GIT Department Of Computer Engineering
CSE 222/505 - Spring 2020
Homework 4 Report

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PART 2

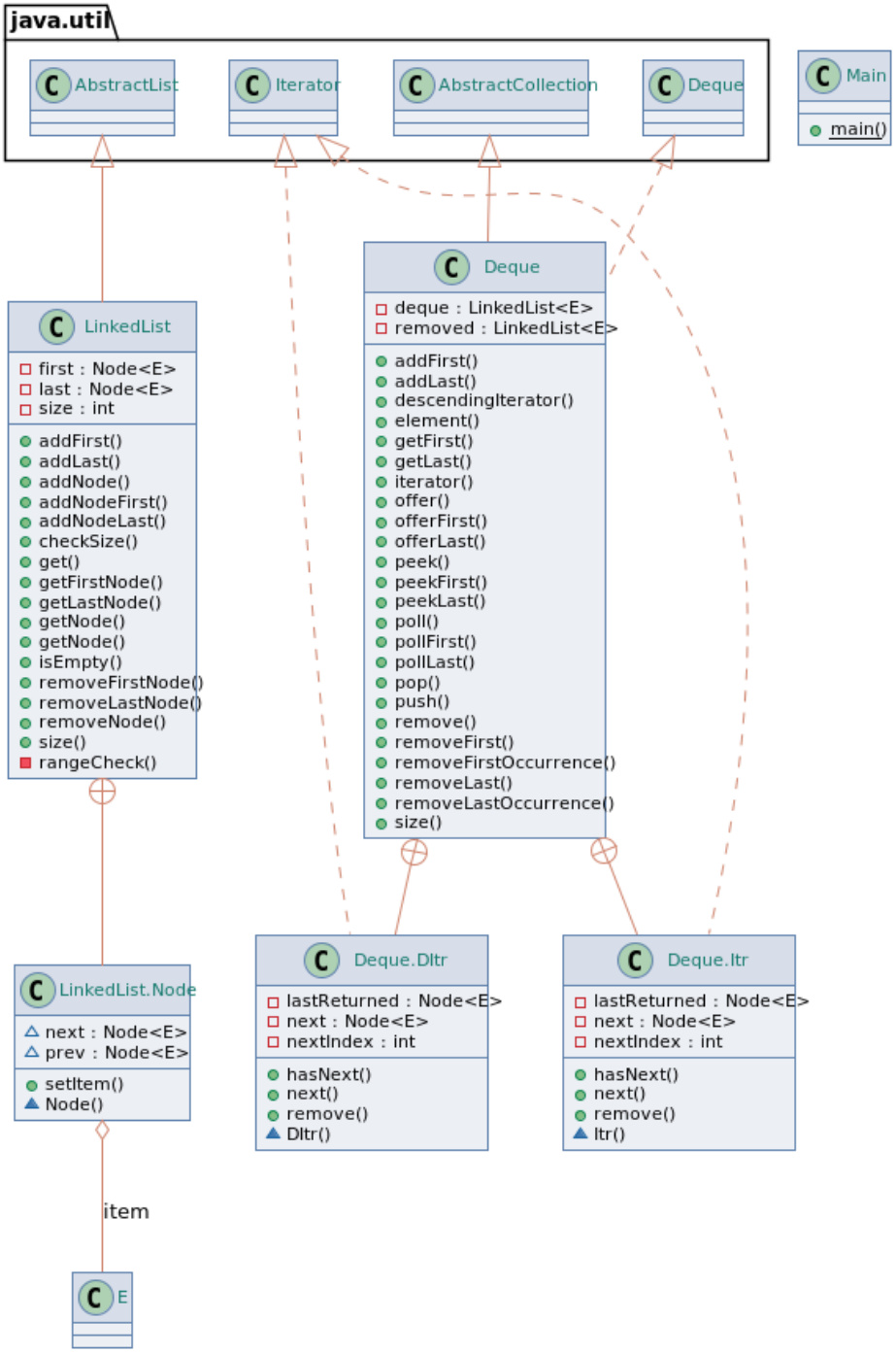
1 Problem Solution Approach

The assignment is implementing a `Deque<E>` class. I have started by reading 'Deque javadoc' of Oracle. Thus I had enough knowledge about method signatures, what they return and whether they throw exception or not.

