

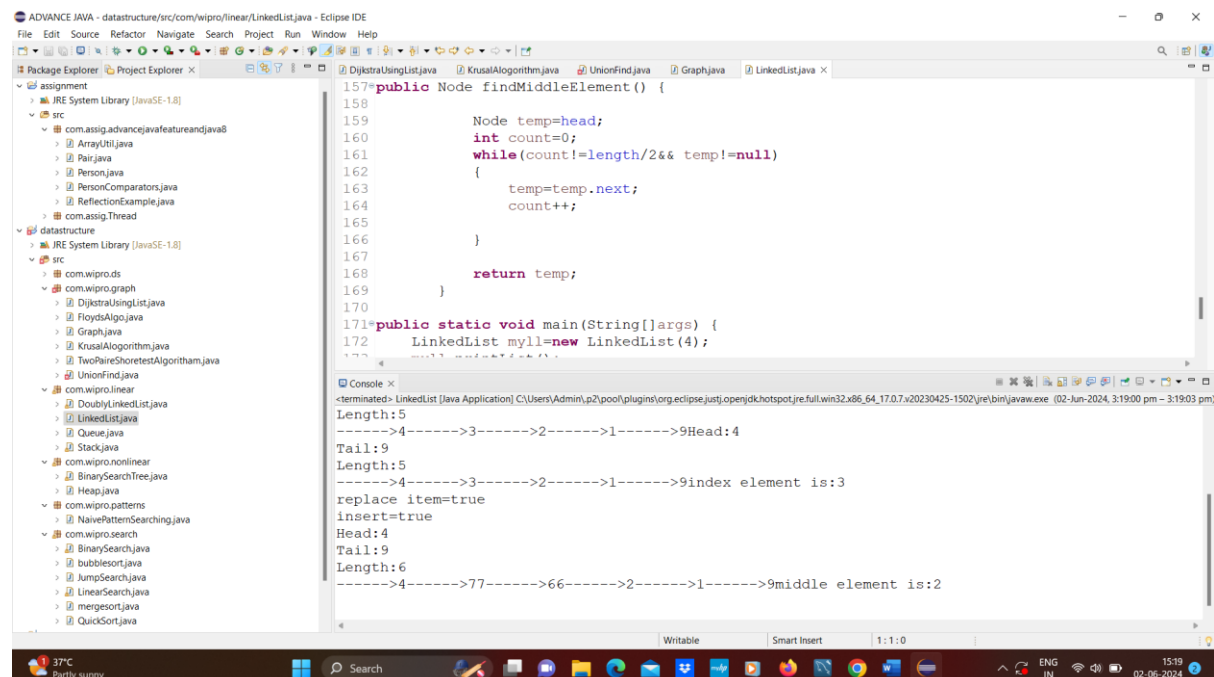
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ASSIGNMENT:Linear Data Structure

Task 2: Linked List Middle Element Search You are given a singly linked list. Write a function to find the middle element without using any extra space and only one traversal through the linked list.

```
public Node findMiddle() {  
    Node temp=head;  
  
    int count=0;  
  
    while(count!=length/2&& temp!=null)  
    {  
        temp=temp.next;  
        count++;  
    }  
  
    return temp;  
}
```

OUTPUT:



```
157=public Node findMiddleElement() {  
158  
159     Node temp=head;  
160     int count=0;  
161     while(count!=length/2&& temp!=null)  
162     {  
163         temp=temp.next;  
164         count++;  
165     }  
166  
167     return temp;  
168 }  
169  
170  
171=public static void main(String[] args) {  
172     LinkedList myll=new LinkedList(4);  
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```
<terminated>- LinkedList [Java Application] C:\Users\Admin\p2\pool\plugins\org.eclipse.justi.openjdk.hotspot.jre.full.win32.x86_64.17.0.7.v20230425-1502\jre\bin\javaw.exe (02-Jun-2024, 3:19:03 pm)  
Length:5  
----->4----->3----->2----->1----->9Head:4  
Tail:9  
Length:5  
----->4----->3----->2----->1----->9index element is:3  
replace item=true  
insert=true  
Head:4  
Tail:9  
Length:6  
----->4----->77----->66----->2----->1----->9middle element is:2
```

Task 3: Queue Sorting with Limited Space You have a queue of integers that you need to sort. You can only use additional space equivalent to one stack. Describe the steps you would take to sort the elements in the queue.

