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Subject: DSA

Task 1: Write and test the following methods:

1. int search(int x) //returns the index of element in the linked list

2. int size() //returns the size of the linked list

3. int sum() //returns the sum of all numbers in the linked list

4. void deleteLast() //deletes the last node in the list

5. LinkedList copy() //returns a new linked list that is the duplicate of the list this method is called up on.

6. LinkedList subList(int p, int q) //returns a new linked list that contains element from node p to node q of the list this method is called up on.

7. void append(LinkedList l) //l is appended to the list this method is called on.

8. LinkedList merged(Linked l) // returns a new list that merges l with the list the method is called on; maintaining the ascending order.

Code:

```
class LinkedList{
        Node start;
        private class Node{
                private int data;
                private Node next;
                public Node(int data){
                        this.data=data;
                }
                public Node(int data,Node next){
                        this.data=data;
                        this.next=next;
                }
```

```
        }


//////////////Method to print elements of LinkedList
        public void printList(){
                System.out.print("[");
                for (Node p=start;p!=null;p=p.next){
                        System.out.print(p.data+",");
                }
                System.out.println("\b]");
        }


//////////////Method to insert an element in LinkedList
        public Node insert(int value){
                if(start==null || start.data>value){
                        start= new Node(value,start);
                                                return start;
                }
                Node p= start;
                while (p.next!=null) {
                        if(p.next.data>value)
                                        break;
                        p=p.next;
```

```
                }
                p.next= new Node(value,p.next);
                return start;
        }

//////////////Method to delete an element from LinkedList
        public Node delete(int value){
                if(start==null || start.data>value)
                        return start;
                if(start.data==value){
                        System.out.println("Deleting element: "+start.data);
                        start= start.next;
                    return start;
                }
                Node p=start;
                while((p=p.next)!=null){
                        if(p.next.data>value) break;
                        if(p.next.data==value){
                                System.out.println("Deleting element: "+p.next.data);
                                p.next=p.next.next;
                                break;
                        }
            }
            return start;
```

```
        }

//////////////Method to search for an element in LinkedList
        public int search(int element){
                if(start==null)
                        throw new IllegalStateException("List is empty!");
                if(start.data>element)
                        return -1;
                Node p=start;
                int index=1;                                    //we will do indexing from 1 unlike arrays
                while((p=p.next)!=null){
                        index++;        //increment before if condition bcz one element(i.e start.data) is already checked above
                        if(p.data==element)
                                return index;
                }
                return -1;
        }

//////////////Method to return total number of elements in LinkedList
        public int size(){
                if(start==null)
                        return 0;
                int size=0;
```

```
                for (Node p=start;p!=null;p=p.next) {
                        size++;
                }
                return size;
        }


//////////////Method to return sum of all elements in LinkedList
        public int sum(){
                if(start==null)
                        return 0;
                int sum=0;
                for (Node p=start;p!=null;p=p.next) {
                        sum+=p.data;
                }
                return sum;
        }


//////////////Method to delete last element of LinkedList
        public void deleteLast(){
                if(start==null)
                        throw new IllegalStateException("List is Empty!");
                Node p=start;
```

```
                while(p.next.next!=null){
                        p=p.next;
                }
                System.out.println("Deleting Last element: "+p.next.data);
                p.next=null;
        }
//////////////Method to return copy of current LinkedList Object
        public LinkedList copy(){
                if(start==null)
                        throw new IllegalStateException("Can not copy  because current
List is Empty!");
                LinkedList list= new LinkedList();
                Node p=start;
                while(p!=null){
                        list.insert(p.data);
                        p=p.next;
                }
                return list;
        }


//////////////Method to return sublist of current LinkedList from Node p to Node q
        public LinkedList subList(int p,int q){
                if(start==null)
                        throw new IllegalStateException("Can not copy  because current
List is Empty!");
```

