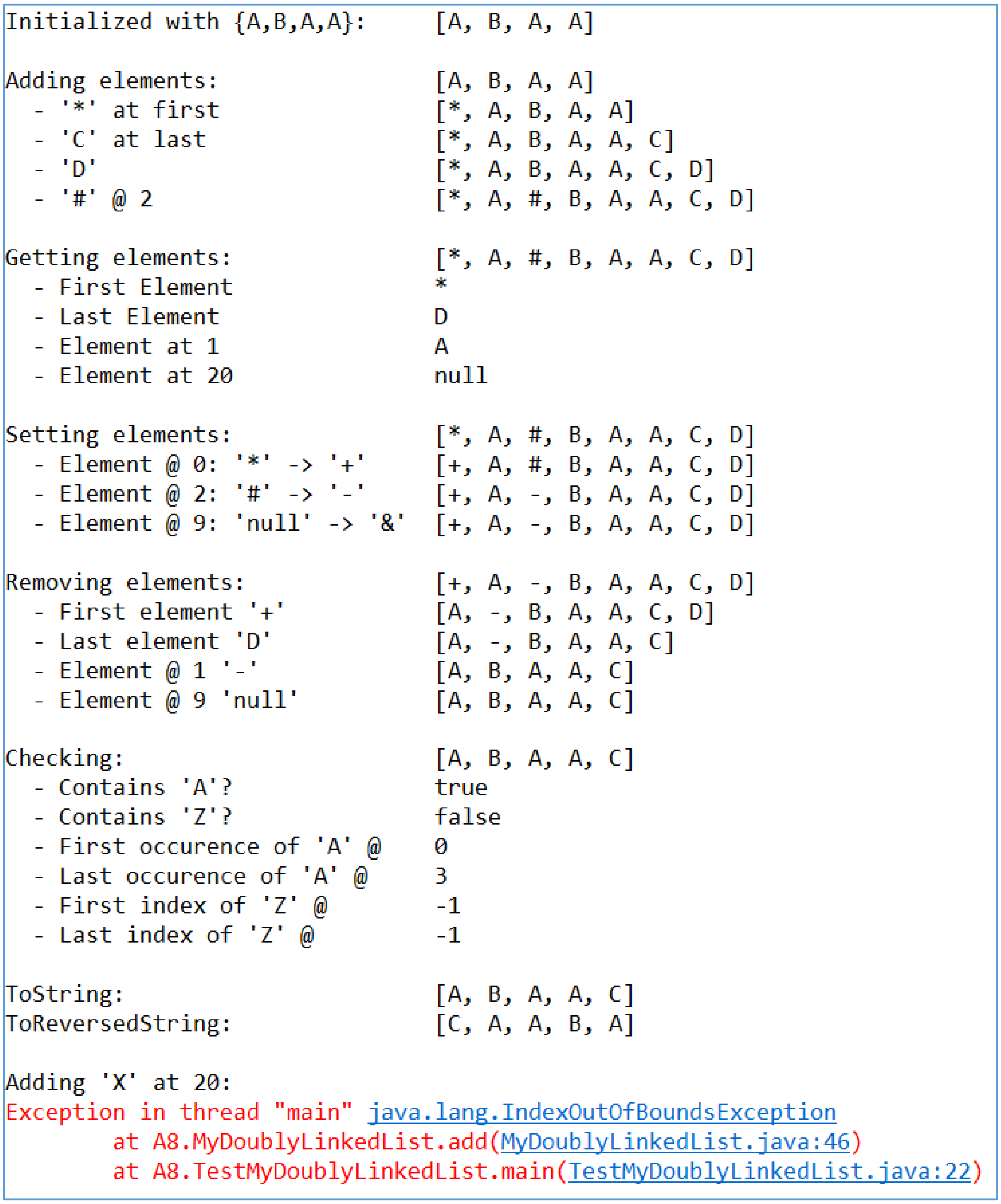
Assignment (20 marks)

***Focus:** Implementing Java Collections (LinkedLists)*

In this assignment, you will convert the `MyLinkedList` class, which we created in class, to a doubly linked list. You need to do the following:

