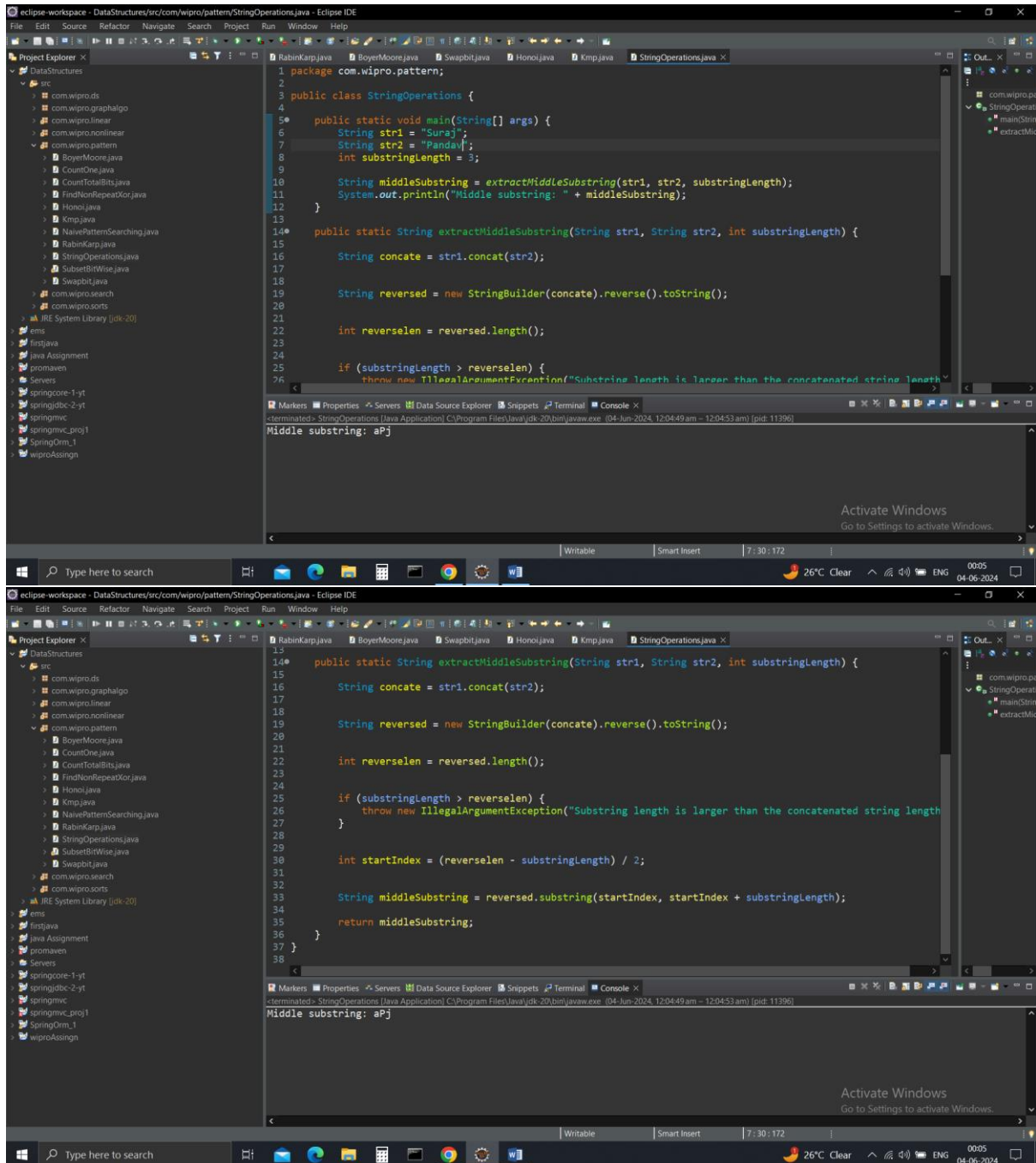


## Task 1: String Operations

Write a method that takes two strings, concatenates them, reverses the result, and then extracts the middle substring of the given length. Ensure your method handles edge cases, such as an empty string or a substring length larger than the concatenated string.



```
1 package com.wipro.pattern;
2
3 public class StringOperations {
4
5     public static void main(String[] args) {
6         String str1 = "Suraj";
7         String str2 = "Pandav";
8         int substringLength = 3;
9
10        String middleSubString = extractMiddleSubString(str1, str2, substringLength);
11        System.out.println("Middle substring: " + middleSubString);
12    }
13
14    public static String extractMiddleSubString(String str1, String str2, int substringLength) {
15        String concat = str1.concat(str2);
16
17        String reversed = new StringBuilder(concat).reverse().toString();
18
19        int reverselen = reversed.length();
20
21        if (substringLength > reverselen) {
22            throw new IllegalArgumentException("Substring length is larger than the concatenated string length");
23        }
24
25        int startIndex = (reverselen - substringLength) / 2;
26
27        String middleSubString = reversed.substring(startIndex, startIndex + substringLength);
28
29        return middleSubString;
30    }
31
32 }
```

The screenshots show the Eclipse IDE interface. The top screenshot displays the initial code with a placeholder for the `extractMiddleSubString` method. The bottom screenshot shows the completed code with the method implementation. The console output in both screenshots is "Middle substring: aPj".

## Task 2: Naive Pattern Search

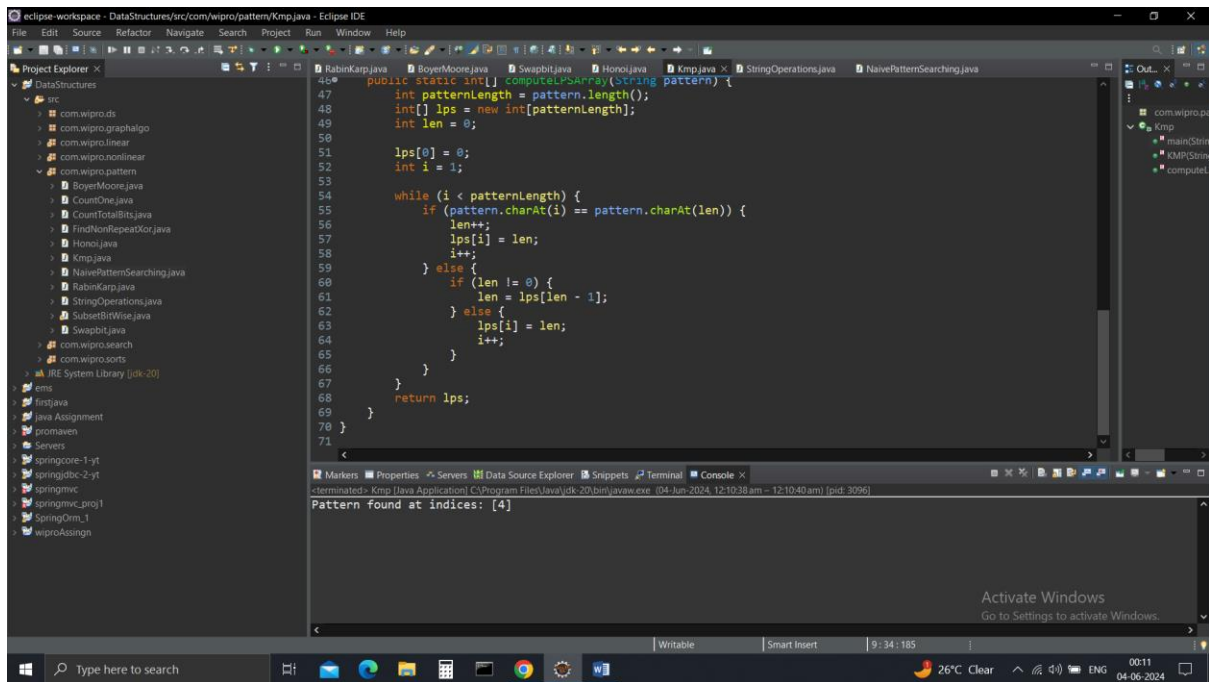
Implement the naive pattern searching algorithm to find all occurrences of a pattern within a given text string. Count the number of comparisons made during the search to evaluate the efficiency of the algorithm

```
1 package com.wipro.pattern;
2
3 public class NaivePatternSearching {
4
5     public static void main(String[] args) {
6         String text = "I Love Cats";
7         String pattern = "Cats";
8         search(text, pattern);
9     }
10
11     private static void search(String text, String pattern) {
12         int strleng = text.length();
13         int patleng = pattern.length();
14
15         for(int i=0; i<=strleng-patleng; i++)
16         {
17             int j;
18             for(j=0; j<patleng; j++) {
19                 if(text.charAt(i+j)!=pattern.charAt(j))
20                 {
21                     break;
22                 }
23             }
24
25             if(i==patleng) {
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### Task 3: Implementing the KMP Algorithm.

