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Substitution Cipher

1) Caesar Cipher:

Program:

```
//import java.system.*;
import java.util.*;

public class Caesar_Cipher{

     void shift_mod(String str,int key,int a){
               String text =
"abcdefghijklmnopqrstuvwxyz";
               int len,i=0,j,k=0,val=0;
               len = str.length();
               char[] e =new char[len+1];
               char[] d =new char[len+1];


          while(i<len)
          {
               j=text.indexOf(str.charAt(i));
               val = (j+key)%26;
               e[k] = text.charAt(val);
               i++;
               k++;
          }

          String en,de;
          for(i=len-1;i>=a;i--)
               {
                    e[i+1]=e[i];
               }
          e[a]=' ';


          en = String.valueOf(e);
          System.out.println("Encrypted Word:"+en);
          i=0;k=0;j=0;
          //String str1 = String.valueOf(e);
          String str1 = String.valueOf(e);
          String st;
          st = str1.replaceAll("\\s", "");
         st = st.toLowerCase();
```

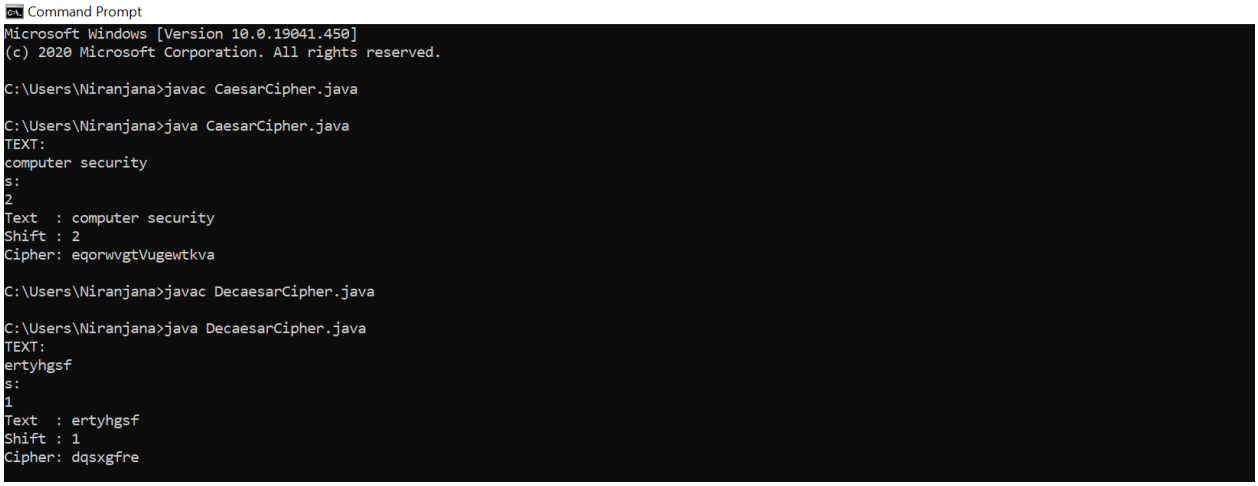
```
        while(i<len)
        {
                j=text.indexOf(st.charAt(i));
                val = (j-key)%26;
                if(val<0)
                        {
                                val = val*(-1);
                                val = 26-val;
                        }
                d[k] = text.charAt(val);
                i++;
                k++;
        }


        for(i=len-1;i>=a;i--)
                {
                        d[i+1]=d[i];
                }
        d[a]=' ';
        de = String.valueOf(d);

        System.out.println("Decrypted Word:"+de);
}

void shift(String str,int key,int a){
String text = "abcdefghijklmnopqrstuvwxyz";
                int len,i=0,j,k=0,val=0;
                len = str.length();
                char[] e =new char[len+1];
                char[] d =new char[len+1];


        while(i<len)
        {
                j=text.indexOf(str.charAt(i));
                val = (j+key);
                if(val>26)
                {
                        val = val-26;
                }
                e[k] = text.charAt(val);
                i++;
                k++;
```

```
        }

        String en,de;
        for(i=len-1;i>=a;i--)
             {
                  e[i+1]=e[i];
             }
        e[a]=' ';
        en = String.valueOf(e);
        System.out.println("Encrypted Word:"+en);
        i=0;k=0;j=0;
        String str1 = String.valueOf(e);
        String st;
        st = str1.replaceAll("\\s", "");
       st = st.toLowerCase();
        while(i<len)
        {
             j=text.indexOf(st.charAt(i));
             val = (j-key);
             if(val<0)
                  {
                       val = val*(-1);
                       val = 26-val;
                  }
             d[k] = text.charAt(val);
             i++;
             k++;
        }


        for(i=len-1;i>=a;i--)
             {
                  d[i+1]=d[i];
             }
        d[a]=' ';

        de = String.valueOf(d);

        System.out.println("Decrypted Word:"+de);
    }

void thank(){
        System.out.println("ThankYou!!!");
        System.exit(0);
```

```
     }

      public static void main(String[] args) {

          String s,str;
          int key,i;
          Caesar_Cipher cc = new Caesar_Cipher();
          char x=' ';
          int ch,op;
          do{
               System.out.println("Enter The String:");
               Scanner scan = new Scanner(System.in);
               s=scan.nextLine();
               i = s.indexOf(" ");
               str = s.replaceAll("\\s", "");
          str = str.toLowerCase();

          //System.out.println(i);
               //System.out.println(str);

               System.out.println("Enter The Key:");
               key=scan.nextInt();
               System.out.println("Enter");
               System.out.println("1.Shifting");
               System.out.println("2.Shifting Using
MOD");
               ch=scan.nextInt();
               switch(ch){

               case 1:   cc.shift(str,key,i);
                         break;
               case 2: cc.shift_mod(str,key,i);
                         break;
               case 3: cc.thank();
                         break;
               default:
                         System.out.println("Invalid
Choice");

          }

               System.out.println("Enter -1 to Exit");
               op = scan.nextInt();
```

```
                }while(op!=-1);
            }
}
```

Screenshot:



2) Vigener:

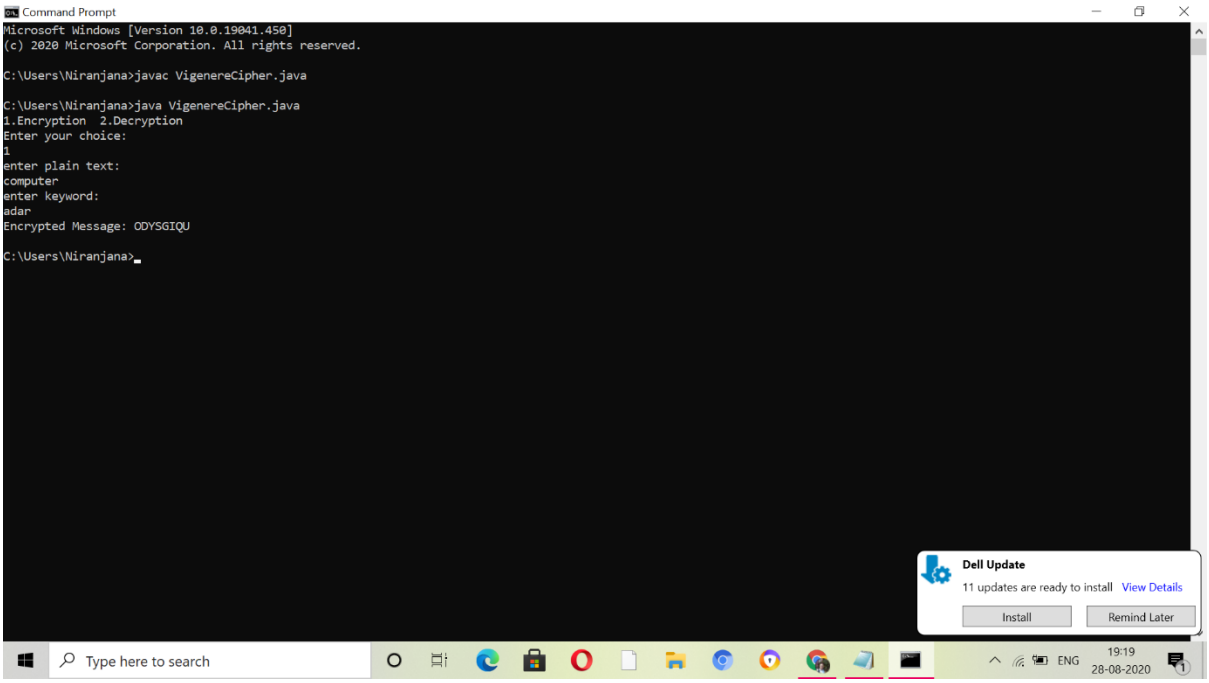
Program:

```
import java.util.*;

public class vigener{

     public static void main(String[] args){

          String text = "abcdefghijklmnopqrstuvwxyz";
               int len,len1,i=0,j=0,x=0,k=0,val=0,in=0;
               String s,str,s1,str1,en,de;
               int ch,op;
               System.out.println("Enter The String:");
               Scanner scan = new Scanner(System.in);
               s=scan.nextLine();
               str = s.replaceAll("\\s", "");
          str = str.toLowerCase();

               System.out.println("Enter The Key
Stream:");
               s1=scan.nextLine();
               str1 = s1.replaceAll("\\s", "");
          str1 = str1.toLowerCase();
          len  = str.length();
          len1 = str1.length();
```

```
char[] e =new char[len];
     char[] d =new char[len];

while(i<len)
{
     if(in<len1)
     {
          j=text.indexOf(str.charAt(i));
          x=text.indexOf(str1.charAt(in));
               val = j+x;

               if(val>=26)
                    val=val-26;
               //System.out.println(val);
               e[k] = text.charAt(val);
               i++;
               k++;
               in++;
          }

          else
               in=0;
}

en = String.valueOf(e);
     System.out.println("Encrypted Word:"+en);

     i=0;k=0;j=0;x=0;val=0;in=0;
     String str2 = String.valueOf(e);
     while(i<len)
     {
          if(in<len1)
     {
          j=text.indexOf(str2.charAt(i));
          x=text.indexOf(str1.charAt(in));
               val = j-x;

               if(val<0)
                    val=26+val;
               d[k] = text.charAt(val);
               i++;
               k++;
               in++;
          }
```

```
                    else
                        in=0;
                }

                de = String.valueOf(d);

                System.out.println("Decrypted Word:"+de);


        }

}
```

Screenshot:



3) Play Fair:

Program:

```
import java.util.Scanner;

public class playfair
{
    private String KeyWord        = new String();
    private String Key            = new String();
    private char   matrix_arr[][] = new char[5][5];

    public void setKey(String k)
    {
```

```
        String K_adjust = new String();
        boolean flag = false;
        K_adjust = K_adjust + k.charAt(0);
        for (int i = 1; i < k.length(); i++)
        {
            for (int j = 0; j < K_adjust.length(); j++)
            {
                if (k.charAt(i) == K_adjust.charAt(j))
                {
                    flag = true;
                }
            }
            if (flag == false)
                K_adjust = K_adjust + k.charAt(i);
            flag = false;
        }
        KeyWord = K_adjust;
    }

    public void KeyGen()
    {
        boolean flag = true;
        char current;
        Key = KeyWord;
        for (int i = 0; i < 26; i++)
        {
            current = (char) (i + 97);
            if (current == 'j')
                continue;
            for (int j = 0; j < KeyWord.length(); j++)
            {
                if (current == KeyWord.charAt(j))
                {
                    flag = false;
                    break;
                }
            }
            if (flag)
                Key = Key + current;
            flag = true;
        }
        System.out.println(Key);
        matrix();
    }
```

```
    private void matrix()
    {
        int counter = 0;
        for (int i = 0; i < 5; i++)
        {
            for (int j = 0; j < 5; j++)
            {
                matrix_arr[i][j] = Key.charAt(counter);
                System.out.print(matrix_arr[i][j] + " ");
                counter++;
            }
            System.out.println();
        }
    }

    private String format(String old_text)
    {
        int i = 0;
        int len = 0;
        String text = new String();
        len = old_text.length();
        for (int tmp = 0; tmp < len; tmp++)
        {
            if (old_text.charAt(tmp) == 'j')
            {
                text = text + 'i';
            }
            else
                text = text + old_text.charAt(tmp);
        }
        len = text.length();
        for (i = 0; i < len; i = i + 2)
        {
            if (text.charAt(i + 1) == text.charAt(i))
            {
                text = text.substring(0, i + 1) + 'x' +
text.substring(i + 1);
            }
        }
        return text;
    }

    private String[] Divid2Pairs(String new_string)
```

```
    {
        String Original = format(new_string);
        int size = Original.length();
        if (size % 2 != 0)
        {
            size++;
            Original = Original + 'x';
        }
        String x[] = new String[size / 2];
        int counter = 0;
        for (int i = 0; i < size / 2; i++)
        {
            x[i] = Original.substring(counter, counter +
2);
            counter = counter + 2;
        }
        return x;
    }

    public int[] GetDiminsions(char letter)
    {
        int[] key = new int[2];
        if (letter == 'j')
            letter = 'i';
        for (int i = 0; i < 5; i++)
        {
            for (int j = 0; j < 5; j++)
            {
                if (matrix_arr[i][j] == letter)
                {
                    key[0] = i;
                    key[1] = j;
                    break;
                }
            }
        }
        return key;
    }

    public String encryptMessage(String Source)
    {
        String src_arr[] = Divid2Pairs(Source);
        String Code = new String();
        char one;
```

```
    char two;
    int part1[] = new int[2];
    int part2[] = new int[2];
    for (int i = 0; i < src_arr.length; i++)
    {
        one = src_arr[i].charAt(0);
        two = src_arr[i].charAt(1);
        part1 = GetDiminsions(one);
        part2 = GetDiminsions(two);
        if (part1[0] == part2[0])
        {
            if (part1[1] < 4)
                part1[1]++;
            else
                part1[1] = 0;
            if (part2[1] < 4)
                part2[1]++;
            else
                part2[1] = 0;
        }
        else if (part1[1] == part2[1])
        {
            if (part1[0] < 4)
                part1[0]++;
            else
                part1[0] = 0;
            if (part2[0] < 4)
                part2[0]++;
            else
                part2[0] = 0;
        }
        else
        {
            int temp = part1[1];
            part1[1] = part2[1];
            part2[1] = temp;
        }
        Code = Code + matrix_arr[part1[0]][part1[1]]
                + matrix_arr[part2[0]][part2[1]];
    }
    return Code;
}

public String decryptMessage(String Code)
```

```
    {
        String Original = new String();
        String src_arr[] = Divid2Pairs(Code);
        char one;
        char two;
        int part1[] = new int[2];
        int part2[] = new int[2];
        for (int i = 0; i < src_arr.length; i++)
        {
            one = src_arr[i].charAt(0);
            two = src_arr[i].charAt(1);
            part1 = GetDiminsions(one);
            part2 = GetDiminsions(two);
            if (part1[0] == part2[0])
            {
                if (part1[1] > 0)
                    part1[1]--;
                else
                    part1[1] = 4;
                if (part2[1] > 0)
                    part2[1]--;
                else
                    part2[1] = 4;
            }
            else if (part1[1] == part2[1])
            {
                if (part1[0] > 0)
                    part1[0]--;
                else
                    part1[0] = 4;
                if (part2[0] > 0)
                    part2[0]--;
                else
                    part2[0] = 4;
            }
            else
            {
                int temp = part1[1];
                part1[1] = part2[1];
                part2[1] = temp;
            }
            Original = Original +
matrix_arr[part1[0]][part1[1]]
                    + matrix_arr[part2[0]][part2[1]];
```

```
            }
            return Original;
        }

        public static void main(String[] args)
        {
            playfair x = new playfair();
            Scanner sc = new Scanner(System.in);
            System.out.println("Enter a keyword:");
            String keyword = sc.next();
            keyword = keyword.replaceAll("\\s","");
            keyword = keyword.toLowerCase();
            x.setKey(keyword);
            x.KeyGen();
            System.out.println("Enter word to encrypt: (Make
    sure length of message is even)");
            String key_input = sc.next();
            key_input = key_input.replaceAll("\\s","");
            key_input = key_input.toLowerCase();
            if (key_input.length() % 2 == 0)
            {
                System.out.println("Encryption: " +
    x.encryptMessage(key_input));
                System.out.println("Decryption: " +
    x.decryptMessage(x.encryptMessage(key_input)));
            }
            else
            {
                System.out.println("Message length should be
    even");
            }
            sc.close();
        }
    }
```

ScreenShot:

```
C:\Users\Niranjana>javac PlayfairCipherDecryption.java

C:\Users\Niranjana>java PlayfairCipherDecryption.java
Enter a keyword:
playfair
playfirbcdeghkmnoqstuvwxz
p l a y f
i r b c d
e g h k m
n o q s t
u v w x z
Enter word to encrypt: (Make sure length of message is even)
qwer
Encryption: wagi
Decryption: qwer

C:\Users\Niranjana>
```

4) **HillCipher:**

Program:

```
import java.util.*;

import java.io.BufferedReader;
import java.io.IOException;
import java.io.InputStreamReader;

public class hillcipher {

     int[] lm;
    int[][] km;
    int[] rm;
    static int choice;
    int [][] invK;

    public void performDivision(String temp, int s)
    {
        while (temp.length() > s)
        {
            String line = temp.substring(0, s);
            temp = temp.substring(s, temp.length());
            calLineMatrix(line);
            if(choice ==1){
                multiplyLineByKey(line.length());
```

```
        }else{
            multiplyLineByInvKey(line.length());
        }
        showResult(line.length());
    }
    if (temp.length() == s){

        if(choice ==1){
        calLineMatrix(temp);
        multiplyLineByKey(temp.length());
        showResult(temp.length());
        }
        else{
            calLineMatrix(temp);
            this.multiplyLineByInvKey(temp.length());
            showResult(temp.length());
        }
    }
    else if (temp.length() < s)
    {
        for (int i = temp.length(); i < s; i++)
            temp = temp + 'x';
        if(choice ==1){
        calLineMatrix(temp);
        multiplyLineByKey(temp.length());
        showResult(temp.length());
        }
        else{
            calLineMatrix(temp);
            multiplyLineByInvKey(temp.length());
            showResult(temp.length());
        }
    }
}


public void calKeyMatrix(String key, int len)
{
    km = new int[len][len];
    int k = 0;
    for (int i = 0; i < len; i++)
    {
        for (int j = 0; j < len; j++)
        {
```

```
            km[i][j] = ((int) key.charAt(k)) - 97;
            k++;
        }
    }
}

public void calLineMatrix(String line)
{
    lm = new int[line.length()];
    for (int i = 0; i < line.length(); i++)
    {
        lm[i] = ((int) line.charAt(i)) - 97;
    }
}

public void multiplyLineByKey(int len)
{
    rm = new int[len];
    for (int i = 0; i < len; i++)
    {
        for (int j = 0; j < len; j++)
        {
            rm[i] += km[i][j] * lm[j];
        }
        rm[i] %= 26;
    }
}
public void multiplyLineByInvKey(int len)
{

    rm = new int[len];
    for (int i = 0; i < len; i++)
    {
        for (int j = 0; j < len; j++)
        {
            rm[i] += invK[i][j] * lm[j];
        }
        rm[i] %= 26;
    }
}


public void showResult(int len)
{
```

```
        String result = "";
        for (int i = 0; i < len; i++)
        {
            result += (char) (rm[i] + 97);
        }
        System.out.print(result);
    }



    public int calDeterminant(int A[][], int N)
    {
        int resultOfDet;
        switch (N) {
            case 1:
                resultOfDet = A[0][0];
                break;
            case 2:
                resultOfDet = A[0][0] * A[1][1] - A[1][0]
* A[0][1];
                break;
            default:
                resultOfDet = 0;
                for (int j1 = 0; j1 < N; j1++)
                {
