Lab Exercise 7: Queues and Stacks
CS 2334

February 27, 2018

Introduction

In this lab, you will experiment with two common data structures: stacks and queues. In particular, you will use the PriorityQueue and Stack classes from the Java Collections Framework. You will also be working more with abstract classes and abstract methods.

Learning Objectives

By the end of this laboratory exercise, you should be able to:

1. Use the Stack class to store and retrieve objects
2. Use the Queue class to store and retrieve objects
3. Create and use Abstract Classes and Methods

Proper Academic Conduct

This lab is to be done individually. Do not look at or discuss solutions with anyone other than the instructor or the TAs. Do not copy or look at specific solutions from the net.

Preparation

1. Import the existing lab7 implementation into your eclipse workspace.

   (a) Download the lab7 implementation from canvas.

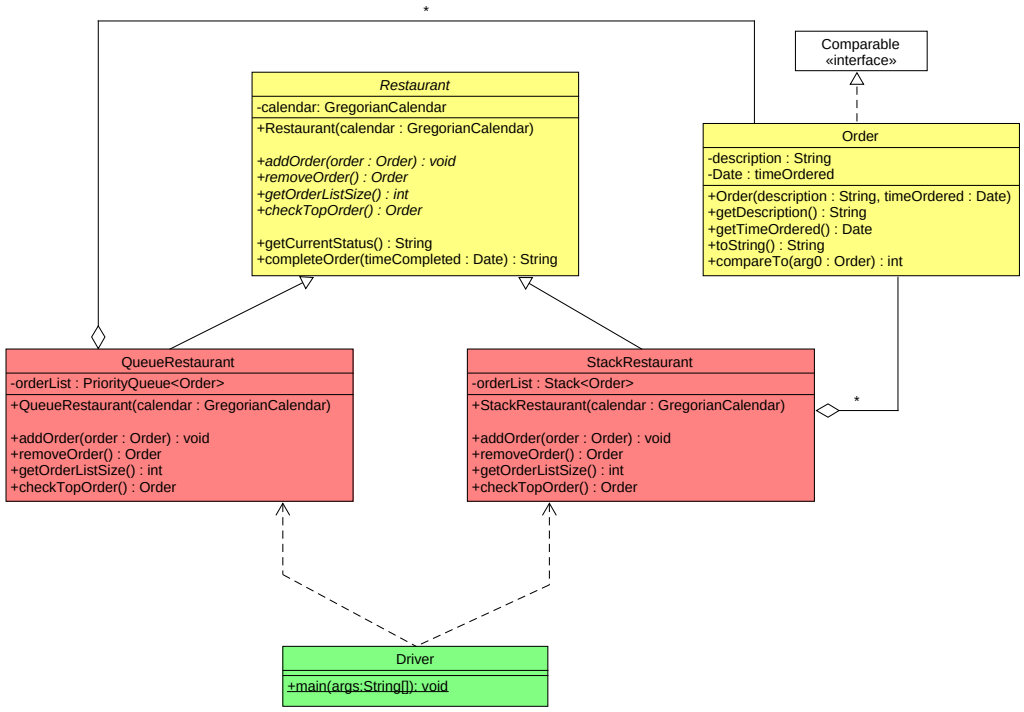
   (b) In Eclipse, select *File/Import*

   (c) Select *General/Existing projects into workspace*. Click *Next*

   (d) Select *Select archive file*. Browse to the lab7.zip file. Click *Finish*

Class Design

Below is the UML representation of the set of classes that make up the implementation for this lab. Note that the code for Order is fully implemented, but you are to add (java-doc style) documentation to it.



- Green colored blocks indicate that they are fully implemented.
- Yellow colored blocks indicate that they are partially implemented.
- Red colored blocks indicate that they have to be implemented by you.
- Purple colored blocks are Java standard classes/interfaces, and you should not attempted to create them.

The key classes in our project are:

- **Order**: class representing an order at a restaurant. The class has two variables: the *description* of the order (i.e. what it is) and the *timeOrdered* marking when the order was made. Some getters are made, and the toString always returns the *description*.

- **Restaurant**: An abstract class representing a restaurant. A Restaurant is expected to store a list of orders, and provides methods for adding and removing them. Subclasses define how orders are stored and removed. In addition, some methods are added to get additional information about the Restaurant or add public accessibility. The following methods defines how it works:

  - Constructor: takes in a GregorianCalendar and stores it.
  - addOrder(): Abstract method. Implementing classes should add the order passed in into an internal data structure. I.e. the order should be stored in some way.
  - removeOrder(): Abstract method. Implementing classes should remove a stored Order from their internal data structures. This method and addOrder define the order in which Orders are completed.
  - getOrderListSize(): Abstract method. Implementing classes should return an int indicating the number of orders that are stored in some internal data structure.
  - checkTopOrder(): Abstract method. Implementing classes should return the order that would next be removed (upon call to removeOrder) **without** removing the order from the storage of the internal data structure. I.e. check what will next be removed without actually removing it.
  - getCurrentStatus(): returns some information. In particular, returns information on the current number of orders stored and what order is next.
  - completeOrder(): public method providing utility to other classes to remove the next order from the internal data structure. Also computes the time since the order was created to the given time that the order was completed and returns information based on this.