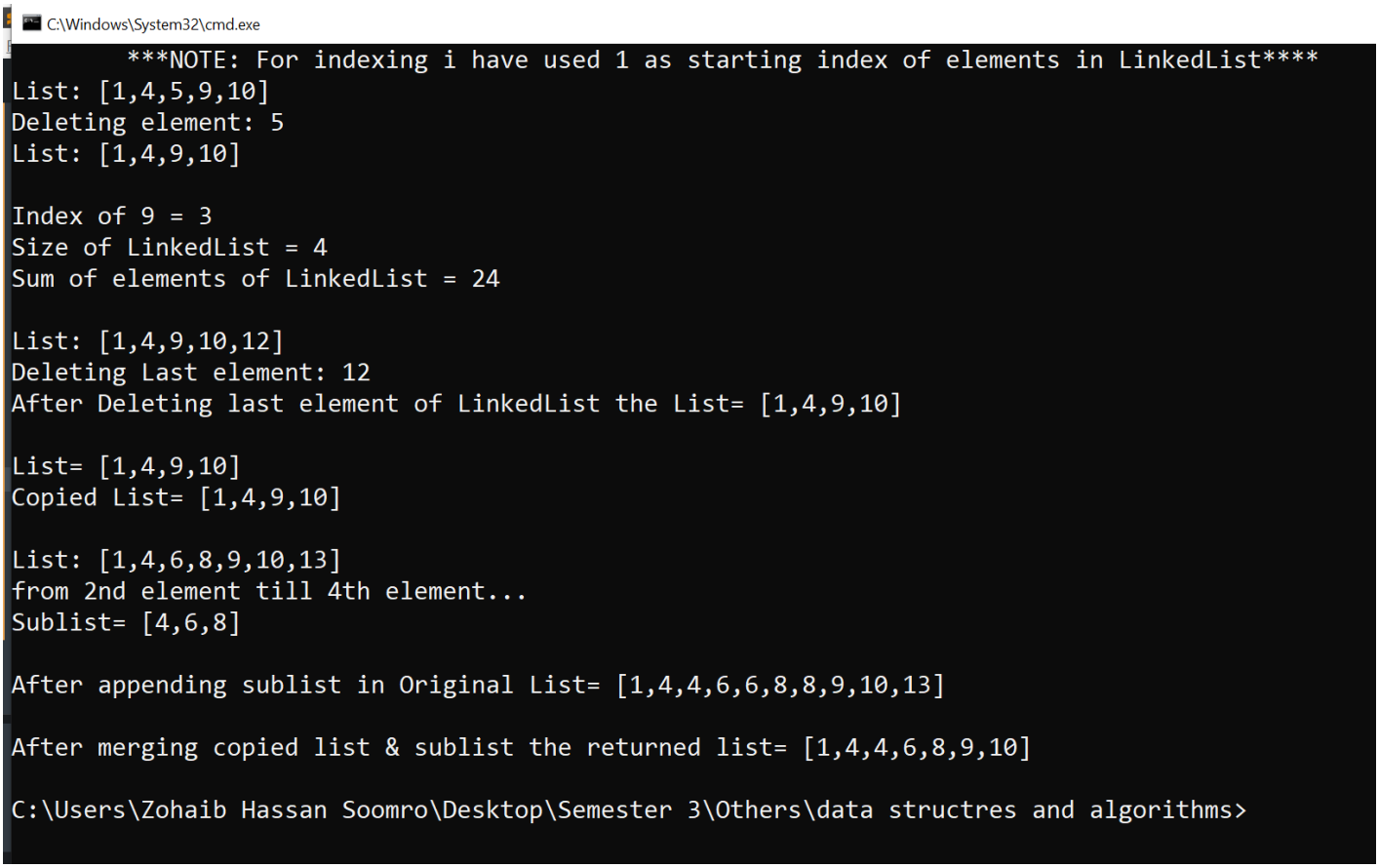
```
                if(p<1 || q<1 || p>this.size() || q>this.size())
                        throw new IllegalArgumentException("Invalid arguments!");
                LinkedList list=new LinkedList();
                int fromTill=1;       //As indexing is from 1
                Node node=start;
                while(node!=null){
                        if(fromTill>=p && fromTill<=q)
                                list.insert(node.data);
                        if(fromTill==q) break;

                        node=node.next;
                        fromTill++;
                }
                return list;
        }


//////////////Method to append argument LinkedList to current LinkedList
   public void append(LinkedList list){
        if(list.size()==0)  return;
        Node p= list.start;
        while(p!=null){
                this.insert(p.data);
                p=p.next;
```

```
        }
    }


//////////////Method to merge argument LinkedList & current LinkedList and return new LinkedList
    public LinkedList merged(LinkedList list){
        if(size()==0 && list.size()==0)
                return new LinkedList();   //return new empty list both current & argument lists are empty
        LinkedList newList= new LinkedList();
        Node p= start;
        while(p!=null){
                newList.insert(p.data);
                p=p.next;
        }
        p=list.start;
        while(p!=null){
                newList.insert(p.data);
                p=p.next;
        }
        return newList;
    }
//////////////main method starts here
        public static void main(String[] args) {
```

```
