Day 7 and 8:

Task 1: Balanced Binary Tree Check

Write a function to check if a given binary tree is balanced. A balanced tree is one where the height of two subtrees of any node never differs by more than one.

```
public boolean isBalanced(Node root) {
        return checkHeight(root) != -1;
    }


    private int checkHeight(Node node) {
        if (node == null) {
            return 0;
        }

        int leftHeight = checkHeight(node.left);
        if (leftHeight == -1) {
            return -1; // Left subtree is not balanced
        }

        int rightHeight = checkHeight(node.right);
        if (rightHeight == -1) {
            return -1; // Right subtree is not balanced
        }

        if (Math.abs(leftHeight - rightHeight) > 1) {
            return -1; // Current node is not balanced
        }

        return Math.max(leftHeight, rightHeight) + 1; // Return the
height
    }
```

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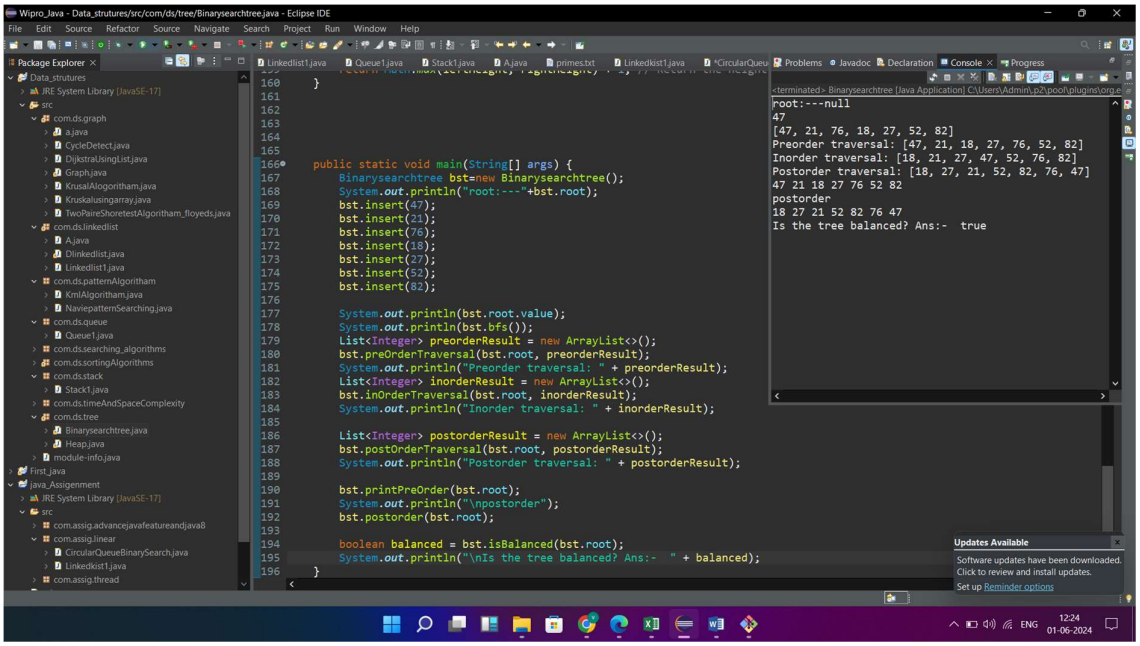

Task 2: Trie for Prefix Checking

Implement a trie data structure in C# that supports insertion of strings and provides a method to check if a given string is a prefix of any word in the trie.

```
package com.assig.nonlinear;


import java.util.HashMap;

import java.util.Map;


class TrieNode {

    Map<Character, TrieNode> children;

    boolean isEndOfWord;


    public TrieNode() {

        children = new HashMap<>();
```

```
        isEndOfWord = false;
    }
}

public class Trie {
    private final TrieNode root;

    public Trie() {
        root = new TrieNode();
    }

    public void insert(String word) {
        TrieNode current = root;
        for (char c : word.toCharArray()) {
            current.children.putIfAbsent(c, new TrieNode());
            current = current.children.get(c);
        }
        current.isEndOfWord = true;
    }

    public boolean isPrefix(String prefix) {
        TrieNode current = root;
        for (char c : prefix.toCharArray()) {
            if (!current.children.containsKey(c)) {
```

```
            return false;
        }
        current = current.children.get(c);
    }
    return true;
  }

  public static void main(String[] args) {
    Trie trie = new Trie();
    trie.insert("apple");
    trie.insert("app");
    trie.insert("application");
    trie.insert("banana");

    System.out.println(trie.isPrefix("app"));
    System.out.println(trie.isPrefix("ban"));
    System.out.println(trie.isPrefix("bat"));
    System.out.println(trie.isPrefix("appl"));
    System.out.println(trie.isPrefix("apx"));
  }
}
```

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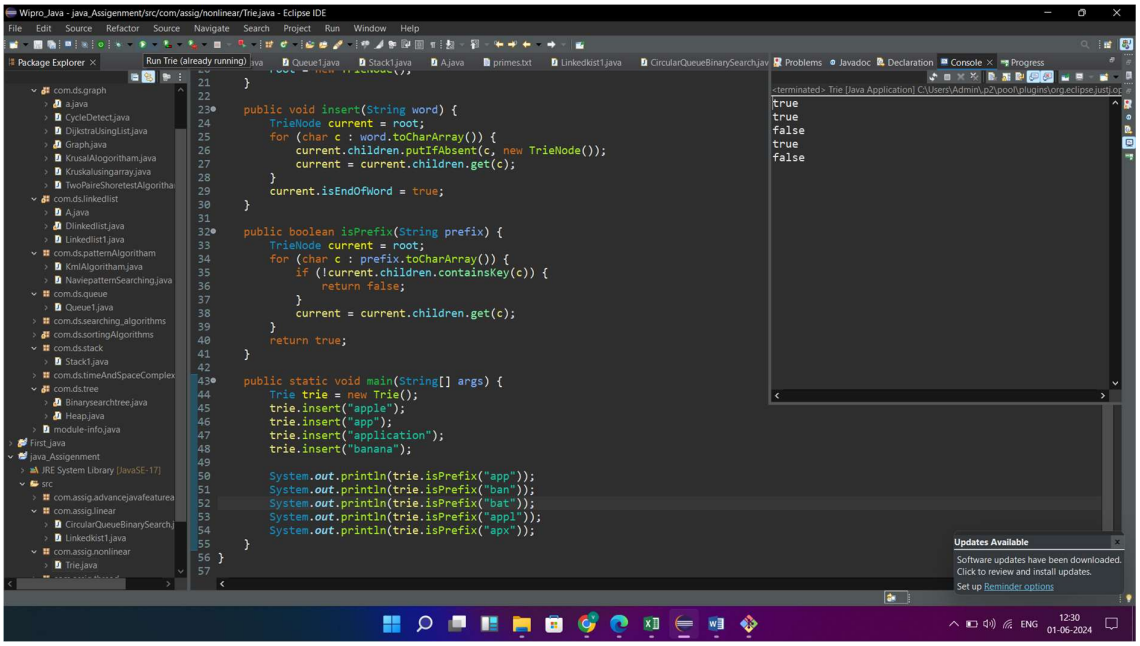

Task 3: Implementing Heap Operations

Code a min-heap in with methods for insertion, deletion, and fetching the minimum element. Ensure that the heap property is maintained after each operation

```
package com.ds.tree;


import java.util.ArrayList;

import java.util.Collection;

import java.util.Collections;

import java.util.List;


public class Heap {
```

```
private List<Integer>heap;
public Heap()
{
        this.heap=new ArrayList<>();

}

public List<Integer> getheap()
{
        return new ArrayList<Integer>(heap);
}


public int lefrchild(int index)
{
        return (index*2)+2;

}

public int rightchild(int index)
{
        return (index*2)+2;

}
```

```
	public int parent(int index)
	{
		return (index-1)/2;

	}

	public void insert(int value)
	{
		heap.add(value);
		int current=heap.size()-1;
		while(current > 0&&
heap.get(current)>heap.get(parent(current)))
		{
			swap(current,parent(current));
			current=parent(current);
		}
	}
	private void swap(int index1, int index2) {
		// TODO Auto-generated method stub

		int temp=heap.get(index1);
		heap.set(index1, heap.get(index2));
		heap.set(index2, temp);
```

```
}


public Integer remove()
{

        if(heap.size()==0)
        {
                return null;

        }
        if(heap.size()==1)
        {
                return heap.remove(0);

        }

        int maxvalue=heap.get(0);
        heap.set(0, heap.remove(heap.size()-1));
        sinkDown(0);
        return maxvalue;
```

```
    }

    private void sinkDown(int index) {

        int maxindex=index;
        int leftindex=lefrchild(index);
        int rightindex=rightchild(index);

    if(leftindex<heap.size()&&heap.get(leftindex)>heap.get(maxind
ex))
        {
            maxindex=leftindex;

        }


    if(rightindex<heap.size()&&heap.get(rightindex)>heap.get(maxi
ndex))
        {
            maxindex=rightindex;

        }
```

```
            if(maxindex!=index)
            {
                swap(index, maxindex);
                index=maxindex;
            }
            // TODO Auto-generated method stub

        }


        public List<Integer> heapSort() {
//          List<Integer> sortedList = new ArrayList<>();
//          while (!heap.isEmpty()) {
//              sortedList.add(remove());
//          }

            Collections.sort(heap);
            return heap;
        }

        public static void main(String[] args) {

            Heap h=new Heap();
```

```
            System.out.println(h.getheap());

        h.insert(99);
        h.insert(66);;
        h.insert(34);
        h.insert(44);
        h.insert(50);

        System.out.println(h.getheap());

        System.out.println("Removed Element is :-   "+h.remove());

        System.out.println(h.getheap());
System.out.println( "sorted array"+h.heapSort());
       }

}
```

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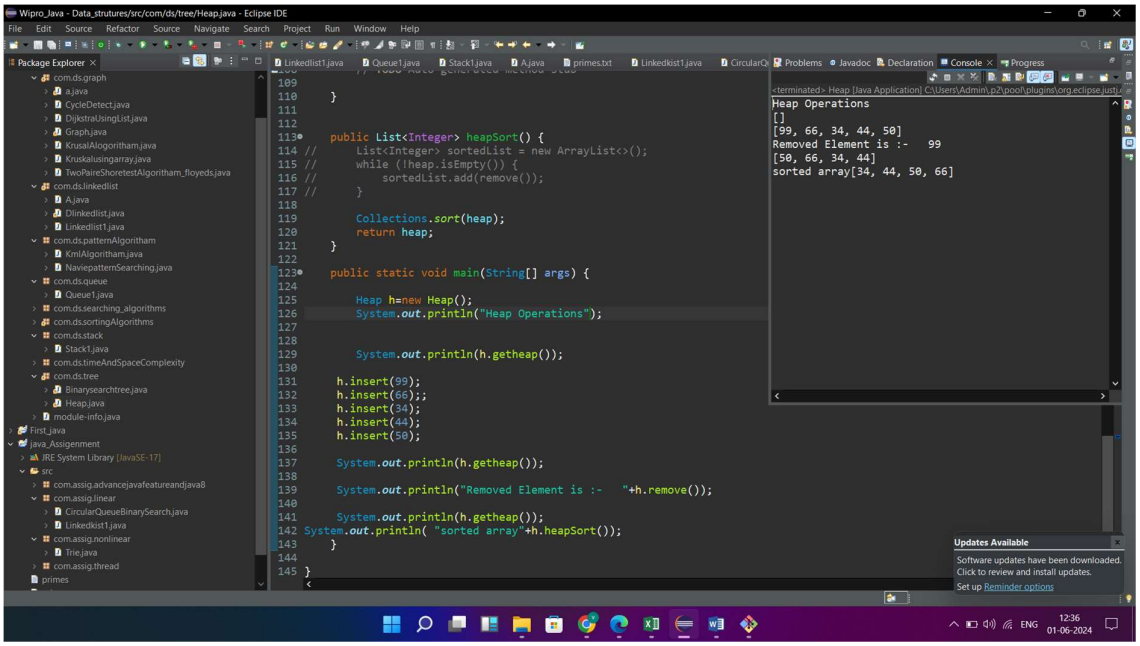