- **StackRestaurant**: An implementation class of Restaurant. A StackRestaurant stores orders in a Stack *orderList*. Stacks are a "Last In - First Out" or "LIFO" data structure. This means that the last element added to a stack is the first one that is removed from it.

e.g. we add the elements A,B, and C to a stack in that order ("pushing" the values onto the stack). We then remove 3 elements ("popping") from the stack. They will be removed in the order c, B, A.

The StackRestaurant completes orders in a LIFO ordering. The overridden abstract methods should reflect this.

- **QueueRestaurant**: An implementation class of Restaurant. A QueueRestaurant stores orders in a PriorityQueue *orderList*. Note that Queue is an interface in Java, not a class. This is why a PriorityQueue is used (PriorityQueues are a bit more complex and change order based on some pre-definined priority. By overriding compareTo in Object to always return 0, we make the PriorityQueue equivalent to the standard Queue data structure). Queues are a "First In - First Out" or "FIFO" data structure. This means that the first element added to a queue is the first one that is removed from it.

  e.g. we add the elements A,B, and C to a queue in that order. We then remove 3 elements from the queue. They will be removed in the order that they were inserted in: A, B, C.

  The QueueRestaurant completes orders in a FIFO ordering. The overridden abstract methods should reflect this.

Lab 7: Implementation Steps

Start from the class files that are provided in lab7.zip.

1. The **Driver** and **Order** classes have been fully implemented and **their code should not be modified**. You do however need to **add java-doc style documentation to the Order class.**

2. The class **Restaurant** is abstract. This class is partially implemented for you. You will need to complete the implementation of each method that is listed in the UML. You will need to create the abstract methods that are not provided in the code.

3. Create and implement the class **StackRestaurant**. Be sure to implement all the abstract methods inherited from Restaurant. Valid stack methods for manipulating elements are push, pop, and peek. You should not use *add* when manipulating the Stack.

4. Create and implement the class **QueueRestaurant**. Be sure to implement all the abstract methods inherited from Restaurant. Valid PriorityQueue methods for manipulating elements are poll, add, and peek.

5. Implement JUnit tests to thoroughly test all classes and methods you created/implemented.

    - We have given a **RestaurantTest.java** for reference, which you can make use of for creating other tests. This test class should already cover all of *Order*. You may add to this test class.
    - You need to convince yourself that everything is working properly
    - Make sure that you cover all of the cases within the methods while creating your tests. Keep in mind that we have our own tests that we will use for grading.

Hints

- See the documentation for PriorityQueue. Keep in mind the methods for a Queue (poll, peek, add):

  https://docs.oracle.com/javase/8/docs/api/java/util/PriorityQueue.html

- See the documentation for Stack. Keep in mind the methods for a Stack (pop, peek, push):

  https://docs.oracle.com/javase/8/docs/api/java/util/Stack.html

- See the documentation for GregorianCalendar (this also shows how to use dates with GregorianCalendars):

  https://docs.oracle.com/javase/8/docs/api/java/util/GregorianCalendar.html

- See the documentation for Date (be wary of the methods listed as "deprecated"):