		System.out.println("\t***NOTE: For indexing i have used 1 as starting index of elements in LinkedList****");
		LinkedList list= new LinkedList();
		list.insert(9);
		list.insert(4);
		list.insert(5);
		list.insert(10);
		list.insert(1);
		System.out.print("List: ");
		list.printList();
		list.delete(5);
		System.out.print("List: ");
		list.printList();
		System.out.println("\nIndex of 9 = "+list.search(9));
		System.out.println("Size of LinkedList = "+list.size());
		System.out.println("Sum of elements of LinkedList = "+list.sum()+"\n");
		list.insert(12);
		System.out.print("List: ");
		list.printList();
		list.deleteLast();
		System.out.print("After Deleting last element of LinkedList the List= ");
		list.printList();

		LinkedList copiedList= list.copy();
		System.out.print("\nList= ");
```

```
                list.printList();
                System.out.print("Copied List= ");
                copiedList.printList();
                list.insert(13);
                list.insert(6);
                list.insert(8);
                System.out.print("\nList: ");
                list.printList();

                LinkedList sublist= list.subList(2,4);  //copies from 2nd element till 4th element
                System.out.print("from 2nd element till 4th element...\nSublist= ");
                sublist.printList();

                list.append(sublist);
                System.out.print("\nAfter appending sublist in Original List= ");
                list.printList();

                LinkedList mergedList= copiedList.merged(sublist);
                System.out.print("\nAfter merging copied list & sublist the returned list= ");
                mergedList.printList();

        }
}
```