Initialization:

Let's denote the queue as Q and the stack as S.

The goal is to transfer elements between Q and S to sort the elements in Q.

Sorting Steps:

While Q is not empty, perform the following operations:

a. Find the Minimum Element:

Initialize a variable min with a value larger than any element in Q (e.g., Integer.MAX_VALUE).

Dequeue all elements from Q one by one.

For each element, compare it with min. If it is smaller, update min with this element.

Push each dequeued element onto S.

Once all elements are transferred to S, min will hold the smallest element from Q.

b. Transfer Elements Back to Q:

Initialize a variable countMin to keep track of how many times min appears.

While S is not empty, perform the following operations:

Pop an element from S.

If the element is equal to min, increment countMin.

If the element is not equal to min, enqueue it back to Q.

c. Place the Minimum Element(s) in Sorted Position:

Enqueue the min element(s) back to Q based on the value of countMin.

Repeat Steps: Repeat the above steps until Q is sorted. In each iteration, the smallest remaining elements are placed in their correct

positions in Q.

Consider the queue Q with elements: [3, 1, 4, 1, 5, 9, 2, 6, 5, 3, 5].

First pass:

Find min = 1, and enqueue two 1s to Q.

Q becomes [1, 1, 3, 4, 5, 9, 2, 6, 5, 3, 5].

Second pass:

Find min = 2, and enqueue 2 to Q.

Q becomes [1, 1, 2, 3, 4, 5, 9, 6, 5, 3, 5].

Third pass:

Find min = 3, and enqueue three 3s to Q.

Q becomes [1, 1, 2, 3, 3, 3, 4, 5, 9, 6, 5, 5].

Task 4: Stack Sorting In-Place

You must write a function to sort a stack such that the smallest items are on the top. You can use an additional temporary stack, but you may not copy the elements into any other data structure such as an array. The stack supports the following operations: push, pop, peek, and isEmpty.

```
public static void sortStack(Stack1 stack) {  
    Stack1 tempS = new Stack1(0);  
    tempS.pop();  
  
    while (!stack.isEmpty()) {  
        int temp = stack.pop().value;  
  
        while (!tempS.isEmpty() && tempS.peek() > temp){ stack.push(tempS.pop().value);  
        }  
        tempS.push(temp);  
    }  
    while (!tempS.isEmpty()) {
```

```

stack.push(tempS.pop().value);

}

}

```

OUTPUT:

```

// Stack1.java
75     return height == 0;
76 }
77
78 public static void main(String[] args) {
79     Stack1 stack = new Stack1(11);
80     stack.push(3);
81     stack.push(10);
82     stack.push(3);
83     stack.push(11);
84     stack.push(5);
85     stack.printstack();
86
87     sortStack(stack);
88     System.out.println("Sorted stack:");
89     stack.printstack();
90 }
91
92 public static void sortStack(Stack1 stack) {
93     Stack1 tempStack = new Stack1(0); // Temporary stack for sorting
94     tempStack.pop(); // Remove the initial value to make it truly empty
95
96     while (!stack.isEmpty()) {
97         int temp = stack.pop().value;
98
99         while (!tempStack.isEmpty() && tempStack.peek() > temp) {
100             stack.push(tempStack.pop().value);
101         }
102
103         tempStack.push(temp);
104     }
105
106     while (!tempStack.isEmpty()) {
107         stack.push(tempStack.pop().value);
108     }
109 }

```

```

<terminated> Stack1 [Java Application] C:\Users\Admin\p2\pool\plugins\org.eclipse.jst.j2ee.ui\bin\
Items in stack:-
5
10
3
11
Sorted stack:
items in stack:-
1
3
5
10
11

