University of Engineering & Management
Institute of Engineering & Management

श्रद्धाबान लभते ज्ञानम्
Good Education, Good Jobs

Institute of Engineering & Management, University of Engineering & Management Kolkata

Department of Computer Science & Engineering

Laboratory: - Introduction to Cyber Security Lab

Name: - Gourab Mondal

Section: - B

Roll Number: - 26

Enrollment Number: - 12022002001116

Year: - 3rd

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INDEX PAGE

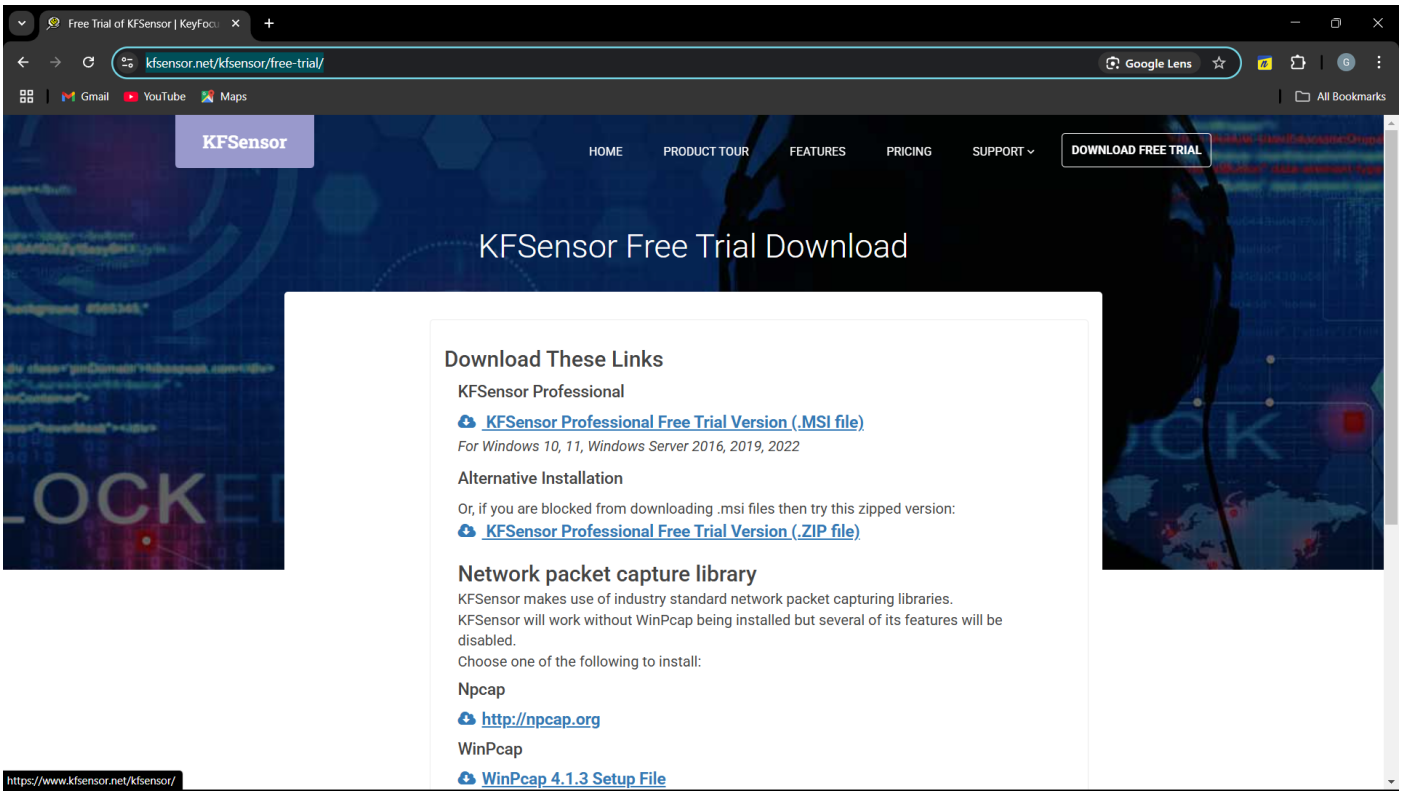
SL NO.	ASSIGNMENT	PAGE NUMBER
1	Week 1: Week 1: Implementation of Caesar cypher and Playfair cypher using java	03 - 11
2	Week 2: Installation of KFSensor and Npcap, Setting up honeypot, java implementation of Hill Cipher	12 - 23
3		
4		
5		
6		
7		
8		
9		
10		

