

# CPSC 2151

## Lab 5

Due Friday, September 25<sup>th</sup> at 10:00 pm

In this lab you will continue working with our queues from lab 4. You will add an `abstract class`, some secondary methods, and create a more meaningful application that utilizes our queues.

### Instructions

1. Create a copy of your project from lab 4 to edit for lab 5.
2. Add a new class called `AbsQueue`. `AbsQueue` will implement `IQueue`, but will contain no actual private data. `AbsQueue` will override the `toString` method inherited from the `Object` class to create a string representation of the values in the queue.
3. Update `ArrayQueue` and `ListQueue` to extend `AbsQueue`, allowing them to inherit the `toString` method.
4. Add the following methods to your `IQueue` interface. All of these methods are secondary and should be implemented as default methods inside the interface. Include all contracts and Javadoc comments for these methods.
  - a. `Integer peek()` – returns the integer at the front of the queue but does not remove it from the queue (final state of the queue is equivalent to the initial state of the queue, the queue can change during the method).
  - b. `Integer endOfQueue()` – returns the integer at the end of the queue, but does not remove it from the queue
  - c. `void insert(Integer x, int pos)` inserts `x` at position `pos` in the queue. `Pos` index starts at 1, so the item at the very front of the queue is `pos 1`.
  - d. `Integer remove(int pos)` – removes whatever integer was in position `pos` in the queue and returns it. `Pos` index starts at 1, so the item at the very front of the queue is `pos 1`.
  - e. `Integer get(int pos)` – returns whatever integer was in position `pos` in the queue and without removing it. `Pos` index starts at 1, so the item at the very front of the queue is `pos 1`.
5. In your `QueueApp` code, you previously had a pretty meaningless `main` method. Update to perform the following
  - a. Ask the user which implementation they would like to use, and create the queue
  - b. Present a numbered menu of options to
    - i. Add to the queue
    - ii. Get the next number from the queue
    - iii. Peek at the first value in the queue
    - iv. Peek at the last value in the queue
    - v. Insert into a position in the queue
    - vi. Peek at a value in any position in the queue
    - vii. Remove a value from any position in the queue and return it
    - viii. Exit
  - c. Complete the requested option, and display any output

- i. Make sure all preconditions for your `IQueue` methods are met. Remember, we can use preconditions to pass responsibility up the chain, but our user does not know about Design-By-Contract or the preconditions. If the user provides bad input, you must provide a meaningful error message and then either allow them to re-enter input or return to the main menu (depending on what is more appropriate)
  - ii. Not all possible errors and error messages are shown in the sample input and output.
- d. Print the current state of the queue
- e. Return to step b and loop until the user opts to exit
- 6. You may create as many helper methods in `QueueApp` as you think are necessary. Remember that they will have to be `static` in order to be called by the `main` method. Make sure you add Javadoc comments and contracts for any helper methods you add.
- 7. Create a `makefile` and test your code on SoC Unix machines before submitting.

### Partners

You may work with one partner on this lab assignment and you are encouraged to do so. Make sure you include both partners' names on the submission. You only need to submit one copy. Remember that working with a partner means working *with* a partner, not dividing up the work. You will need this code for a later lab, so make sure both partners have a copy of it.

### Before Submitting

You need to make sure your code will run on SoC Unix machines and create a `makefile`.

### Submitting your file

You will submit your files using handin in the lab section you are enrolled in. If you are unfamiliar with handin, more information is available at <https://handin.cs.clemson.edu/help/students/>. You should submit a zipped directory with your package directory and your `makefile`. The TA should be able to unzip your directory and type `make` to compile your code, `make run` to run it and `make clean` to delete any `.class` files.

**NOTE:** Make sure you zipped up your files correctly and didn't forget something! Always check your submissions on handin to ensure you uploaded the correct zip file.

### Sample input and output

**Note:** This sample input does not include all possible error messages (such as the queue being full)

```
Enter 1 for array implementation or 2 for List implementation
1
Select an option:
1. Add to the Queue
2. Get next number from the Queue
3. Peek at the front of the Queue
4. Peek at the end of the Queue
5. Insert in the Queue
```

6. Get a position in the Queue
  7. Remove from a position in the Queue
  8. Quit
- 2

Queue is empty!

Queue is:

Select an option:

1. Add to the Queue
  2. Get next number from the Queue
  3. Peek at the front of the Queue
  4. Peek at the end of the Queue
  5. Insert in the Queue
  6. Get a position in the Queue
  7. Remove from a position in the Queue
  8. Quit
- 3

Queue is empty!

Queue is:

Select an option:

1. Add to the Queue
  2. Get next number from the Queue
  3. Peek at the front of the Queue
  4. Peek at the end of the Queue
  5. Insert in the Queue
  6. Get a position in the Queue
  7. Remove from a position in the Queue
  8. Quit
- 4

Queue is empty!

Queue is:

Select an option:

1. Add to the Queue
  2. Get next number from the Queue
  3. Peek at the front of the Queue
  4. Peek at the end of the Queue
  5. Insert in the Queue
  6. Get a position in the Queue
  7. Remove from a position in the Queue
  8. Quit
- 6

Queue is empty!