```

Task 5: Removing Duplicates from a Sorted Linked List A sorted linked list has been constructed with repeated elements. Describe an algorithm to remove all duplicates from the linked list efficiently.

```
private void removeDuplicates() {
```

```
Node current = head;
```

```
while (current != null && current.next != null) { if (current.value ==
current.next.value) {
```

```
current.next = current.next.next;
```

```
length--;
```

```
} else {
```

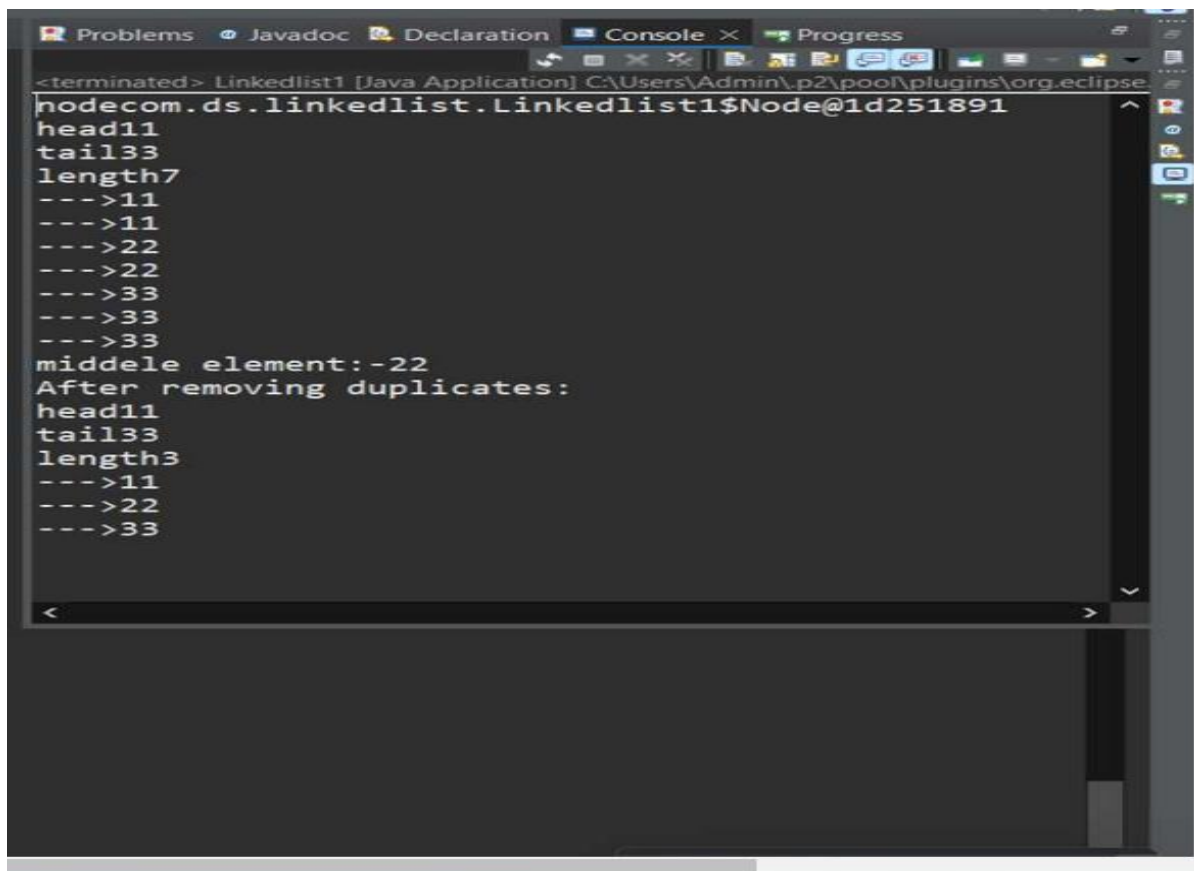
```
current = current.next;
```

```
}
```

```
}
```

}

OUTPUT:



```
<terminated> LinkedList1 [Java Application] C:\Users\Admin\p2\pool\plugins\org.eclipse
nodecom.ds.linkedlist.LinkedList1$Node@1d251891
head11
tail33
length7
--->11
--->11
--->22
--->22
--->33
--->33
--->33
middele element:-22
After removing duplicates:
head11
tail33
length3
--->11
--->22
--->33
```