I preferred to keep 2 `LinkedLists` in `Deque`, so that I can avoid code repetition for operations on deque and removed nodes.

To implement `iterator` and `descendingIterator` I created new inner classes, and I have filled necessary methods which are `next()` and `hasNext()`. For `remove()` method I have preferred to throw `UnsupportedOperationException`, unless `lastReturned` node is either first or last node.

2 Class Diagrams



3 Test Cases

I have created some text cases for some adding and removing operations which is present on my main method.

Test Case ID	Test Scenario	Test Steps	Expected Results	Actual Results	Pass/Fail
T01	add new element with various methods	1. deque.addFirst(2) 2. deque.push(1) 3. deque.offer(3) 4. deque.addLast(4)	[1,2,3,4]	As expected	Pass
T02	iterate through deque and print	while iterator has next, iteratate and print	1 2 3 4	As expected	Pass
T03	iterate through deque reversely and print	while descending iterator has next, iteratate and print	4 3 2 1	As expected	Pass
T04	remove first element	deque.removeFirst()	[2,3,4]	As expected	Pass
T05	remove last element	deque.removeLast()	[2,3]	As expected	Pass
T06	peek first element	deque.peekFirst()	2	As expected	Pass
T07	poll from deque	deque.poll()	deque: [3]	As expected	Pass
T08	pop from deque	deque.pop()	deque: [] (empty)	As expected	Pass
T09	poll from deque, when is empty	deque.poll()	returns null	As expected	Pass
T10	pop from deque, when is empty	deque.pop()	Throw exception	As expected	Pass

4 Running and Results

```
Deque<Integer> deque = new Deque<>();
System.out.println("Test Cases");
System.out.println("T01");
deque.addFirst(2);
deque.push(1);

deque.offer(3);
deque.addLast(4);

System.out.println(deque);

System.out.println("T02");
Iterator<Integer> iter = deque.iterator();
while (iter.hasNext())
  System.out.print(iter.next() + " ");
System.out.println();

System.out.println("T03");
Iterator<Integer> diter = deque.descendingIterator();
while (diter.hasNext())
  System.out.print(diter.next() + " ");
System.out.println();

System.out.println("T04");
deque.removeFirst();
System.out.println(deque);

System.out.println("T05");
deque.removeLast();
System.out.println(deque);

System.out.println("T06");
System.out.println(deque.peekFirst());
System.out.println(deque);

System.out.println("T07");
deque.poll();
System.out.println(deque);

System.out.println("T08");
deque.pop();
System.out.println(deque);

System.out.println("T09");
System.out.println(deque.poll());
System.out.println(deque);

System.out.println("T10");
deque.pop();
System.out.println(deque);
```

Listing 1: Testing methods in main method

Output of the test cases;

```
Test Cases
T01
[1, 2, 3, 4]
T02
1 2 3 4
T03
4 3 2 1
T04
[2, 3, 4]
T05
[2, 3]
T06
2
[2, 3]
T07
[3]
T08
[]
T09
null
[]
T10
Exception in thread "main" java.util.NoSuchElementException: stack is empty
at LinkedList.checkSize(LinkedList.java:10)
at Deque.removeFirst(Deque.java:150)
at Deque.pop(Deque.java:260)
at Main.main(Main.java:53)
```

PART 3

1 Problem Solution Approach

I have created a public static method for every problem, and since I need some extra parameters, I have called private helper methods.

1. Base case is if there is not any space in the string. In that case it will return.
   Otherwise append the last word to `StringBuilder` and call the method again with excluding the last word.

2. Base case is if length of the string is greater than 0. In that case it should return if the word is elfish.
   Other cases are checking if current character is one of elf letters or not.
   At last, call the method again with substring includes rest of the characters.

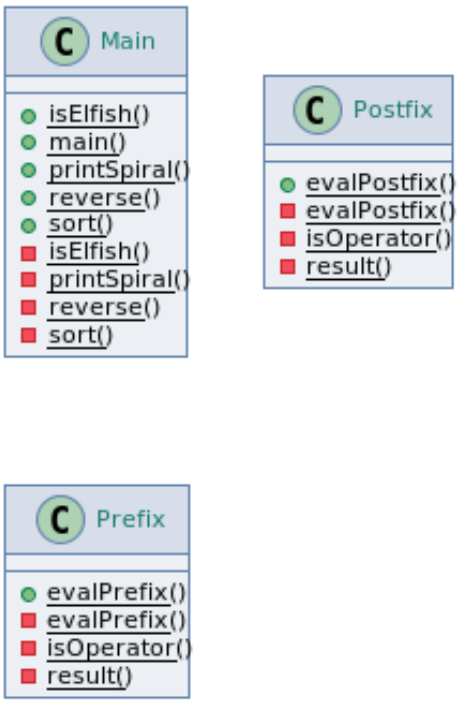
3. Base case is checking if we reach the end of the array. In that case we should return.
   Other case is after iterating the array once. At this point we supposed to be found the minimum element. In that case we should do the swap and find the next minimum element in rest of the array by calling the method again.
   Another case is while iterating the array, if there is any element less than suppositional minimum element, then update minimum element.
   To apply this for all elements, we call recursively this method, with next element.

4. Base case is checking if index is less than 0, since the iteration starts from end, and goes to beginning. In this case it will return the remaining element in the stack.
   Other cases are if the current element is an operator or an operand. If it is operator it takes 2 operand from the stack, perform the required operation and push the result to the stack. If its operand then it will push it to the stack. Finally, call the function recursively, for previous indexes.

5. Base case is checking if index is greater than array length, since the iteration starts from beginning, and goes to end. In this case it will return the remaining element in the stack.
   Other cases are if the current element is an operator or an operand. If it is operator it takes 2 operand from the stack, perform the required operation and push the result to the stack. If its operand then it will push it to the stack. Finally, call the function recursively, for previous indexes.

6. Base case is checking if number of iterations reach the size of the array ($m \times n$). In this case it will return.
   Other cases are checking the direction of iteration. While iterating through the direction, if we reach the edges of the 2 dimensional array, we change the direction to the right, and update the bounds. Therefore, we reach center of the array by following the spiral path.

2 Class Diagram



3 Test Cases

I tested methods in my main method.

```
    System.out.println("Test Cases");
    System.out.println("T_1.1");
    System.out.println(reverse("this function writes the sentence in reverse"));
    System.out.println("T_1.2");
    System.out.println(reverse("oneWord"));
    System.out.println("T_1.3");
    System.out.println(reverse("")); //empty string

    System.out.println("T_2.1");
    System.out.println(isElfish("white leaf"));
    System.out.println("T_2.2");
    System.out.println(isElfish("not ELFish"));
    System.out.println("T_2.3");
    System.out.println(isElfish("")); //empty string

    int[] arr = {3, 5, 7, 1, 2, 4, 9, 8, 6, 0};
    int[] emptyArr = {};

    System.out.println("T_3.1");
    sort(arr);
    for (int value : arr)
      System.out.print(value + " ");
    System.out.println();

    System.out.println("T_3.2");
    sort(emptyArr);

    System.out.println("T_4.1");
    System.out.println(Postfix.evalPostfix("3 4 1 2 * - 2 / + 5 + 6 3 / -"));
    System.out.println("T_4.2");
    System.out.println(Postfix.evalPostfix(""));
    System.out.println("T_5.1");
    System.out.println(Prefix.evalPrefix("- + + 3 / - 4 * 1 2 2 5 / 6 3"));
    System.out.println("T_5.2");
    System.out.println(Prefix.evalPrefix(""));

    System.out.println("T_6.1");
    int[][] arr2D = {{1, 2, 3, 4}, {5, 6, 7, 8}, {9, 10, 11, 12}, {13, 14, 15, 16}, {17, 18,
    19, 20}};
    int[][] emptyArr2D = new int[][]{};

    printSpiral(arr2D);
    System.out.println("T_6.2");
    printSpiral(emptyArr2D);

```

Listing 2: Testing methods in main method

Here's the result;

```
Test Cases
T_1.1
reverse in sentence the writes function
T_1.2
oneWord
T_1.3

T_2.1
true
T_2.2
false
T_2.3
false
T_3.1
0 1 2 3 4 5 6 7 8 9
T_3.2
T_4.1
7.0
T_4.2
null
T_5.1
7.0
T_5.2
null
T_6.1
1 2 3 4 8 12 16 20 19 18 17 13 9 5 6 7 11 15 14 10
T_6.2
```