- Download the attached classes (**MyLinkedList.java** and **TestMyDoublyLinkedList.java**) and add them to your project in Eclipse. Fix the package statement in each class to refer to your current package.
- Rename `MyLinkedList` class to `MyDoublyLinkedList` (see "Useful Eclipse Shortcuts" below).
- At this point, Eclipse should show no syntax errors.
- Add or change the code in `MyDoublyLinkedList` so as to convert it to a doubly linked list. That is, you need to have and use two references for each node: `next`, pointing to the next node, and `previous`, pointing to the previous node. Comments are added to `MyDoublyLinkedList` beside the parts that need to be changed. Whenever you make a change, make sure that `next` and `previous` properly point to the correct nodes or to `null`.
- Some comments ask you to improve the performance of your code using `previous`. Here, you have to think about how the performance can be improved knowing that each node points to both the next and the previous nodes. For example, if you want to get a reference to the second-to-last node, you would only need to use `tail.previous` instead of having to traverse the list from `head` up to the node at `size-2` in case of singly linked lists.
- To improve the readability and maintainability of your code, try to use helper methods whenever appropriate. A method that you **have to create** is `getNodeAt(int  index)` which returns a reference to a node at a given index. Again, you have to try to improve the performance of this method given that you have both `next` and `previous`.
- **Testing**: Use the `TestMyDoublyLinkedList` class to test your code. You should have an output similar to the one in the next page.

Test Output:



```
Initialized with {A,B,A,A}:     [A, B, A, A]

Adding elements:                [A, B, A, A]
  - '*' at first                [*, A, B, A, A]
  - 'C' at last                 [*, A, B, A, A, C]
  - 'D'                         [*, A, B, A, A, C, D]
  - '#' @ 2                     [*, A, #, B, A, A, C, D]

Getting elements:               [*, A, #, B, A, A, C, D]
  - First Element               *
  - Last Element                D
  - Element at 1                A
  - Element at 20               null

Setting elements:               [*, A, #, B, A, A, C, D]
  - Element @ 0: '*' -> '+'     [+, A, #, B, A, A, C, D]
  - Element @ 2: '#' -> '-'     [+, A, -, B, A, A, C, D]
  - Element @ 9: 'null' -> '&'  [+, A, -, B, A, A, C, D]

Removing elements:              [+, A, -, B, A, A, C, D]
  - First element '+'           [A, -, B, A, A, C, D]
  - Last element 'D'            [A, -, B, A, A, C]
  - Element @ 1 '-'             [A, B, A, A, C]
  - Element @ 9 'null'          [A, B, A, A, C]

Checking:                       [A, B, A, A, C]
  - Contains 'A'?               true
  - Contains 'Z'?               false
  - First occurence of 'A' @    0
  - Last occurence of 'A' @     3
  - First index of 'Z' @        -1
  - Last index of 'Z' @         -1

ToString:                       [A, B, A, A, C]
ToReversedString:               [C, A, A, B, A]

Adding 'X' at 20:
Exception in thread "main" java.lang.IndexOutOfBoundsException
        at A8.MyDoublyLinkedList.add(MyDoublyLinkedList.java:46)
        at A8.TestMyDoublyLinkedList.main(TestMyDoublyLinkedList.java:22)
```

Grading:

See the comments in the given Java file for detailed breakdown of the mark.

Submission Instructions

For this assignment, you need to do the following:

1- Create a Java project of which name consists of **your student number followed by the assignment number,** e.g., “1234567_A8”.
2- Create one class for each question and write your answer inside that class. Your classes should have the same name as the question number (e.g., Q1)
3- After solving all questions, open Windows Explorer (or any other file explorer).
4- Navigate to your Java project folder (can be found inside your Eclipse workspace folder).
5- Locate the “src” folder for this project (the folder that includes the source code for all questions).
6- Zip the “src” folder and rename the zipped file to match your project name (e.g., 1234567_A8.zip).
7- Submit the zipped file **to Canvas.**

Note that you can resubmit an assignment, but the new submission overwrites the old submission and receives a new timestamp.