Task#1 Output:



Task 2: Implement a linked list for Student class. Student class should have roll_num and name as instance variables. The linked list should have the following operations:

◦ insert(Student s)

◦ delete(Student s)

◦ printList() // print the roll numbers and names of every student in the list.

Code:

```
class Student{
        String rollNumber,name;
```

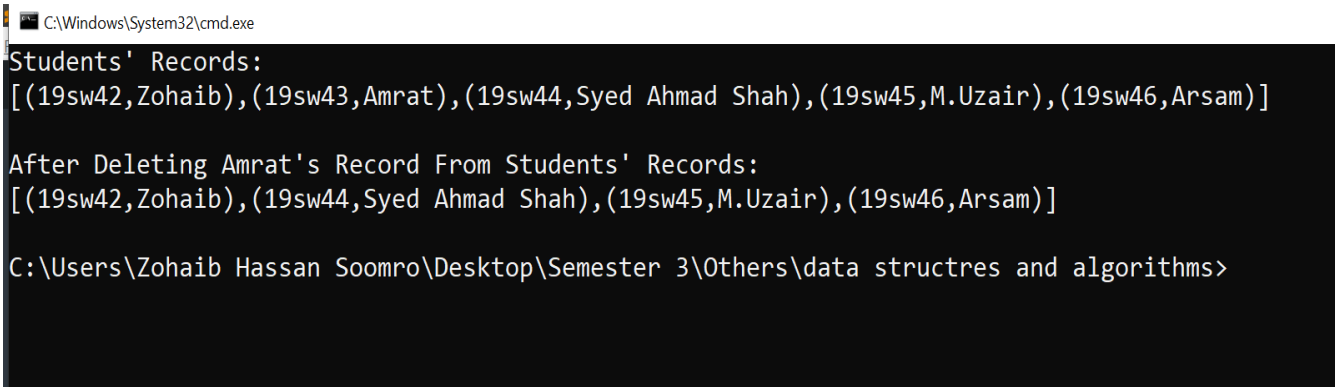
```
	public Student(String rollNumber, String name){
		this.rollNumber=rollNumber;
		this.name=name;
	}
}

class LinkedListTask2{
	Node start;
	private class Node{
		private Student std;
		private Node next;
		public Node(Student std){
			this.std=std;
		}
		public Node(Student std,Node next){
			this.std=std;
			this.next=next;
		}
	}

//////////////Method to print all students' records in LinkedList
	public void printList(){
		if(start==null)
			throw new IllegalStateException("Student LinkedList is empty!");
```

```
                Node p=start;
                System.out.print("[");
                while(p!=null){
                        System.out.print("("+p.std.rollNumber+","+p.std.name+"),");
                        p=p.next;
                }
                System.out.println("\b]");
        }



//////////////Method to insert a student record in LinkedList
        public Node insert(Student std){
                if(start==null){
                        start= new Node(std,start);
                        return start;
                }
                Node p= start;
                while (p.next!=null) {
                        p=p.next;
                }
                p.next= new Node(std,p.next);
                return start;
        }
```

```
//////////Method to delete an Student record from LinkedList
        public Node delete(Student s){
                if(start==null)
                        return start;
                if(start.std.rollNumber.equals(s.rollNumber) &&
start.std.name.equals(s.name)){
                                start= start.next;
                                return start;
                }
                Node p=start;
                while(p.next!=null){
                        if(p.next.std.rollNumber.equals(s.rollNumber) &&
p.next.std.name.equals(s.name)){
                                p.next=p.next.next;
                                break;
                        }
                        p=p.next;
            }
            return start;
        }
        public static void main(String[] args) {
                LinkedListTask2 studentRecords= new LinkedListTask2();
```

```
                Student zohaib=new Student("19sw42","Zohaib");
                Student amrat=new Student("19sw43","Amrat");
                Student ahmad=new Student("19sw44","Syed Ahmad Shah");
                Student uzair=new Student("19sw45","M.Uzair");
                Student arsam=new Student("19sw46","Arsam");
                studentRecords.insert(zohaib);
                studentRecords.insert(amrat);
                studentRecords.insert(ahmad);
                studentRecords.insert(uzair);
                studentRecords.insert(arsam);
                System.out.println("Students' Records: ");
                studentRecords.printList();
                studentRecords.delete(amrat);
                System.out.println("\nAfter Deleting Amrat's Record From Students'
Records: ");
                studentRecords.printList();
        }
}
```

Task#2 Output:



Task 3: Explore java.util.LinkedList class; Create a linked list of type String using this class and apply any 5 of its methods.

Code:

```
import java.util.LinkedList;
class ApplyMethodsTask3{
	public static void main(String[] args) {
		LinkedList<String> countries= new LinkedList<String>();
		countries.add("Pakistan");				//#1
		countries.add("India");
		countries.addFirst("Bangladesh");	//#2
		countries.addLast("Russia");	//#3
		countries.add("USA");
		String allCountries= countries.toString();	//#4
		System.out.println("LinkedList<String>= "+allCountries);
		System.out.println("Element at index 2= "+countries.get(2));	//#5
	}
}
```

Task#3 Output: