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(Autonomous College Affiliated to the University of Mumbai)
NAAC ACCREDITED with "A" GRADE (CGPA : 3.18)

Department of Information Technology

COURSE CODE: DJS22ITL502 **DATE: 7-10-24**

COURSE NAME: Advanced Data Structures Laboratory **CLASS:** TY B. TECH

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EXPERIMENT NO. 5

CO/LO: Choose appropriate data structure and use it to design algorithm for solving a specific problem

AIM / OBJECTIVE: To implement various operations on Leftist Heap.

Properties of Leftist Heap:

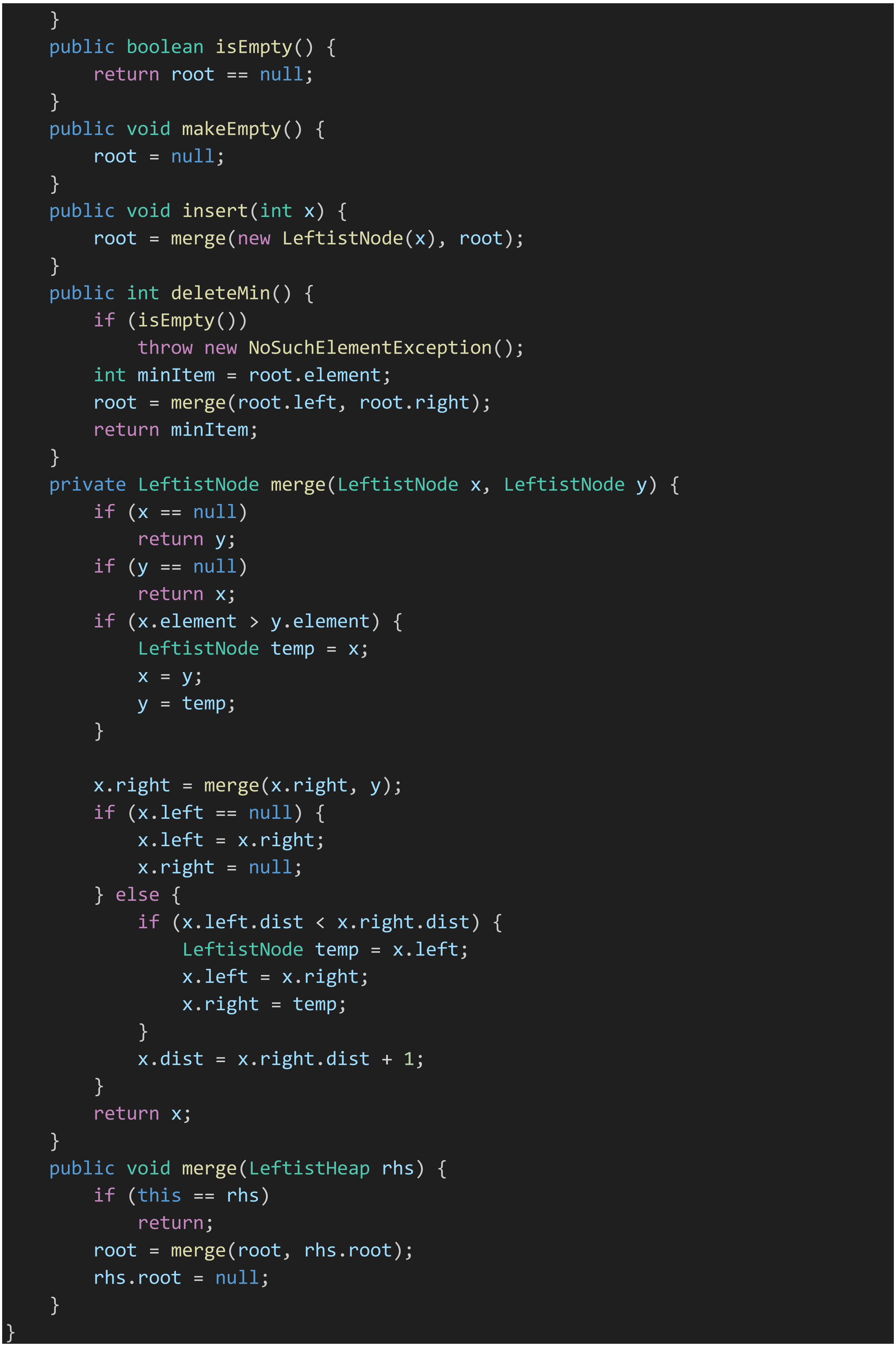
1. Skewed Structure: A leftist heap is biased to the left, with a path-heavy left child to minimize merging costs.
2. Heap Property: The heap maintains the min-heap property.
3. Merging: Merging two heaps takes O(logn), as the right paths are as short as possible.
4. Shortest Path Property: The rank (null path length) of the right child is always less than or equal to the left child.
5. Efficient Insert/Delete: Insert and delete-min both take O(logn) time through merging.

