as it makes grading much easier. <https://docs.oracle.com/javase/tutorial/java/data/numberformat.html> Here's a friendly reference page: <https://alvinalexander.com/programming/printf-format-cheat-sheet>

General Recommendations

You might want to use the toString() method for CommandStack to make debugging and printing easier. You do not have to do this, but it will help you.

You can feel free to add extra methods and variables if you need.

Program Sample

```
Welcome to the LIRR Simulator, Leaving Irate Riders
Regularly
//This sample I/O is supposed to show you the mechanics of
the program, the numbers are made up and may not add up.
Mineola:
Please enter first class arrival probability: .3
Please enter second class arrival probability: .5

Hicksville:
Please enter first class arrival probability: .3
Please enter second class arrival probability: .7

Syosset:
Please enter first class arrival probability: .4
Please enter second class arrival probability: .6

Huntington:
Please enter first class arrival probability: .2
Please enter second class arrival probability: .5

Please enter first class capacity: 7

Please enter second class capacity: 15

Please enter number of trains: 4

Please enter last arrival time of passengers: 14 //Throw
exception if after last station arrival of last train

Begin Simulation:
-----
```

Time 0:

Station overview:

Mineola:

No first class passenger arrives

Second class passenger ID 1 arrives

Queues:

First [empty]

Second [P1@T0 //Basically Passenger 1 arrived at Time 0

Hicksville:

First class passenger ID 2 arrives

Second class passenger ID 3 arrives

Queues:

First [P2@T0

Second [P3@T0

Syosset:

No first class passenger arrives

No second class passenger arrives

Queues:

First [empty]

Second [empty]

Huntington:

First class passenger ID 4 arrives

Second class passenger ID 5 arrives

Queues:

First [P4@T0

Second [P5@T0

Trains:

Train 1 arrives at Huntington, There are 0 passengers in first class and 0 in second class.

Passengers embarking in first class: P4

Passengers embarking in second class: P5

Train 2 will arrive at Huntington in 5 minutes.

Train 3 will arrive at Huntington in 10 minutes.

Train 4 will arrive at Huntington in 15 minutes.

Time 1:

Station overview:

Mineola:

First Class Passenger ID 6 arrives

Second class passenger ID 7 arrives

Queues:

First [P6@T1

Second [P1@T0,P7@T1

Hicksville:

First class passenger ID 8 arrives

Second class passenger ID 9 arrives

Queues:

First [P2@T0,P8@T1
Second [P3@T0,P9@T1

Syosset:
First class passenger ID 10 arrives
Second class passenger ID 11 arrives
Queues:
First [P10@T1
Second [P11@T1

Huntington:
No first class passenger arrives
No second class passenger arrives
Queues:
First [empty]
Second [empty]

Trains:

Train 1 will arrive in Syosset in 4 minutes
Train 2 will arrive at Huntington in 4 minutes.
Train 3 will arrive at Huntington in 9 minutes.
Train 4 will arrive at Huntington in 14 minutes.

...//Much Later; we skipped a bunch of time steps

Time 15: //No more arrivals

Station overview:

Mineola:
No first class passenger arrives
No second class passenger arrives
Queues:
First [P6@T1, P14@T3, P18@T4, P23@T6, P28@T7, 40@T10,
P45@T11, P47@T12, P55@T14
Second [P1@T0,P7@T1 P15@T3, P19@T4, P29@T7, P33@T9, P48@t12,
P50@T13, P56@T14

//The lines here are expected to be very long before first
train arrives

Hicksville:
No first class passenger arrives
No second class passenger arrives
Queues:
First [P46@T11, P57@T14
Second [P52@T13, P58@T14

Syosset:
No first class passenger arrives
No second class passenger arrives
Queues:
First [P52@T13, P59@T14
Second [P49@T12, P60@T14

Huntington:
No first class passenger arrives
No second class passenger arrives

Queues:

First [P53@T13, P61@T14

Second [P54@T13, P62@T14

Trains:

Train 1 arrives at Mineola, there are 7 passengers in first class and 10 in second class.

Passengers embarking in first class: none //it's full

Passengers embarking in second class: P6, P14, P18, P23, P28

//first class has priority, fill the train, 2nd class will wait

Train 2 arrives at Hicksville, there are 3 passengers in first class, and 5 in second class.

Passengers embarking in first class: P46, P57

Passengers embarking in second class: P49, P60

Train 3 arrives at Syosset, there are 1 passengers in first class and 2 in second class.

Passengers embarking in first class: P52, P59

Passengers embarking in second class: P49, P60

Train 4 arrives at Huntington, there are 0 passengers in first class and 0 in second class.

Passengers embarking in first class: P53, P61

Passengers embarking in second class: P54, P62

...//Much Later; we skipped a bunch of time steps

//After a train has passed mineola, write "Train X has stopped picking up passengers."

//These are sample stats and may not reflect the above simulation. Average wait time may be rounded to the nearest integer.

//Only consider passengers picked up by trains for average wait time. Count first class passengers sitting in second class as 1st class for stats

At the end of the simulation:

A total of 63 passengers were served, 5 first class passengers were left without a seat, 9 second class passengers were left without a seat.

At Mineola 8 first class passengers were served with an average wait time of 19 min, 8 second class passengers were served with an average wait time of 23 min. 0 first class passengers and 0 second class passengers were left without a seat.

At Mineola 7 first class passengers were served with an average wait time of 13 min, 12 second class passengers were served with an average wait time of 16 min. 1 first class passengers and 0 second class passengers were left without a seat.

At Syosset 3 first class passengers were served with an average wait time of 8 min, 5 second class passengers were

served with an average wait time of 8 min. 2 first class passengers and 3 second class passengers were left without a seat.

At Huntington 8 first class passengers were served with an average wait time of 1 min, 12 second class passengers were served with an average wait time of 2 min. 2 first class passengers and 6 second class passengers were left without a seat.//It's possible for passengers to arrive after the last train passes their station everywhere but the last station.

Extra Credit

You will get up to 5 points extra credit for creating a JavaFX GUI, and up to 7 points for creating an Android App, 10 points for making a web application using JSP or JSF, make a nice animation. The extra credit is reduced in this homework due to fewer interaction components.

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