Task 6: Searching for a Sequence in a Stack Given a stack and a smaller array representing a sequence, write a function that determines if the sequence is present in the stack. Consider the sequence present if, upon popping the elements, all elements of the array appear consecutively in the stack

```
public static boolean containsSequence(Stack1 stack, int[]sequence){
```

```
Stack1 reversedStack = new Stack1(0);
```

```
reversedStack.pop();
```

```
while (!stack.isEmpty()) {
```

```
reversedStack.push(stack.pop().value);
```

```
}
```

```
for (int i = sequence.length - 1; i >= 0; i--) { if (reversedStack.isEmpty() ||
reversedStack.pop().value!= sequence[i]) {
```

```
while (!reversedStack.isEmpty()) {
```

```

stack.push(reversedStack.pop().value); }

return false;

}

}

while (!reversedStack.isEmpty()) {

stack.push(reversedStack.pop().value);

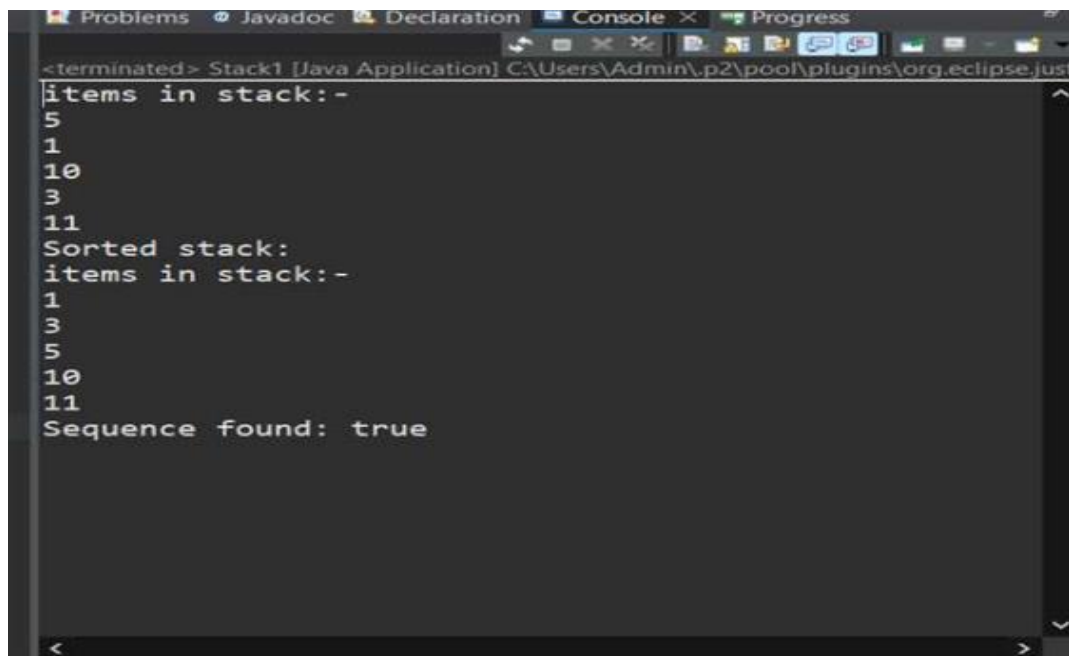
}

return true;

}

```

OUTPUT:



```

<terminated> Stack1 [Java Application] C:\Users\Admin\p2\pool\plugins\org.eclipse.just
items in stack:-
5
1
10
3
11
Sorted stack:
items in stack:-
1
3
5
10
11
Sequence found: true

```

Task 7: Merging Two Sorted Linked Lists You are provided with the heads of two sorted linked lists. The lists are sorted in ascending order. Create a merged linked list in ascending order from the two input lists without using any extra space (i.e., do not create any new nodes).

```

public static Linkedlist1 mergeLists(Linkedlist1 l1, Linkedlist1 l2)
{
    if (l1.head == null) return l2;
    if (l2.head == null) return l1;
    Node dummy = new Node(0); // dummy node to simplify merge

```

logic

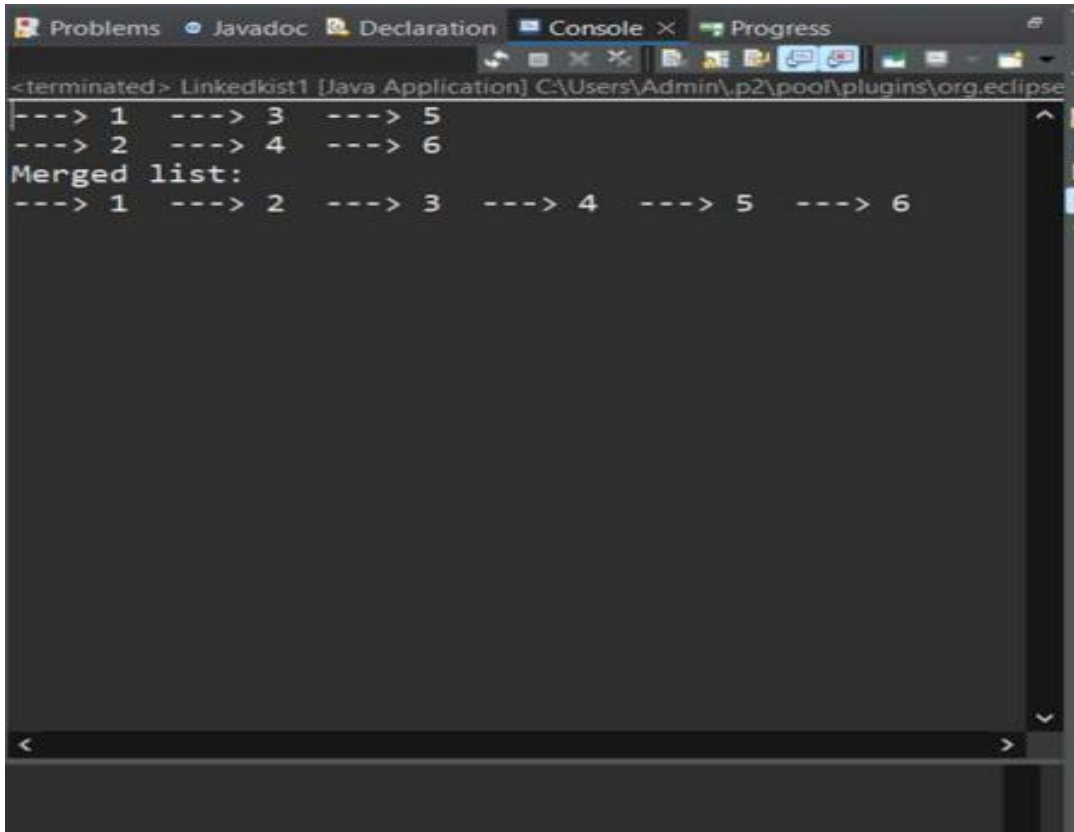
```
Node tail = dummy;
Node h1 = l1.head;
Node h2 = l2.head;
while (h1 != null && h2 != null) {
    if (h1.value < h2.value) {
        tail.next = h1;
        h1 = h1.next;
    } else {
        tail.next = h2;
        h2 = h2.next;
    }
    tail = tail.next;
}
if (h1 != null) {
    tail.next = h1;
} else {
    tail.next = h2;
}
l1.head = dummy.next;
l1.tail = l1.head;
l1.length = 0;
Node temp = l1.head;
while (temp != null) {
    l1.length++;
    if (temp.next == null) {
        l1.tail = temp;
    }
    temp = temp.next;
```

```

}
Return l1;
}

```

OUTPUT:



```

<terminated> Linkedlist1 [Java Application] C:\Users\Admin\p2\pool\plugins\org.eclipse
|---> 1  ---> 3  ---> 5
|---> 2  ---> 4  ---> 6
Merged list:
|---> 1  ---> 2  ---> 3  ---> 4  ---> 5  ---> 6