TECHNOLOGY STACK USED: C, C++, JAVASOURCE

CODE:

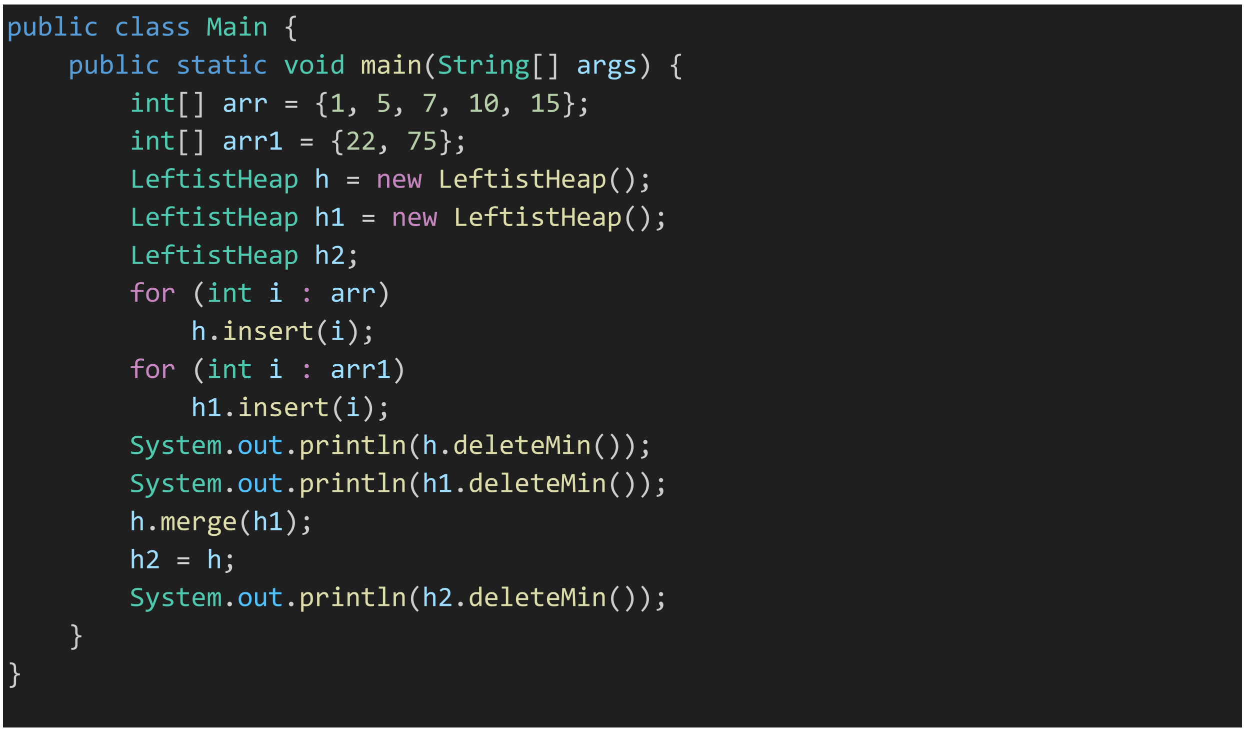
```
import java.util.*;

class LeftistNode {
    int element, dist;
    LeftistNode left, right;
    public LeftistNode(int element) {
        this(element, null, null);
    }
    public LeftistNode(int element, LeftistNode left, LeftistNode right) {
        this.element = element;
        this.left = left;
        this.right = right;
        this.dist = 0;
    }
}
class LeftistHeap {
    private LeftistNode root;
    public LeftistHeap() {
        root = null;
```



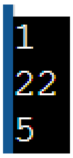
```java
    }
    public boolean isEmpty() {
        return root == null;
    }
    public void makeEmpty() {
        root = null;
    }
    public void insert(int x) {
        root = merge(new LeftistNode(x), root);
    }
    public int deleteMin() {
        if (isEmpty())
            throw new NoSuchElementException();
        int minItem = root.element;
        root = merge(root.left, root.right);
        return minItem;
    }
    private LeftistNode merge(LeftistNode x, LeftistNode y) {
        if (x == null)
            return y;
        if (y == null)
            return x;
        if (x.element > y.element) {
            LeftistNode temp = x;
            x = y;
            y = temp;
        }

        x.right = merge(x.right, y);
        if (x.left == null) {
            x.left = x.right;
            x.right = null;
        } else {
            if (x.left.dist < x.right.dist) {
                LeftistNode temp = x.left;
                x.left = x.right;
                x.right = temp;
            }
            x.dist = x.right.dist + 1;
        }
        return x;
    }
    public void merge(LeftistHeap rhs) {
        if (this == rhs)
            return;
        root = merge(root, rhs.root);
        rhs.root = null;
    }
}
```



```java
public class Main {
    public static void main(String[] args) {
        int[] arr = {1, 5, 7, 10, 15};
        int[] arr1 = {22, 75};
        LeftistHeap h = new LeftistHeap();
        LeftistHeap h1 = new LeftistHeap();
        LeftistHeap h2;
        for (int i : arr)
            h.insert(i);
        for (int i : arr1)
            h1.insert(i);
        System.out.println(h.deleteMin());
        System.out.println(h1.deleteMin());
        h.merge(h1);
        h2 = h;
        System.out.println(h2.deleteMin());
    }
}
```

OUTPUT:



```
1
22
5
```

CONCLUSION: In this experiment we understood and implemented Leftist heaps

REFERENCES:

1. Peter Brass, “Advanced Data Structures”, Cambridge University Press, 2008

2. Robert Sedgewick & Kevin Wayne, “Algorithms”, 4th Edition, Addison-Wesley Professional, 2011.