Queue is:

Select an option:

1. Add to the Queue
2. Get next number from the Queue
3. Peek at the front of the Queue
4. Peek at the end of the Queue
5. Insert in the Queue
6. Get a position in the Queue
7. Remove from a position in the Queue
8. Quit

7

Queue is empty!

Queue is:

Select an option:

1. Add to the Queue
2. Get next number from the Queue
3. Peek at the front of the Queue
4. Peek at the end of the Queue
5. Insert in the Queue
6. Get a position in the Queue
7. Remove from a position in the Queue
8. Quit

1

What number to add to the Queue?

42

Queue is:

42

Select an option:

1. Add to the Queue
2. Get next number from the Queue
3. Peek at the front of the Queue
4. Peek at the end of the Queue
5. Insert in the Queue
6. Get a position in the Queue
7. Remove from a position in the Queue
8. Quit

1

What number to add to the Queue?

37

Queue is:

42, 37

Select an option:

1. Add to the Queue
2. Get next number from the Queue
3. Peek at the front of the Queue
4. Peek at the end of the Queue
5. Insert in the Queue
6. Get a position in the Queue
7. Remove from a position in the Queue
8. Quit

1

What number to add to the Queue?

36

Queue is:

42, 37, 36

Select an option:

1. Add to the Queue
2. Get next number from the Queue
3. Peek at the front of the Queue
4. Peek at the end of the Queue
5. Insert in the Queue
6. Get a position in the Queue
7. Remove from a position in the Queue
8. Quit

2

Next number is 42

Queue is:

37, 36

Select an option:

1. Add to the Queue
2. Get next number from the Queue
3. Peek at the front of the Queue
4. Peek at the end of the Queue
5. Insert in the Queue
6. Get a position in the Queue
7. Remove from a position in the Queue
8. Quit

1

What number to add to the Queue?

42

Queue is:

37, 36, 42

Select an option:

1. Add to the Queue
2. Get next number from the Queue
3. Peek at the front of the Queue
4. Peek at the end of the Queue
5. Insert in the Queue
6. Get a position in the Queue
7. Remove from a position in the Queue
8. Quit

3

Peek: 37

Queue is:

37, 36, 42

Select an option:

1. Add to the Queue
2. Get next number from the Queue
3. Peek at the front of the Queue
4. Peek at the end of the Queue
5. Insert in the Queue
6. Get a position in the Queue
7. Remove from a position in the Queue
8. Quit

4

Peek at end: 42

Queue is:

37, 36, 42

Select an option:

1. Add to the Queue
2. Get next number from the Queue
3. Peek at the front of the Queue
4. Peek at the end of the Queue
5. Insert in the Queue
6. Get a position in the Queue
7. Remove from a position in the Queue
8. Quit

6

What position to get from the Queue?

7

Not a valid position in the Queue!

What position to get from the Queue?

2

36 is at position 2 in the queue

Queue is:

37, 36, 42

Select an option:

1. Add to the Queue
2. Get next number from the Queue
3. Peek at the front of the Queue
4. Peek at the end of the Queue
5. Insert in the Queue
6. Get a position in the Queue
7. Remove from a position in the Queue
8. Quit

5

What number to add to the Queue?

17

What position to insert in?

9

Not a valid position in the Queue!

What position to insert in?

1

Queue is:

17, 37, 36, 42

Select an option:

1. Add to the Queue
2. Get next number from the Queue
3. Peek at the front of the Queue
4. Peek at the end of the Queue
5. Insert in the Queue
6. Get a position in the Queue
7. Remove from a position in the Queue
8. Quit

5

What number to add to the Queue?

19

What position to insert in?

5

Queue is:

17, 37, 36, 42, 19

Select an option:

1. Add to the Queue
2. Get next number from the Queue
3. Peek at the front of the Queue
4. Peek at the end of the Queue
5. Insert in the Queue
6. Get a position in the Queue
7. Remove from a position in the Queue

8. Quit

7

What position to remove from the Queue?

1

17 was at position 1 in the queue

Queue is:

37, 36, 42, 19

Select an option:

1. Add to the Queue

2. Get next number from the Queue

3. Peek at the front of the Queue

4. Peek at the end of the Queue

5. Insert in the Queue

6. Get a position in the Queue

7. Remove from a position in the Queue

8. Quit

7

What position to remove from the Queue?

5

Not a valid position in the Queue!

What position to remove from the Queue?

4

19 was at position 4 in the queue

Queue is:

37, 36, 42

Select an option:

1. Add to the Queue

2. Get next number from the Queue

3. Peek at the front of the Queue

4. Peek at the end of the Queue

5. Insert in the Queue

6. Get a position in the Queue

7. Remove from a position in the Queue

8. Quit

7

What position to remove from the Queue?

2

36 was at position 2 in the queue

Queue is:

37, 42

Select an option:

1. Add to the Queue



2. Get next number from the Queue
3. Peek at the front of the Queue
4. Peek at the end of the Queue
5. Insert in the Queue
6. Get a position in the Queue
7. Remove from a position in the Queue
8. Quit

9

Not a valid option!

Queue is:

37, 42

Select an option:

1. Add to the Queue
2. Get next number from the Queue
3. Peek at the front of the Queue
4. Peek at the end of the Queue
5. Insert in the Queue
6. Get a position in the Queue
7. Remove from a position in the Queue
8. Quit

8

Process finished with exit code 0