CPSC 2151

Lab 4

Due Friday, February 12th at 10:00 pm

In this lab, you will continue working with our deques from lab 3. You will add an `abstract class`, some secondary methods and create a more meaningful application that utilizes our deques.

Instructions
1. Create a copy of your project from lab 3 to edit for lab 4.
2. Add the following methods to your `IDeque` 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. `Character peek()` – returns the character at the front of the deque but does not remove it from the deque (final state of the deque is equivalent to the deque's initial state, the deque can change during the method).
   b. `Character endOfDeque()` – returns the character at the end of the deque but does not remove it from the deque.
   c. `void insert(Character c, int pos)` inserts `c` at position `pos` in the deque. `Pos` index starts at 1, so the item at the very front of the deque is `pos` 1.
   d. `Character remove(int pos)` – removes whatever character was in position `pos` in the deque and returns it. `Pos` index starts at 1, so the item at the very front of the deque is `pos` 1.
   e. `Character get(int pos)` – returns whatever character was in position `pos` in the deque and without removing it. `Pos` index starts at 1, so the item at the very front of the deque is `pos` 1.
3. Add a new class called `AbsDeque`. `AbsDeque` will implement `IDeque` but will contain no actual private data. `AbsDeque` will override the `toString` method inherited from the `Object` class to create a string representation of the values in the deque.
4. Update `ArrayDeque` and `ListDeque` to extend `AbsDeque`, allowing them to inherit the `toString` method.
5. In your `DequeApp` 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 deque
   b. Present a numbered menu of options to
      i. Add to the end of the deque
      ii. Add to the front of the deque
      iii. Remove from the front of the deque
      iv. Remove from the end of the deque
      v. Peek at the front of the deque
      vi. Peek at the end of the deque
      vii. Insert into a position in the deque
      viii. Remove a value from any position in the deque and return it
      ix. Peek at a value in any position in the deque

        x.   Returns the length of the deque

       xi.   Clears the deque

      xii.   Exit

   c.   Complete the requested option, and display any output

        i.   Make sure all preconditions for your `IDeque` 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 deque

   e.   Return to step b and loop until the user opts to exit

6.   You may create as many helper methods in `DequeApp` 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 it.

Partners

You are required to work with one partner on this lab assignment. 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` 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 deque being full)

```
Enter 1 for array implementation or 2 for List implementation
1
```

```
Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
3
Deque is empty!
Deque is:
<>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
5
Deque is empty!
Deque is:
<>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
```

```
12. Quit
6
Deque is empty!
Deque is:
<>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
9
Deque is empty!
Deque is:
<>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
8
Deque is empty!
Deque is:
<>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
```

```
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
4
Deque is empty!
Deque is:
<>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
1
What character to enqueue to the end of the Deque?
a
Deque is:
<a>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
1
What character to enqueue to the end of the Deque?
b
Deque is:
```

```
<a, b>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
2
What character to inject to the front of the Deque?
c
Deque is:
<c, a, b>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
3
Character at the front: c
Deque is:
<a, b>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
```

```
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
4
Character at the end: b
Deque is:
<a>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
1
What character to enqueue to the end of the Deque?
6
Deque is:
<a, 6>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
1
What character to enqueue to the end of the Deque?
k
Deque is:
<a, 6, k>

Select an option:
```

```
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
5
Peek: a
Deque is:
<a, 6, k>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
6
EndOfDeque: k
Deque is:
<a, 6, k>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
```

```
9
What position to get from the Deque?
7
Not a valid position in the Deque!
What position to get from the Deque?
2
6 is at position 2 in the Deque.
Deque is:
<a, 6, k>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
7
What character to insert to the Deque?
z
What position to insert in?
9
Not a valid position in the Deque!
What position to insert in?
2
Deque is:
<a, z, 6, k>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
7
```

```
What character to insert to the Deque?
?
What position to insert in?
4
Deque is:
<a, z, 6, ?, k>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
8
What position to remove from the Deque?
1
a was at position 1 in the Deque.
Deque is:
<z, 6, ?, k>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
8
What position to remove from the Deque?
5
Not a valid position in the Deque!
What position to remove from the Deque?
4
k was at position 4 in the Deque.
Deque is:
```

```
<z, 6, ?>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
10
Length of Deque: 3
Deque is:
<z, 6, ?>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
11
Deque is now empty!
Deque is:
<>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
```

```
10. Get the length of the Deque
11. Clear the Deque
12. Quit
2
What character to inject to the front of the Deque?
b
Deque is:
<b>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
13
Not a valid option!
Deque is:
<b>

Select an option:
1. Add to the end of the Deque
2. Add to the front of the Deque
3. Remove from the front of the Deque
4. Remove from the end of the Deque
5. Peek from the front of the Deque
6. Peek from the end of the Deque
7. Insert to a position in the Deque
8. Remove from a position in the Deque
9. Get a position in the Deque
10. Get the length of the Deque
11. Clear the Deque
12. Quit
12

Process finished with exit code 0
```