Week 2

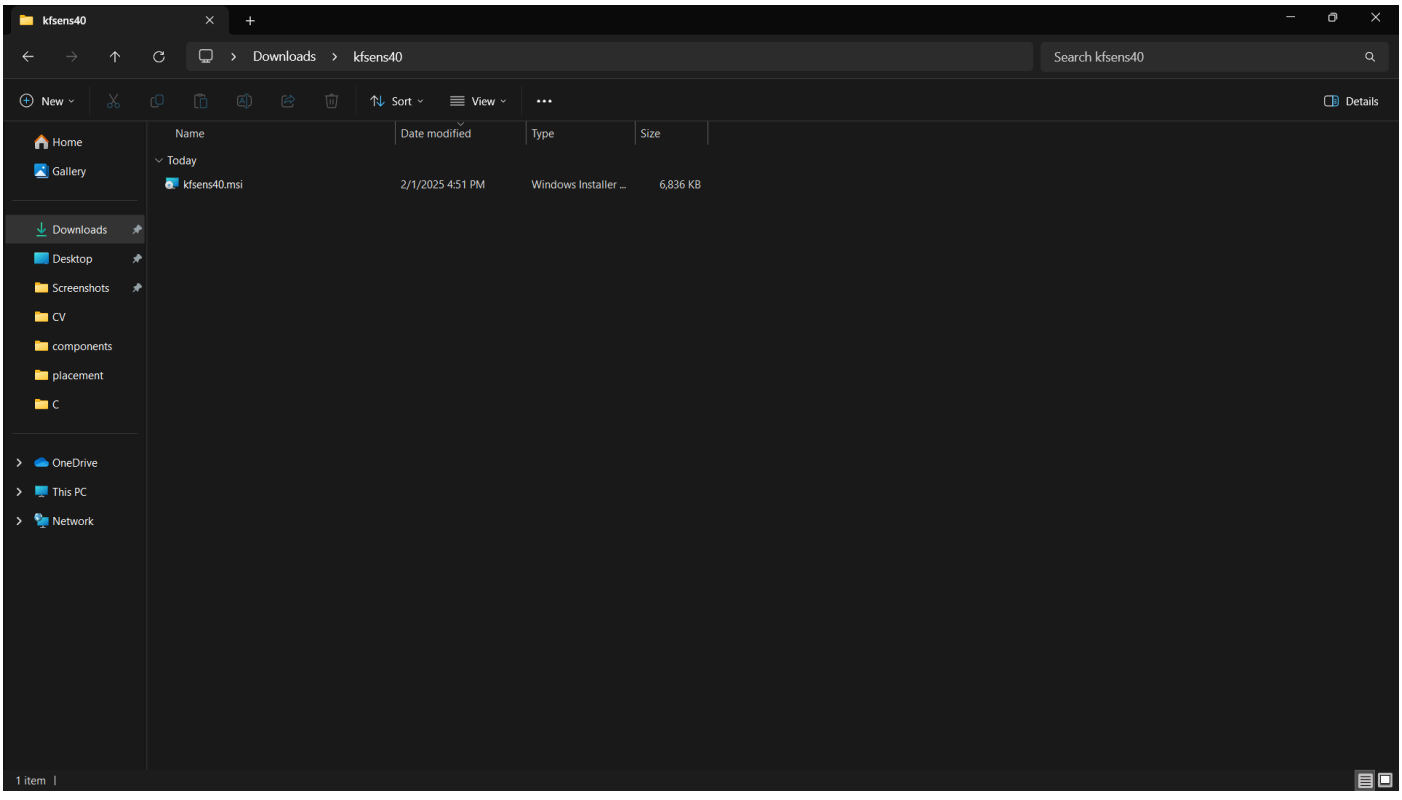
1a.

Title: Installation of **Npcap** and **KFSensor** and setting up **honey pot.**

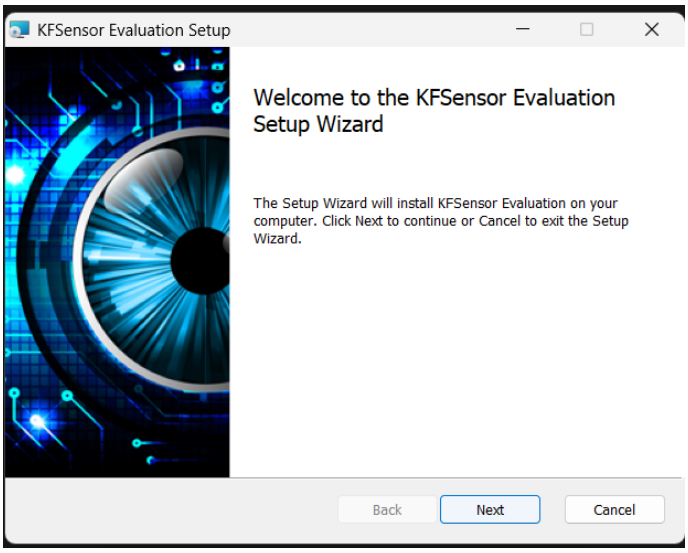
Step 1: Visit the link https://www.kfsensor.net/kfsensor/free-trial/

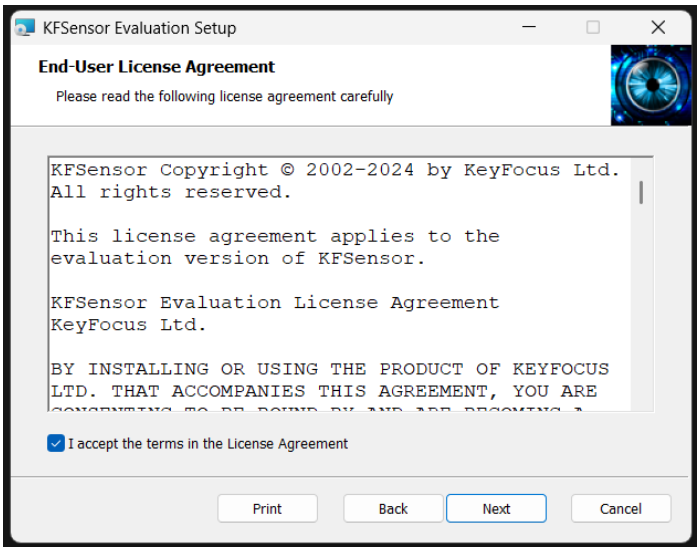


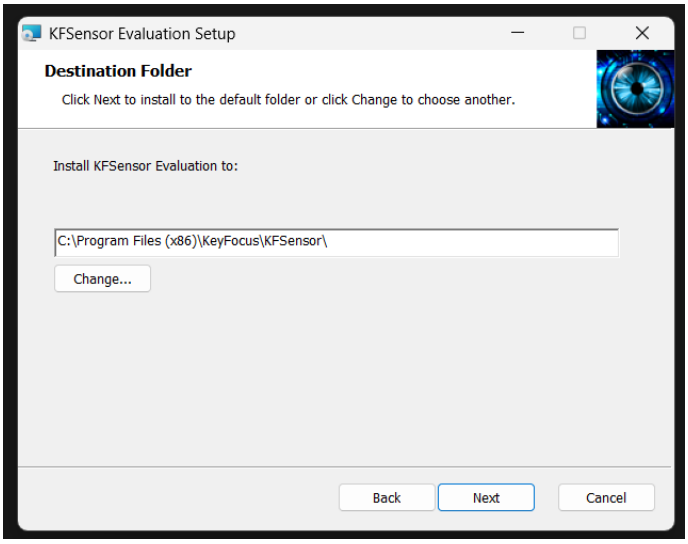
Step 2: Install the free trial version of KFSensor in ZIP format and extract in explorer

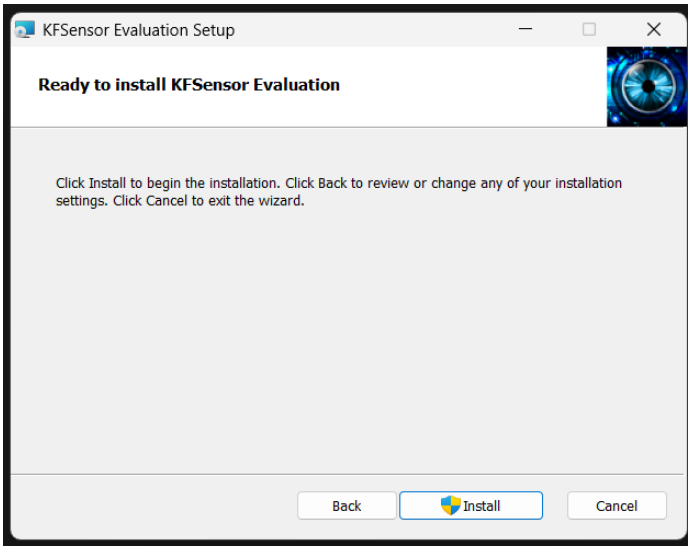


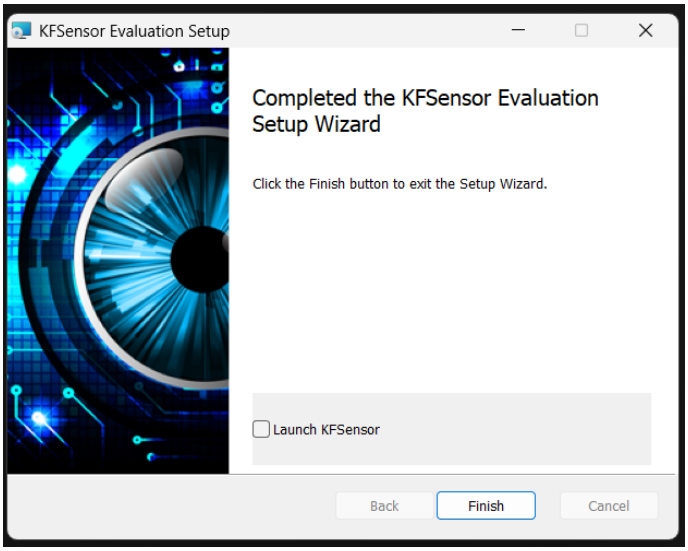
Step 3: Run the msi executable and follow below steps



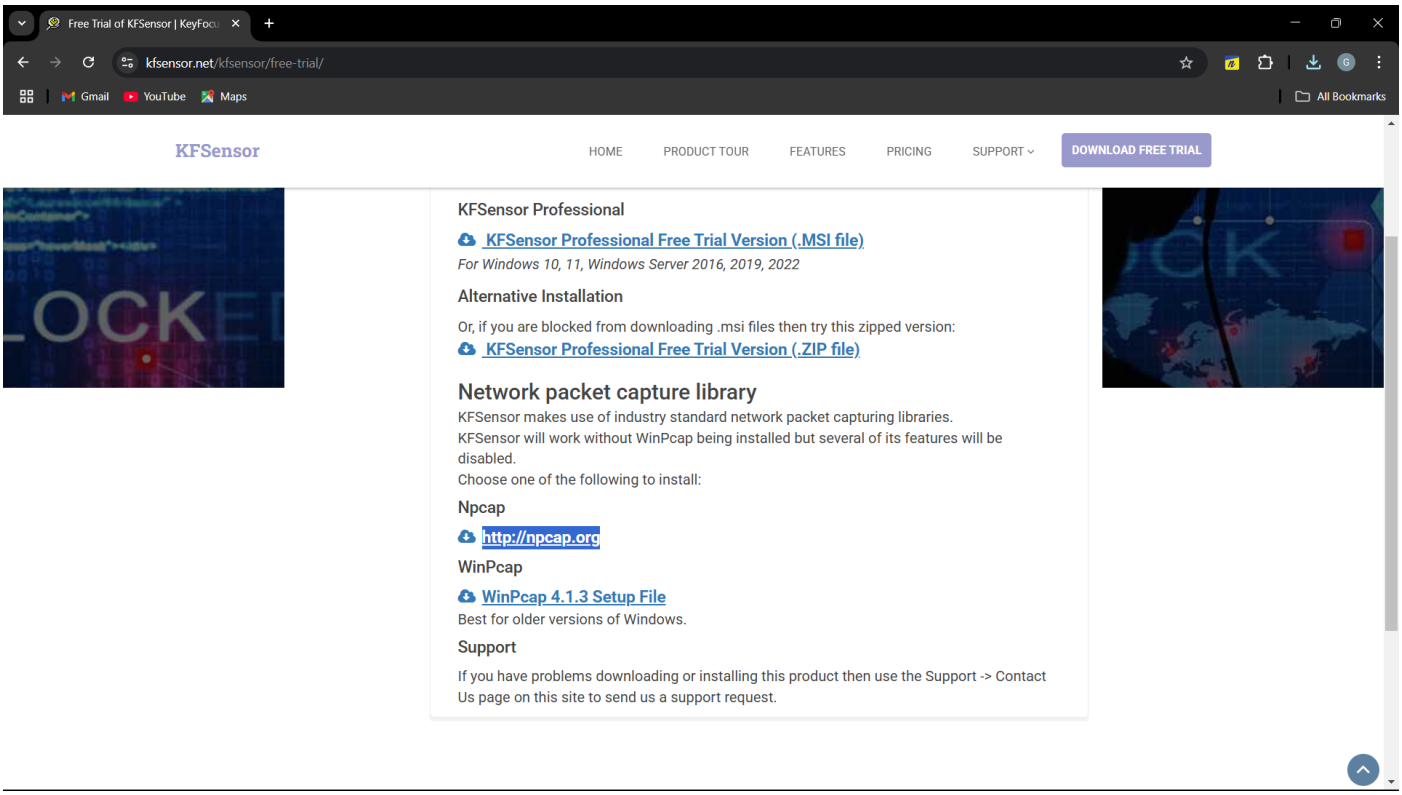




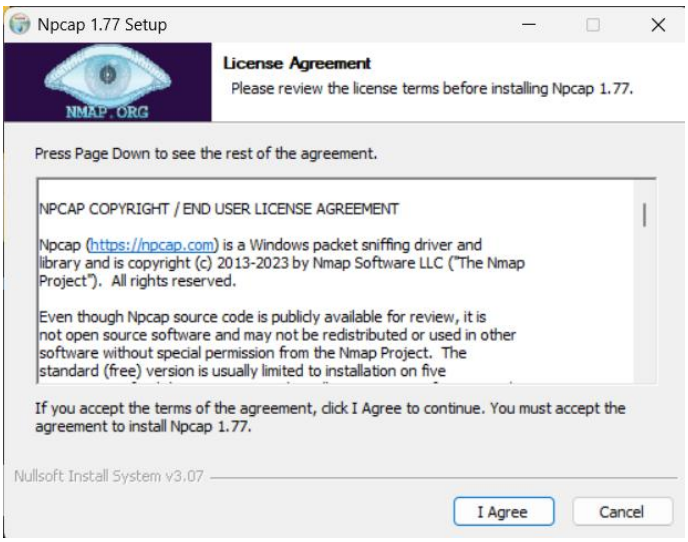


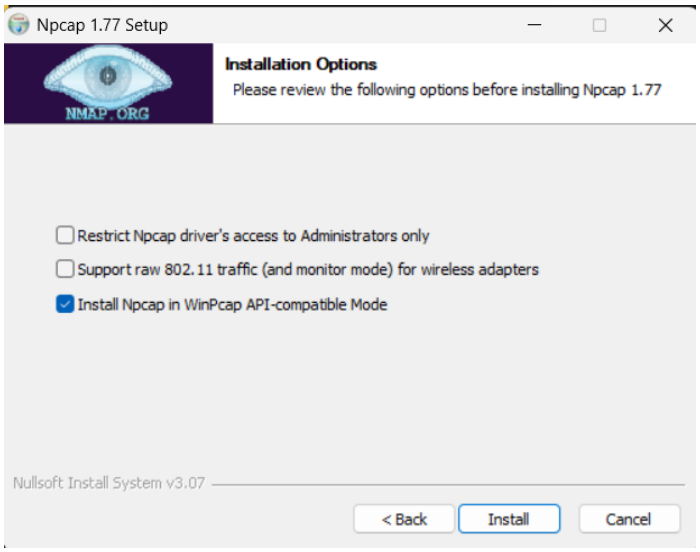


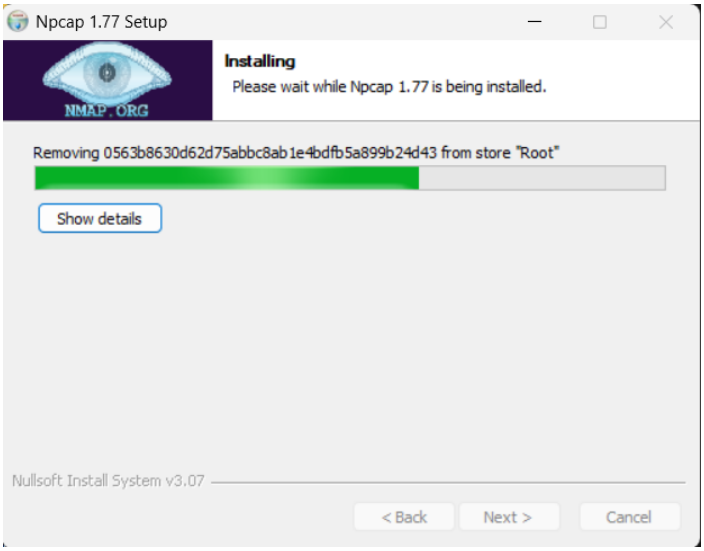
Step 4: From https://www.kfsensor.net/kfsensor/free-trial/ also visit the link for Npcap

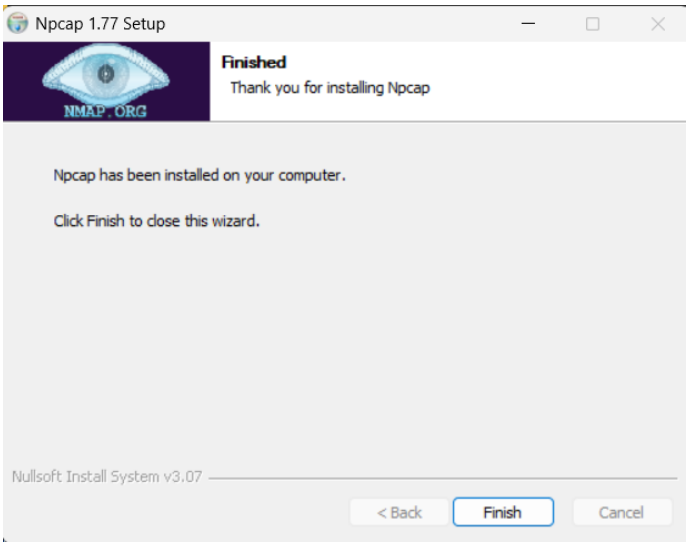


Step 5: Run the recently installed Npcap setup exe file and follow below steps

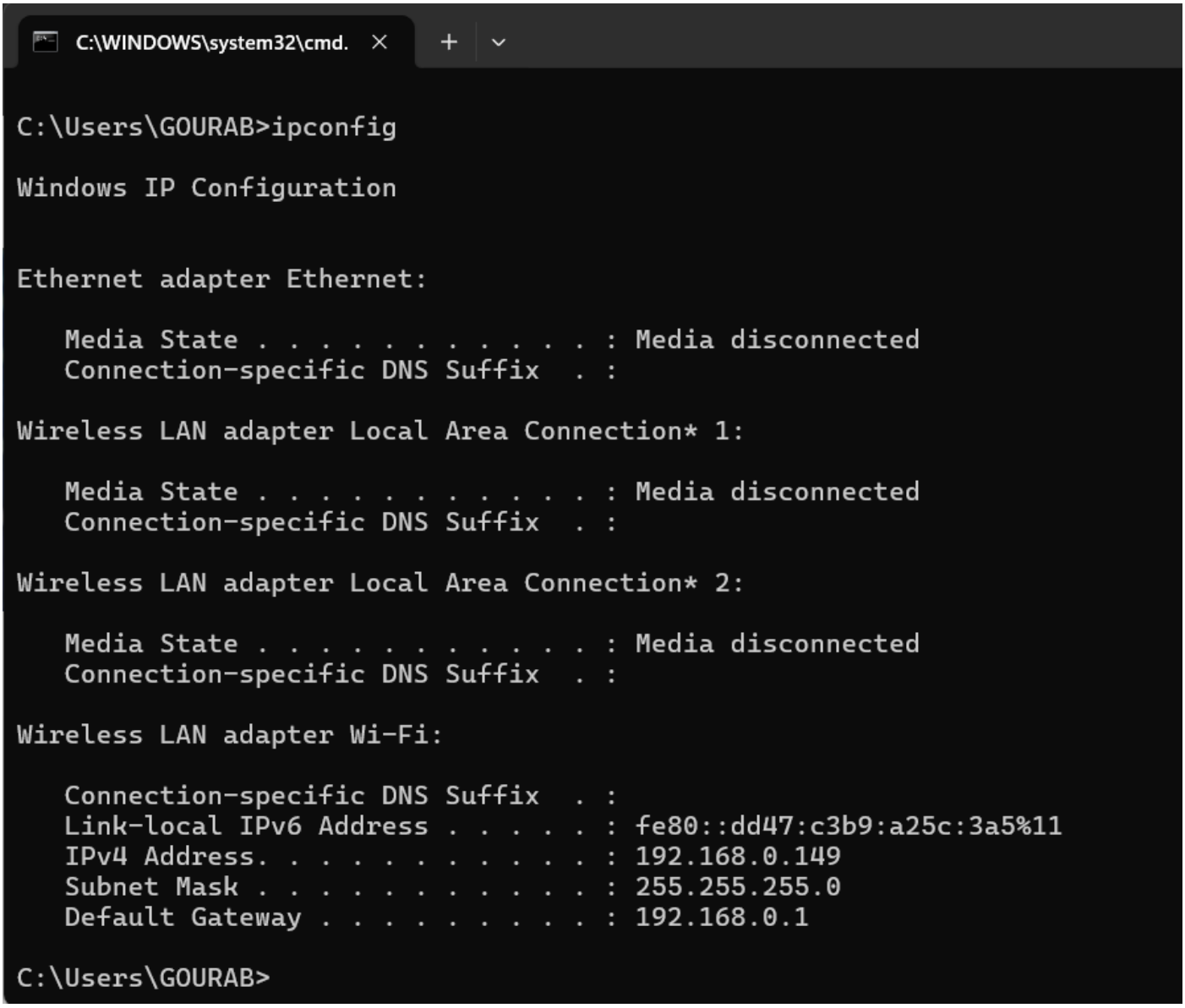




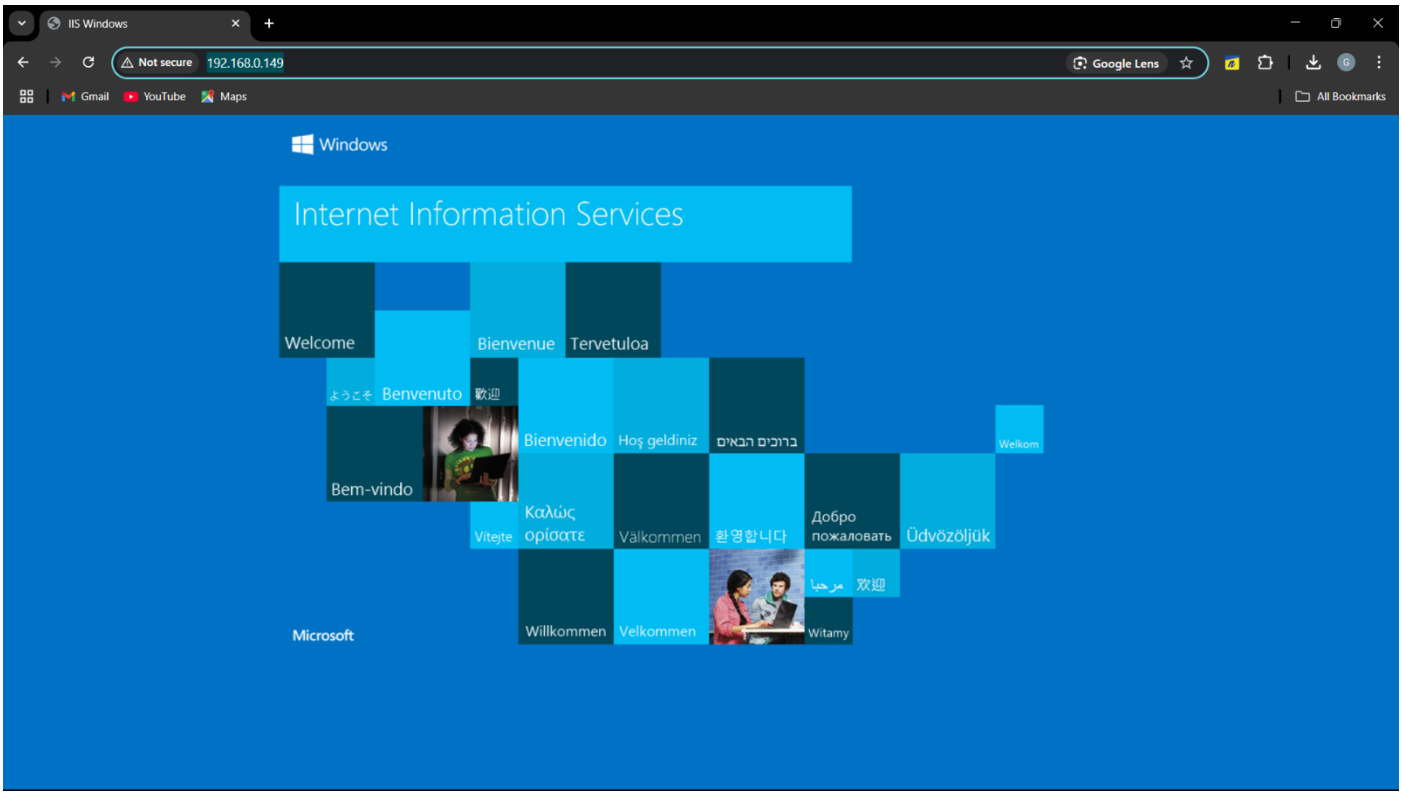




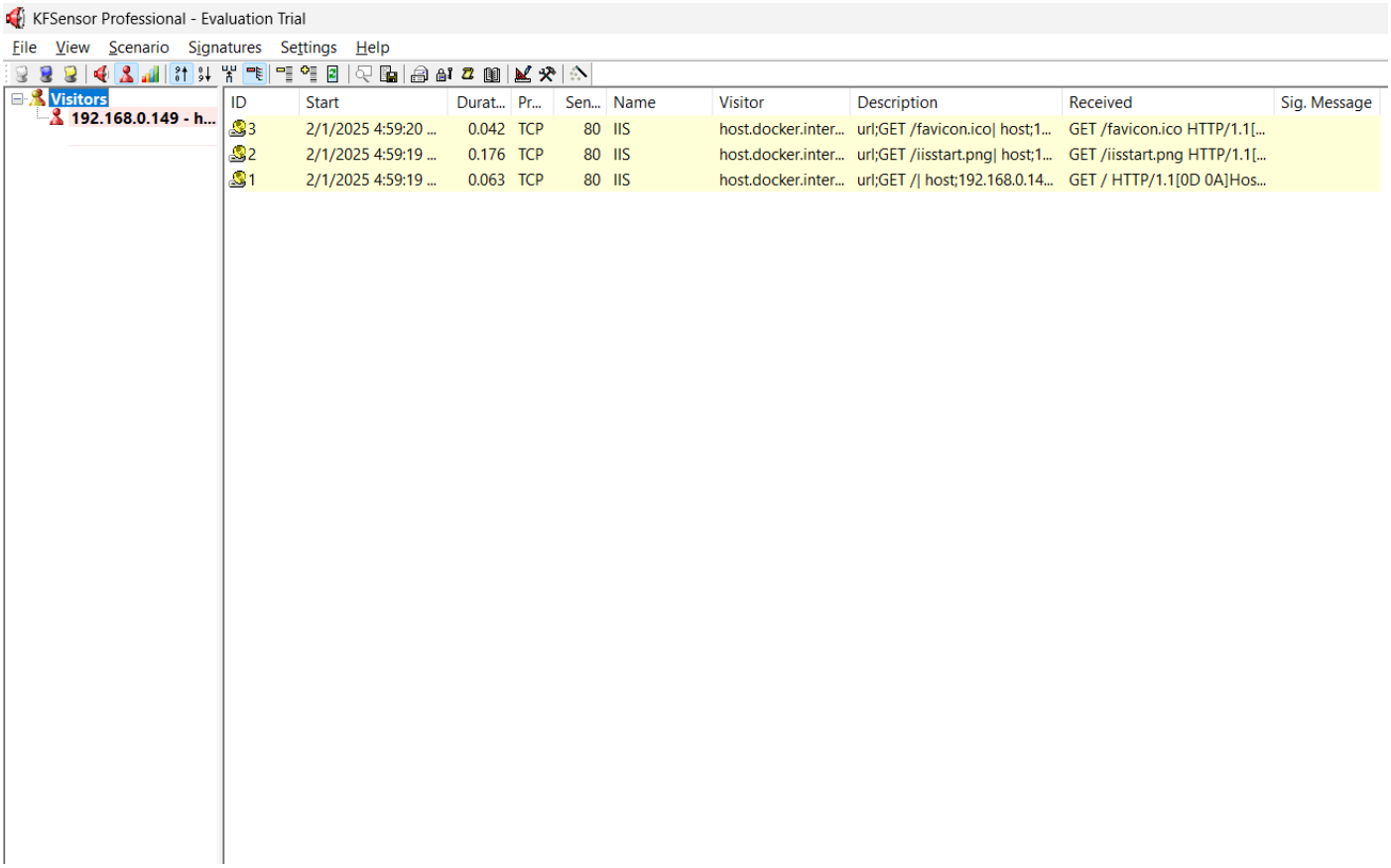
Step 6: Run CMD and execute command “ipconfig” copy the ipv4 address



Step 7: Launch kfsensor and paste the ipv4 address in browser



Step 8: Check the logs in kfsensor for recent http request in visitors tab



1b.

Title: Implementation of Hill Cipher using java

Algorithm:

- **Key Preparation:**
  - Choose a key of length n×n (3x3 for this implementation).
  - Ensure the key has no non-alphabetic characters and is of the required length.
  - Convert the key to lowercase.
- **Matrix Creation (for encryption):**
  - Convert the key into a matrix of numbers (0-25 for letters 'a' to 'z').
- **Plaintext Preparation:**
  - Remove any non-alphabetic characters and convert to lowercase.
  - If the plaintext length is not a multiple of n, add padding (commonly 'x').
- **Encryption:**
  - Break the plaintext into digraphs (pairs of n characters).
  - For each digraph, convert each character to its numerical equivalent.
  - Multiply the key matrix with the digraph matrix (mod 26).
  - Convert the result back to characters to form the ciphertext.

$$C = K \times P \ (\text{mod} 26)$$

- **Matrix Inversion (for decryption):**
  - Calculate the determinant of the key matrix (mod 26).
  - Find the modular inverse of the determinant.
  - Compute the adjugate matrix of the key matrix.
  - Multiply the adjugate matrix by the modular inverse of the determinant (mod 26) to obtain the inverse matrix.
- **Decryption:**
  - For each ciphertext digraph, convert each character to its numerical equivalent.
  - Multiply the inverse key matrix with the ciphertext matrix (mod 26).
  - Convert the result back to characters to recover the plaintext.

$$P = K^{-1} \times C \ (mod 26)$$

Java Program:

```
// basic implementation of hill cipher for only 3*3 key matrix
class HillCipher {
    private static final int KEYSIZE = 3;
    private int[][] keyMat = new int[KEYSIZE][KEYSIZE];
    private String key;
    private static final Map<Character, Integer> CHAR_TO_NUM = new HashMap<>();
    private static final Map<Integer, Character> NUM_TO_CHAR = new HashMap<>();
    static {
        for (char i = 'a'; i <= 'z'; i++) {
            CHAR_TO_NUM.put(i, i - 'a');
        }
        for (char i = 'a'; i <= 'z'; i++) {
            NUM_TO_CHAR.put(i - 'a', i);
        }
    }

    HillCipher(String key) {
        this.key = key;
        this.validateAndFormatKey();
        this.createKeyMat();
    }

    private void validateAndFormatKey() {
        this.key = this.key.replaceAll("[^a-zA-Z]", "");

        if (this.key.length() != KEYSIZE * KEYSIZE) {
            throw new IllegalArgumentException("Key must contain exactly 9
alphabetic characters for a 3x3 matrix.");
        }

        this.key = this.key.toLowerCase();
    }

    private int getNumVal(char c) {
        return CHAR_TO_NUM.getOrDefault(c, -1);
    }

    public char getCharVal(int n) {
        return NUM_TO_CHAR.getOrDefault(n, '_');
    }

    private void createKeyMat() {
        int k = 0;
        for (int i = 0; i < KEYSIZE; i++) {
```

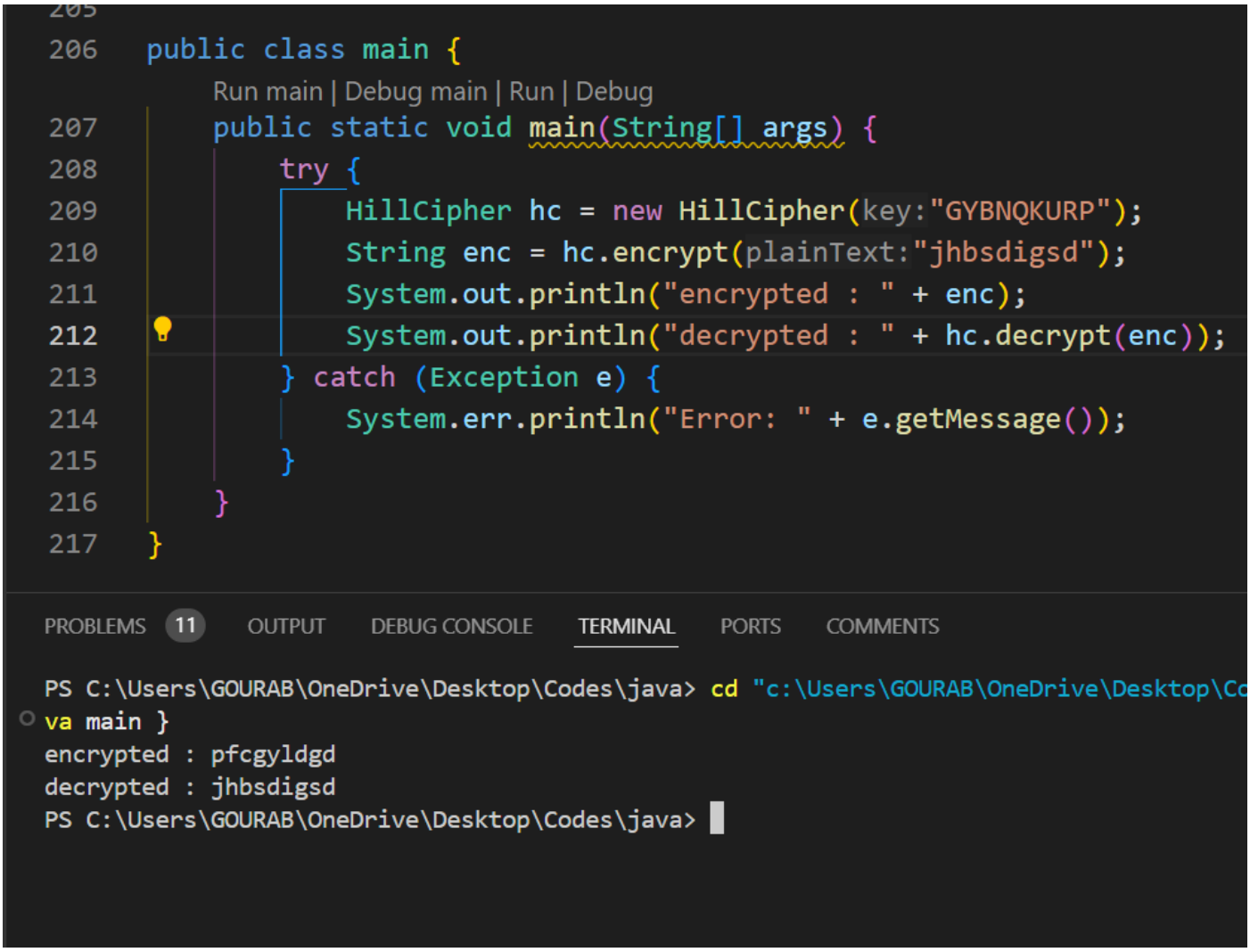
```
            for (int j = 0; j < KEYSIZE; j++) {
                this.keyMat[i][j] = this.getNumVal(this.key.charAt(k++));
            }
        }
    }

    private String addPadding(String text) {
        if (text.length() % KEYSIZE == 0) {
            return text;
        }
        StringBuilder sb = new StringBuilder(text);
        while (sb.length() % KEYSIZE != 0) {
            sb.append('x');
        }
        return sb.toString();
    }

    private String formatText(String text) {
        if (!text.matches("[a-zA-Z]+")) {
            throw new IllegalArgumentException("text must contain only
alphabetic characters.");
        }

        text = text.toLowerCase();
        text = this.addPadding(text);

        return text;
    }

    private List<int[]> createDigraphs(String plainText) {
        List<int[]> digraphs = new ArrayList<>();

        for (int j = 0; j < plainText.length(); j += KEYSIZE) {
            int[] digraph = new int[KEYSIZE];
            for (int k = 0; k < KEYSIZE; k++) {
                digraph[k] = this.getNumVal(plainText.charAt(j + k));
            }
            digraphs.add(digraph);
        }

        return digraphs;
    }

    private int[] multiplyMatrices(int[][] keyMat, int[] digraph) {
        int[] result = new int[KEYSIZE];
```

```
        for (int i = 0; i < KEYSIZE; i++) {
            result[i] = 0;
            for (int j = 0; j < KEYSIZE; j++) {
                result[i] += keyMat[i][j] * digraph[j];
            }
            result[i] = result[i] % 26;
        }

        return result;
    }

    private String getCipher(int[] digraph) {
        int[] cipher = this.multiplyMatrices(this.keyMat, digraph);
        String cipherText = "";

        for (int i = 0; i < cipher.length; i++) {
            cipherText =
cipherText.concat(String.valueOf(this.getCharVal(cipher[i])));
        }

        return cipherText;
    }

    public String encrypt(String plainText) {
        String cipherText = "";
        plainText = this.formatText(plainText);
        List<int[]> digraphs = this.createDigraphs(plainText);
        for (int[] digraph : digraphs) {
            cipherText = cipherText + this.getCipher(digraph);
        }

        return cipherText;
    }

    private int determinant(int[][] matrix) {
        return (matrix[0][0] * (matrix[1][1] * matrix[2][2] - matrix[1][2] *
matrix[2][1]) -
                matrix[0][1] * (matrix[1][0] * matrix[2][2] - matrix[1][2] *
matrix[2][0]) +
                matrix[0][2] * (matrix[1][0] * matrix[2][1] - matrix[1][1] *
matrix[2][0])) % 26;
    }

    private int modInverse(int det, int mod) {
        det = (det % mod + mod) % mod;
        for (int i = 1; i < mod; i++) {
```

```
            if ((det * i) % mod == 1)
                return i;
        }
        throw new ArithmeticException("No modular inverse exists!");
    }

    private int[][] invertMatrix(int[][] matrix) {
        int det = determinant(matrix);
        int detInverse = modInverse(det, 26);

        int[][] adj = new int[3][3];

        adj[0][0] = (matrix[1][1] * matrix[2][2] - matrix[1][2] * matrix[2][1])
% 26;
        adj[0][1] = (matrix[0][2] * matrix[2][1] - matrix[0][1] * matrix[2][2])
% 26;
        adj[0][2] = (matrix[0][1] * matrix[1][2] - matrix[0][2] * matrix[1][1])
% 26;

        adj[1][0] = (matrix[1][2] * matrix[2][0] - matrix[1][0] * matrix[2][2])
% 26;
        adj[1][1] = (matrix[0][0] * matrix[2][2] - matrix[0][2] * matrix[2][0])
% 26;
        adj[1][2] = (matrix[0][2] * matrix[1][0] - matrix[0][0] * matrix[1][2])
% 26;

        adj[2][0] = (matrix[1][0] * matrix[2][1] - matrix[1][1] * matrix[2][0])
% 26;
        adj[2][1] = (matrix[0][1] * matrix[2][0] - matrix[0][0] * matrix[2][1])
% 26;
        adj[2][2] = (matrix[0][0] * matrix[1][1] - matrix[0][1] * matrix[1][0])
% 26;

        for (int i = 0; i < 3; i++) {
            for (int j = 0; j < 3; j++) {
                adj[i][j] = (adj[i][j] * detInverse) % 26;
                if (adj[i][j] < 0)
                    adj[i][j] += 26;
            }
        }

        return adj;
    }

    private String getDecipher(int[] digraph) {
        int[][] inverseKeyMat = this.invertMatrix(this.keyMat);
```

```
        int[] deCipher = this.multiplyMatrices(inverseKeyMat, digraph);
        StringBuilder deCipherText = new StringBuilder();

        for (int num : deCipher) {
            deCipherText.append(this.getCharVal(num));
        }

        return deCipherText.toString();
    }

    public String decrypt(String cipherText) {
        StringBuilder plainText = new StringBuilder();
        cipherText = this.formatText(cipherText);
        List<int[]> digraphs = this.createDigraphs(cipherText);

        for (int[] digraph : digraphs) {
            plainText.append(this.getDecipher(digraph));
        }

        return plainText.toString();
    }
}
```

Output:


206 public class main {
Run main | Debug main | Run | Debug
207 public static void main(String[] args) {
208 try {
209 HillCipher hc = new HillCipher(key:"GYBNQKURP");
210 String enc = hc.encrypt(plainText:"jhbsdigsd");
211 System.out.println("encrypted : " + enc);
212 System.out.println("decrypted : " + hc.decrypt(enc));
213 } catch (Exception e) {
214 System.err.println("Error: " + e.getMessage());
215 }
216 }
217 }
PROBLEMS 11 OUTPUT DEBUG CONSOLE TERMINAL PORTS COMMENTS
PS C:\Users\GOURAB\OneDrive\Desktop\Codes\java> cd "c:\Users\GOURAB\OneDrive\Desktop\Co
va main }
encrypted : pfcgyldgd
decrypted : jhbsdigsd
PS C:\Users\GOURAB\OneDrive\Desktop\Codes\java>