```

Task 8: Circular Queue Binary Search

Consider a circular queue (implemented using a fixed-size array)

where the elements are sorted but have been rotated at an unknown

index. Describe an approach to perform a binary search for a given

element within this circular queue.

```

package com.assig.linear;
public class CircularQueueBinarySearch {

    public static int search(int[] array, int target) {
        int low = 0;
        int high = array.length - 1;

```

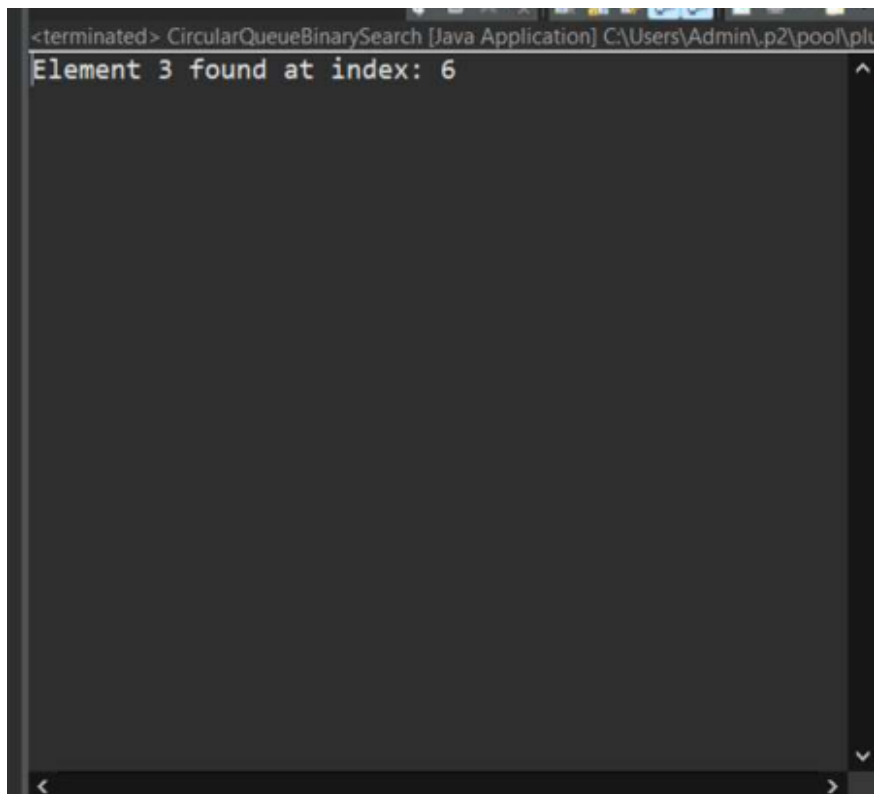


```
while (low <= high) {  
    int mid = low + (high - low) / 2;  
  
    if (array[mid] == target) {  
        return mid;  
    }  
  
    if (array[low] <= array[mid]) {  
        if (array[low] <= target && target < array[mid]) {  
            high = mid - 1;  
        } else {  
            low = mid + 1;  
        }  
    } else {  
        if (array[mid] < target && target <= array[high]) {  
            low = mid + 1;  
        } else {  
            high = mid - 1;  
        }  
    }  
}  
  
return -1;  
}
```

```
public static void main(String[] args) {  
    int[] array = { 6, 7, 8, 9, 1, 2, 3, 4, 5 };  
    int target = 3;  
    int index = search(array, target);  
}
```

```
if (index != -1) {  
    System.out.println("Element " + target + " found at  
index: " + index);  
} else {  
    System.out.println("Element " + target + " not found.");  
}  
}  
}
```

OUTPUT:

A screenshot of a Java application window. The title bar reads "<terminated> CircularQueueBinarySearch [Java Application] C:\Users\Admin\p2\pool\plu". The main content area is dark gray and displays the text "Element 3 found at index: 6" in a light gray font. The window has standard Windows-style scrollbars on the right and bottom.