Code the Knuth-Morris-Pratt (KMP) algorithm in C# for pattern searching which pre-processes the pattern to reduce the number of comparisons. Explain how this pre-processing improves the search time compared to the naive approach

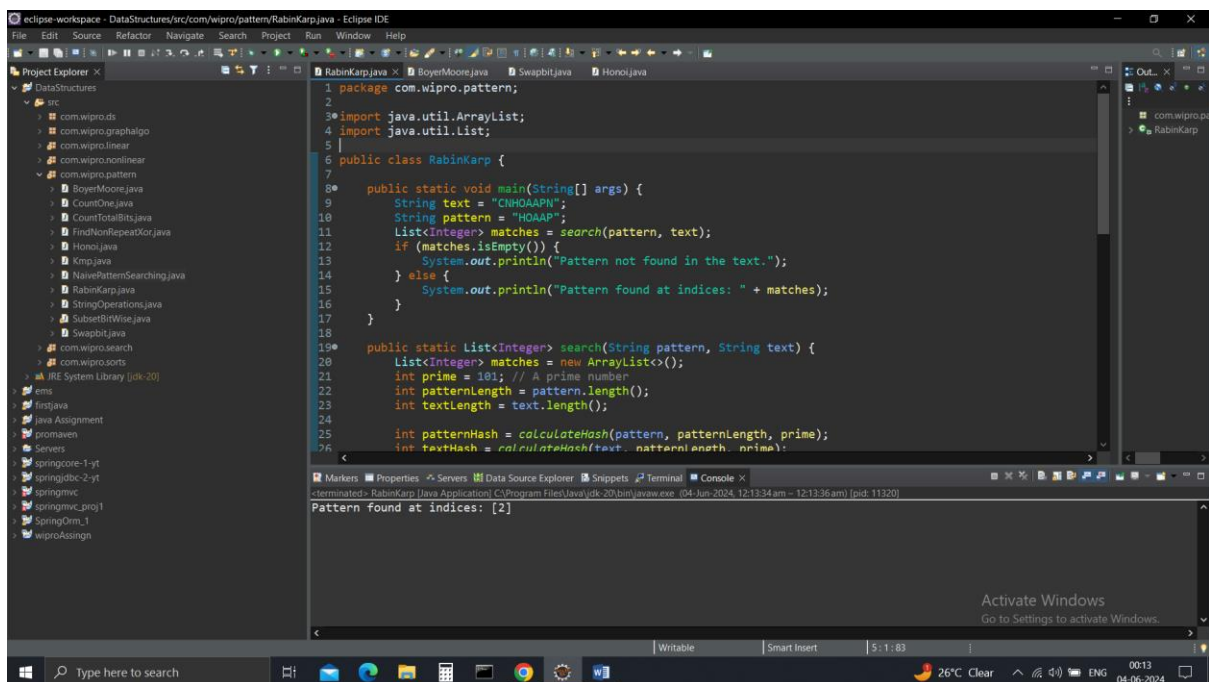
```
1 package com.wipro.pattern;
2
3 import java.util.ArrayList;
4 import java.util.List;
5
6 public class Kmp {
7
8     public static void main(String[] args) {
9         String text = "IUHFCBANFGKJ";
10        String pattern = "CBANFG";
11        List<Integer> matches = KMP(pattern, text);
12        if (matches.isEmpty()) {
13            System.out.println("Pattern not found in the text.");
14        } else {
15            System.out.println("Pattern found at indices: " + matches);
16        }
17    }
18
19    public static List<Integer> KMP(String pattern, String text) {
20        List<Integer> matches = new ArrayList<>();
21        int[] lps = computeLPSArray(pattern);
22        int i = 0;
23        int j = 0;
24        int textLength = text.length();
25        int patternLength = pattern.length();
26
27        while (i < textLength) {
28            if (pattern.charAt(j) == text.charAt(i)) {
29                i++;
30                j++;
31            }
32            if (j == patternLength) {
33                matches.add(i - j);
34                j = lps[j - 1];
35            } else if (i < textLength && pattern.charAt(j) != text.charAt(i)) {
36                if (j != 0) {
37                    j = lps[j - 1];
38                } else {
39                    i++;
40                }
41            }
42        }
43        return matches;
44    }
45
46    public static int[] computeLPSArray(String pattern) {
47        int patternLength = pattern.length();
48        int[] lps = new int[patternLength];
49        int len = 0;
50
51        lps[0] = 0;
```



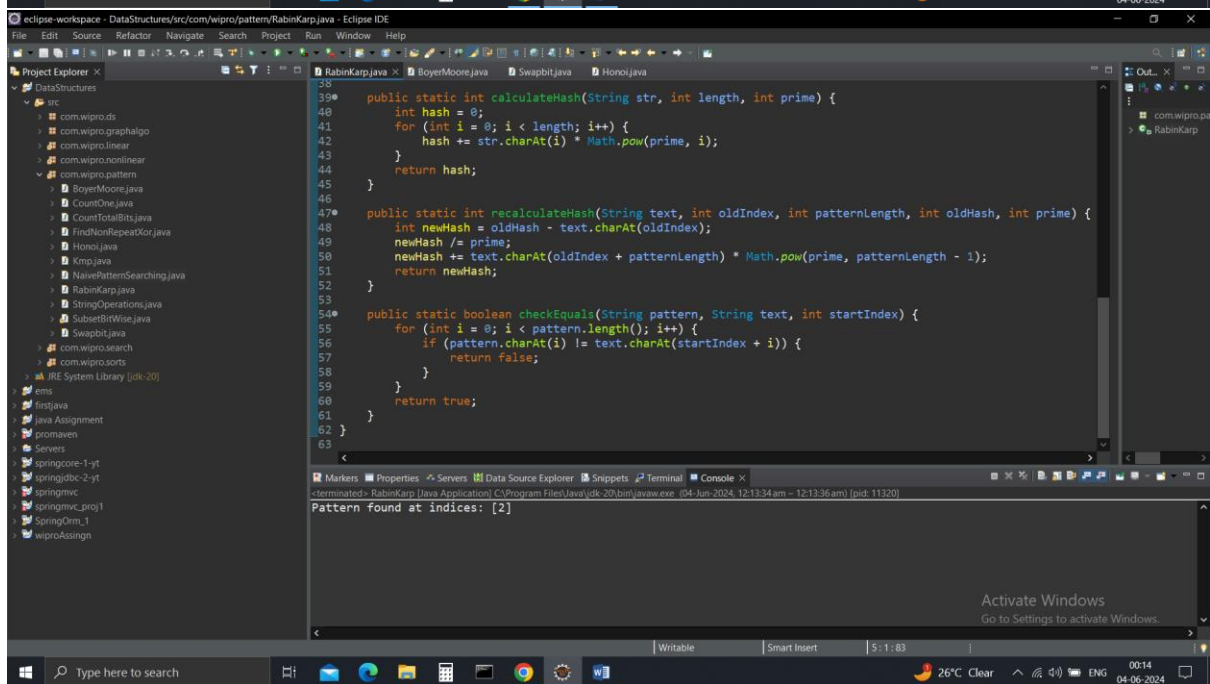
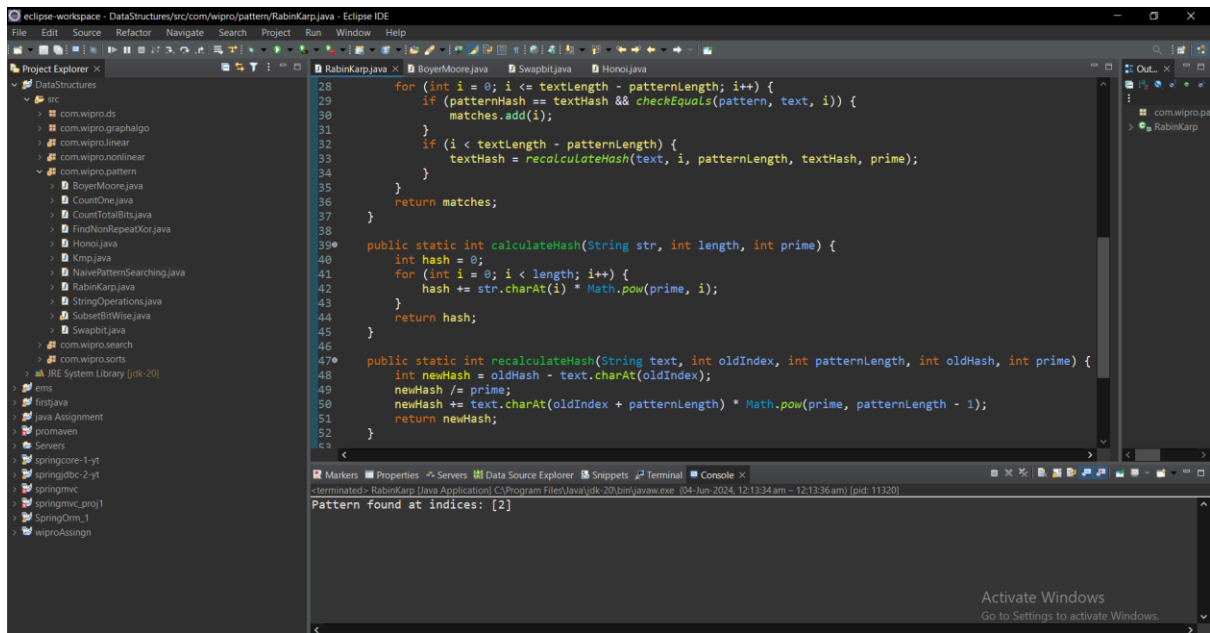
## Task 4: Rabin-Karp Substring Search

Implement the Rabin-Karp algorithm for substring search using a rolling hash.

Discuss the impact of hash collisions on the algorithm's performance and how to handle them.

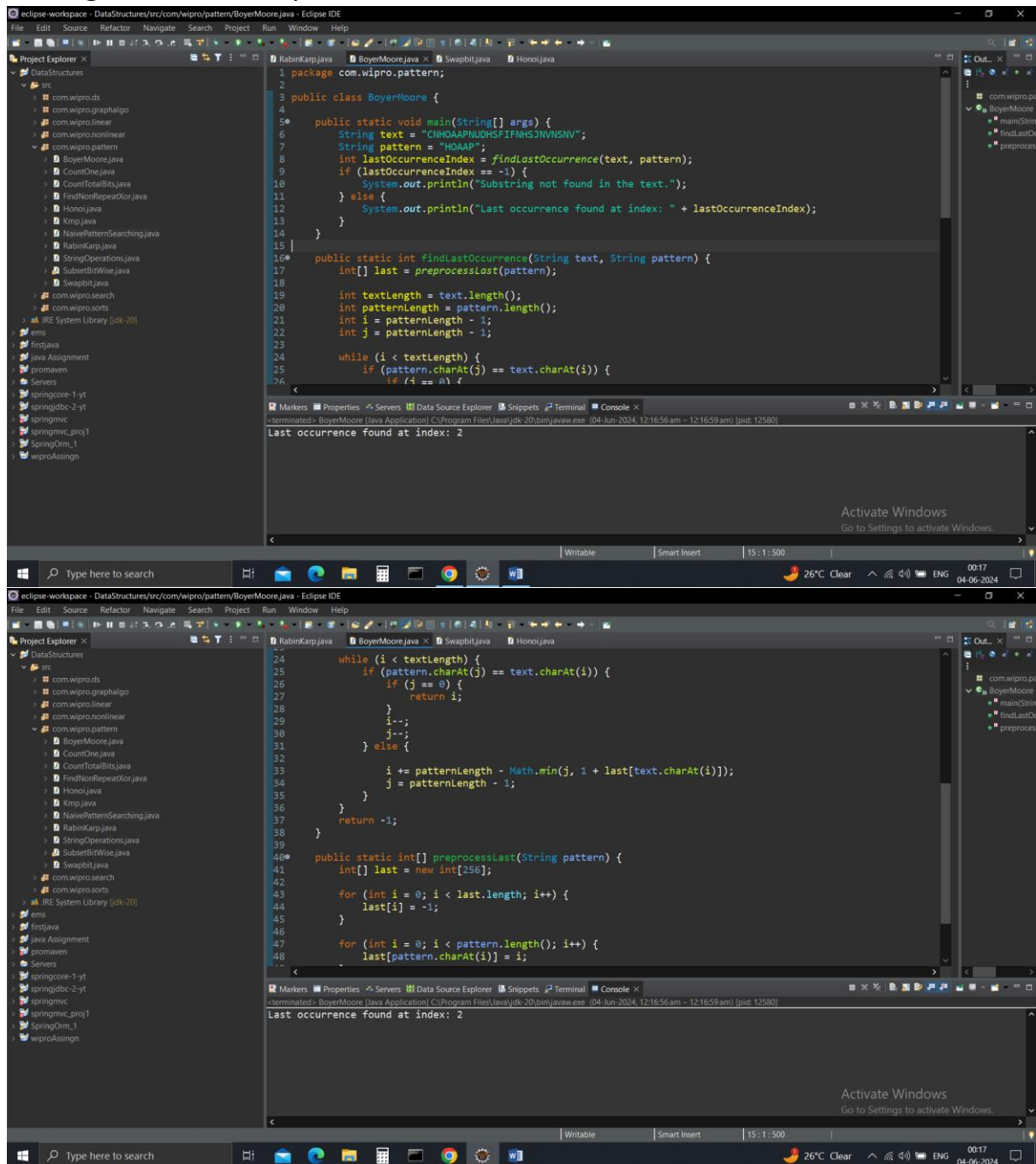






## Task 5: Boyer-Moore Algorithm Application

Use the Boyer-Moore algorithm to write a function that finds the last occurrence of a substring in a given string and returns its index. Explain why this algorithm can outperform others in certain scenarios.



```
1 package com.wipro.pattern;
2
3 public class BoyerMoore {
4
5     public static void main(String[] args) {
6         String text = "CNHOAAPNUHDSFIFNHSJNVNSNV";
7         String pattern = "HOAAP";
8         int lastOccurrenceIndex = findLastOccurrence(text, pattern);
9         if (lastOccurrenceIndex == -1) {
10             System.out.println("Substring not found in the text.");
11         } else {
12             System.out.println("Last occurrence found at index: " + lastOccurrenceIndex);
13         }
14     }
15
16     public static int findLastOccurrence(String text, String pattern) {
17         int[] last = preprocessLast(pattern);
18
19         int textLength = text.length();
20         int patternLength = pattern.length();
21         int i = patternLength - 1;
22         int j = patternLength - 1;
23
24         while (i < textLength) {
25             if (pattern.charAt(j) == text.charAt(i)) {
26                 if (j == 0) {
27                     return i;
28                 }
29                 i--;
30                 j--;
31             } else {
32                 i += patternLength - Math.min(j, 1 + last[text.charAt(i)]);
33                 j = patternLength - 1;
34             }
35             return -1;
36         }
37     }
38
39     public static int[] preprocessLast(String pattern) {
40         int[] last = new int[256];
41
42         for (int i = 0; i < last.length; i++) {
43             last[i] = -1;
44         }
45
46         for (int i = 0; i < pattern.length(); i++) {
47             last[pattern.charAt(i)] = i;
48         }
49     }
50 }
```

The top screenshot shows the initial code with a placeholder for the preprocessing function. The bottom screenshot shows the completed code with the preprocessing function implemented.