  https://docs.oracle.com/javase/8/docs/api/java/util/Date.html

Example Output

Below is an example output of the full program. The details of your interaction will vary (we do not test the output of Driver).

```
Please choose a restaurant option:
1. [enter] an order.
2. [complete] an order.
3. [check] the next order to be completed.
4. [quit]
enter
Please enter an order description and an order time (comma separated) with the ↩
    following format:
<description>,<time as a long>
Turkey,1000
Please choose a restaurant option:
1. [enter] an order.
2. [complete] an order.
3. [check] the next order to be completed.
4. [quit]
enter
Please enter an order description and an order time (comma separated) with the ↩
    following format:
<description>,<time as a long>
Ham,2000
Please choose a restaurant option:
1. [enter] an order.
2. [complete] an order.
3. [check] the next order to be completed.
4. [quit]
check
For the stack restaurant:
Ham
For the queue restaurant:
Turkey
Please choose a restaurant option:
1. [enter] an order.
2. [complete] an order.
3. [check] the next order to be completed.
4. [quit]
enter
Please enter an order description and an order time (comma separated) with the ↩
    following format:
<description>,<time as a long>
Chicken,2005
Please choose a restaurant option:
1. [enter] an order.
2. [complete] an order.
3. [check] the next order to be completed.
4. [quit]
check
For the stack restaurant:
Chicken
For the queue restaurant:
Turkey
```

```
Please choose a restaurant option:
1. [enter] an order.
2. [complete] an order.
3. [check] the next order to be completed.
4. [quit]
complete
Please enter the time of completion as a long:
3000
The completion for the stack restaurant:
It tooks 0 hours, 0 minutes, and 1 seconds to complete the following order: ↩
    Chicken

The completion for the queue restaurant:
It tooks 0 hours, 0 minutes, and 2 seconds to complete the following order: Turkey

Please choose a restaurant option:
1. [enter] an order.
2. [complete] an order.
3. [check] the next order to be completed.
4. [quit]
complete
Please enter the time of completion as a long:
6000
The completion for the stack restaurant:
It tooks 0 hours, 0 minutes, and 4 seconds to complete the following order: Ham

The completion for the queue restaurant:
It tooks 0 hours, 0 minutes, and 4 seconds to complete the following order: ↩
    Chicken

Please choose a restaurant option:
1. [enter] an order.
2. [complete] an order.
3. [check] the next order to be completed.
4. [quit]
check
For the stack restaurant:
Turkey
For the queue restaurant:
Ham
Please choose a restaurant option:
1. [enter] an order.
2. [complete] an order.
3. [check] the next order to be completed.
4. [quit]
quit
```

Final Steps

1. Generate Javadoc using Eclipse.
    - Select *Project/Generate Javadoc...*
    - Make sure that your project (and all classes within it) is selected

- Select *Private* visibility
- Use the default destination folder
- Click *Finish*.

2. Open the *lab7/doc/index.html* file using your favorite web browser or Eclipse (double clicking in the package explorer will open the web page). Check to make sure that that all of your classes are listed and that all of your documented methods have the necessary documentation.

3. If you complete the above instructions during lab, you may have your implementation checked by one of the TAs.

Submission Instructions

Before submission, finish testing your program by executing your unit tests. If your program passes all tests and your classes are covered completely by your test classes, then you are ready to attempt a submission. Here are the details:

- All required components (source code and compiled documentation) are due at 11:59pm on Friday, March 2. **Submission must be done through the Web-Cat server.**

- Submit the assignment plan to canvas by the end of your lab session. Submit the completed plan with updated time tracking to canvas when you have finished your lab.

- Use the same submission process as you used in lab 4. You must submit your implementation to the *Lab 7: Queues and Stacks* area on the Web-Cat server.

Rubric

The project will be graded out of 100 points. The distribution is as follows:

Correctness/Testing: 45 points

The Web-Cat server will grade this automatically upon submission. Your code will be compiled against a set of tests (called *Unit Tests*). These unit tests will not be visible to you, but the Web-Cat server will inform you as to which tests your code passed/failed. This grade component is a product of the fraction of **our tests** that your code passes and the fraction of **your code** that is covered by *your tests*. In other words, your submission must perform well on both metrics in order to receive a reasonable grade.

Style/Coding: 20 points

The Web-Cat server will grade this automatically upon submission. Every violation of the *Program Formatting* standard described in Lab 1 will result in a subtraction of a small number of points (usually two points). Looking at your submission report on the Web-Cat server, you will be able to see a notation for each violation that describes the nature of the problem and the number of subtracted points.

Design/Readability: 35 points

This element will be assessed by a grader (typically sometime after the lab deadline). Any *errors* in your program will be noted in the code stored on the Web-Cat server, and two points will be deducted for each. Possible errors include:

- Non-descriptive or inappropriate project- or method-level documentation (up to 10 points)
- Missing or inappropriate inline documentation (2 points per violation; up to 10 points)
- Inappropriate choice of variable or method names (2 points per violation; up to 10 points)
- Inefficient implementation of an algorithm (minor errors: 2 points each; up to 10 points)
- Incorrect implementation of an algorithm (minor errors: 2 points each; up to 10 points)

If you do not submit compiled Javadoc for your project, 5 points will be deducted from this part of your score.

Note that the grader may also give *warnings* or other feedback. Although no points will be deducted, the issues should be addressed in future submissions(where points may be deducted).

Bonus: up to 5 points

You will earn one bonus point for every two hours that your assignment is submitted early.

Penalties: up to 100 points

You will lose ten points for every minute that your assignment is submitted late. For a submission to be considered *on time*, it must arrive at the server by the designated minute (and zero seconds). For a deadline of 9:00, a submission that arrives at 9:00:01 is considered late (in this context, it is one minute late).

After 15 submissions to Web-Cat, you will be penalized one point for every additional submission.

For labs, the server will continue to accept submissions for three days after the deadline. In these cases, you will still have the benefit of the automatic feedback. However, beyond ten minutes late, you will receive a score of zero.

The grader will make their best effort to select the submission that yields the highest score.