Task 4: Graph Edge Addition Validation

Given a directed graph, write a function that adds an edge between two nodes and then checks if the graph still has no cycles. If a cycle is created, the edge should not be added.

```
package com.assig.nonlinear;


import java.util.ArrayList;

import java.util.HashMap;

import java.util.List;

import java.util.Map;


class Graph {

    private final Map<Integer, List<Integer>> adjacencyList;


    public Graph() {
```

```
        adjacencyList = new HashMap<>();
    }

    public void addEdge(int from, int to) {
        if (!adjacencyList.containsKey(from)) {
            adjacencyList.put(from, new ArrayList<>());
        }
        adjacencyList.get(from).add(to);
    }

    public boolean hasCycle(int from, int to) {
        addEdge(from, to); // Add the edge temporarily
        boolean[] visited = new boolean[adjacencyList.size() + 1];
        boolean[] recursionStack = new boolean[adjacencyList.size() +
1];

        for (int i : adjacencyList.keySet()) {
            if (!visited[i] && isCyclicUtil(i, visited, recursionStack)) {
                // Remove the temporarily added edge
                adjacencyList.get(from).remove(Integer.valueOf(to));
                return true;
            }
        }
```

```
        // Remove the temporarily added edge
        adjacencyList.get(from).remove(Integer.valueOf(to));
        return false;
    }

    private boolean isCyclicUtil(int v, boolean[] visited, boolean[]
recursionStack) {
        if (recursionStack[v]) {
            return true;
        }

        if (visited[v]) {
            return false;
        }

        visited[v] = true;
        recursionStack[v] = true;

        List<Integer> neighbors = adjacencyList.getOrDefault(v, new
ArrayList<>());
        for (int neighbor : neighbors) {
            if (isCyclicUtil(neighbor, visited, recursionStack)) {
                return true;
            }
```

```
        }


        recursionStack[v] = false;
        return false;
    }
}


public class Addegdge {
    public static void main(String[] args) {
        Graph graph = new Graph();
        graph.addEdge(0, 1);
        graph.addEdge(1, 2);
        graph.addEdge(2, 0);


        System.out.println("Graph has cycle: " + graph.hasCycle(2, 0)); //
Output: true
        System.out.println("Graph has cycle: " + graph.hasCycle(3, 5));
    }
}
```

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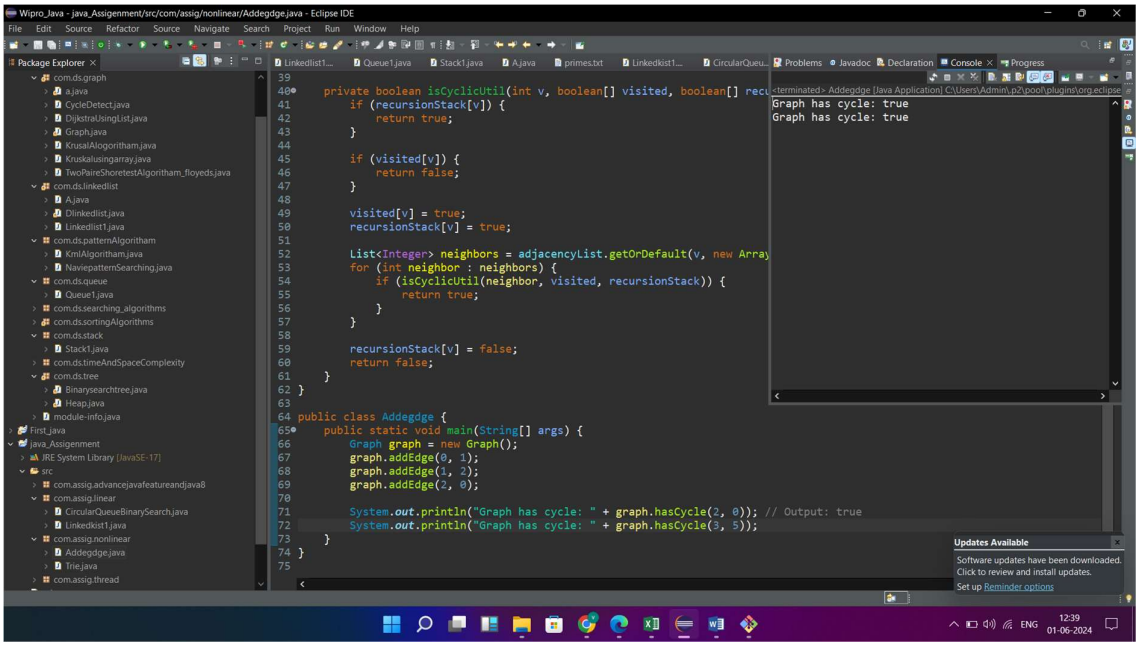

Task 5: Breadth-First Search (BFS) Implementation

For a given undirected graph, implement BFS to traverse the graph starting from a given node and print each node in the order it is visited.

```java
package com.assig.nonlinear;

import java.util.*;

public class Graph1 {
    private int V; // Number of vertices
    private LinkedList<Integer> adj[]; // Adjacency List

    public Graph1(int v) {
        V = v;
        adj = new LinkedList[v];
        for (int i = 0; i < v; ++i)
            adj[i] = new LinkedList();
    }

    void addEdge(int v, int w) {
        adj[v].add(w);
        adj[w].add(v); // For undirected graph
    }
```

```
    void BFS(int s) {
        boolean visited[] = new boolean[V];
        LinkedList<Integer> queue = new LinkedList<Integer>();

        visited[s] = true;
        queue.add(s);

        while (queue.size() != 0) {
            s = queue.poll();
            System.out.print(s + " ");

            Iterator<Integer> i = adj[s].listIterator();
            while (i.hasNext()) {
                int n = i.next();
                if (!visited[n]) {
                    visited[n] = true;
                    queue.add(n);
                }
            }
        }
    }

    public static void main(String args[]) {
        Graph1 g = new Graph1(4);

        g.addEdge(0, 1);
        g.addEdge(0, 2);
        g.addEdge(1, 2);
        g.addEdge(2, 3);

        System.out.println("BFS starting from vertex 2:");
        g.BFS(2);
    }
}
```

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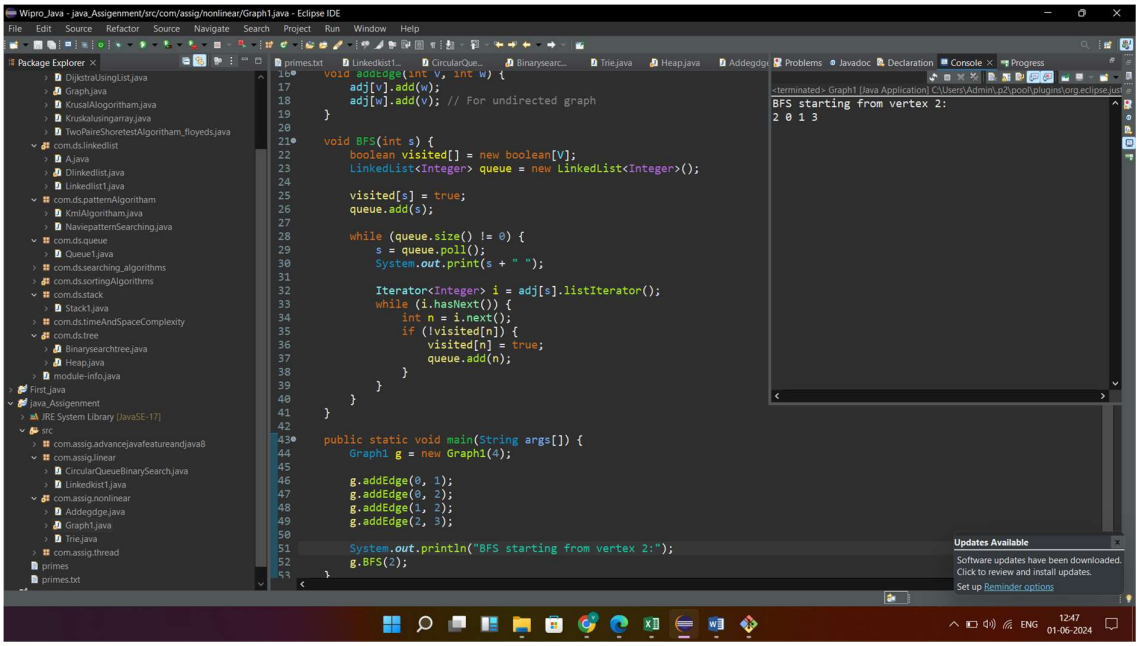

Task 6: Depth-First Search (DFS) Recursive

Write a recursive DFS function for a given undirected graph. The function should visit every node and print it out.

```
package com.assig.nonlinear;

import java.util.*;

public class DFS1 {
    private int V; // Number of vertices
    private LinkedList<Integer> adj[]; // Adjacency List

    public DFS1(int v) {
        V = v;
        adj = new LinkedList[v];
        for (int i = 0; i < v; ++i)
            adj[i] = new LinkedList();
    }

    void addEdge(int v, int w) {
        adj[v].add(w);
        adj[w].add(v); // For undirected graph
    }

    void DFSUtil(int v, boolean visited[]) {
        visited[v] = true;
        System.out.print(v + " ");
```

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```
        Iterator<Integer> i = adj[v].listIterator();
        while (i.hasNext()) {
            int n = i.next();
            if (!visited[n])
                DFSUtil(n, visited);
        }
    }

    void DFS(int v) {
        boolean visited[] = new boolean[V];
        DFSUtil(v, visited);
    }

    public static void main(String args[]) {
      DFS1 g = new DFS1(4);

        g.addEdge(0, 1);
        g.addEdge(0, 2);
        g.addEdge(1, 2);
        g.addEdge(2, 3);

        System.out.println("DFS starting from vertex 2:");
        g.DFS(2);
    }
}
```

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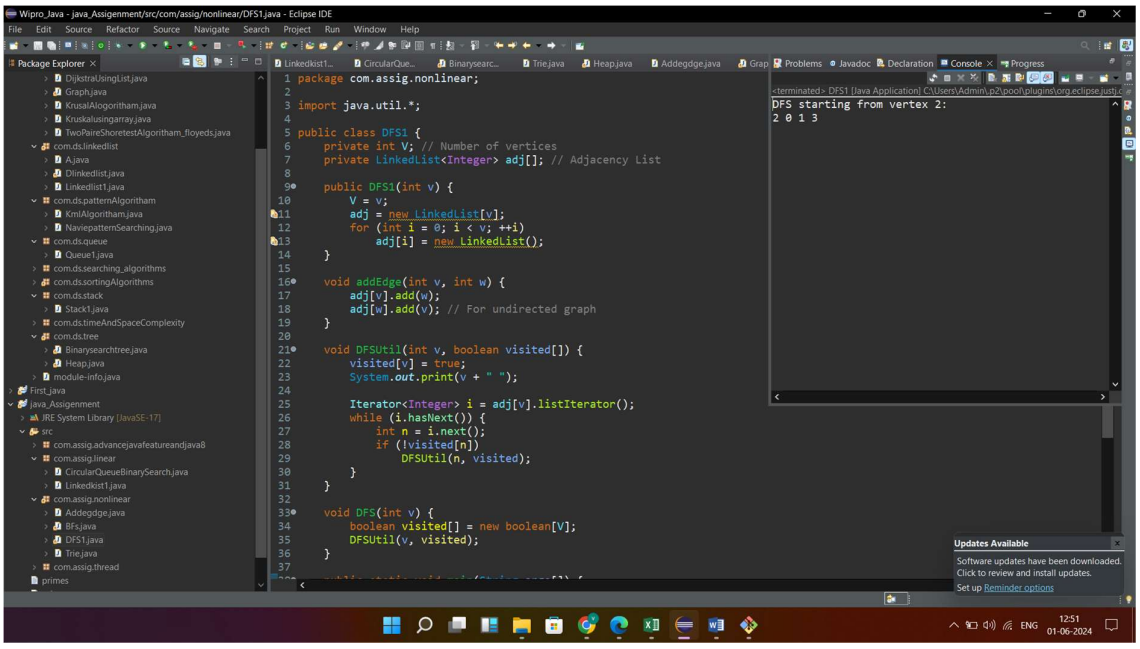

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