                    int m[][] = new int[N - 1][N - 1];
                    for (int i = 1; i < N; i++)
                    {
                        int j2 = 0;
                        for (int j = 0; j < N; j++)
                        {
                            if (j == j1)
                                continue;
                            m[i - 1][j2] = A[i][j];
                            j2++;
                        }
                    }
                    resultOfDet += Math.pow(-1.0, 1.0 +
j1 + 1.0) * A[0][j1]
                            * calDeterminant(m, N - 1);
                }   break;
        }
        return resultOfDet;
    }
```

```
    public void cofact(int num[][], int f)
    {
        int b[][], fac[][];
        b = new int[f][f];
        fac = new int[f][f];
        int p, q, m, n, i, j;
        for (q = 0; q < f; q++)
        {
            for (p = 0; p < f; p++)
            {
                m = 0;
                n = 0;
                for (i = 0; i < f; i++)
                {
                    for (j = 0; j < f; j++)
                    {
                        b[i][j] = 0;
                        if (i != q && j != p)
                        {
                            b[m][n] = num[i][j];
                            if (n < (f - 2))
                                n++;
                            else
                            {
                                n = 0;
                                m++;
                            }
                        }
                    }
                }
                fac[q][p] = (int) Math.pow(-1, q + p) *
calDeterminant(b, f - 1);
            }
        }
        trans(fac, f);
    }

    void trans(int fac[][], int r)
    {
        int i, j;
        int b[][], inv[][];
        b = new int[r][r];
        inv = new int[r][r];
```

```
    int d = calDeterminant(km, r);
    int mi = mi(d % 26);
    mi %= 26;
    if (mi < 0)
        mi += 26;
    for (i = 0; i < r; i++)
    {
        for (j = 0; j < r; j++)
        {
            b[i][j] = fac[j][i];
        }
    }
    for (i = 0; i < r; i++)
    {
        for (j = 0; j < r; j++)
        {
            inv[i][j] = b[i][j] % 26;
            if (inv[i][j] < 0)
                inv[i][j] += 26;
            inv[i][j] *= mi;
            inv[i][j] %= 26;
        }
    }
    //System.out.println("\nInverse key:");
    //matrixtoinvkey(inv, r);

    invK = inv;
}

public int mi(int d)
{
    int q, r1, r2, r, t1, t2, t;
    r1 = 26;
    r2 = d;
    t1 = 0;
    t2 = 1;
    while (r1 != 1 && r2 != 0)
    {
        q = r1 / r2;
        r = r1 % r2;
        t = t1 - (t2 * q);
        r1 = r2;
        r2 = r;
        t1 = t2;
```

```
            t2 = t;
        }
        return (t1 + t2);
    }

    public void matrixtoinvkey(int inv[][], int n)
    {
        String invkey = "";
        for (int i = 0; i < n; i++)
        {
            for (int j = 0; j < n; j++)
            {
                invkey += (char) (inv[i][j] + 97);
            }
        }
        System.out.print(invkey);
    }
     public boolean check(String key, int len)
    {
        calKeyMatrix(key, len);
        int d = calDeterminant(km, len);
        d = d % 26;
        if (d == 0)
        {
            System.out.println("Key is not invertible");
            return false;
        }
        else if (d % 2 == 0 || d % 13 == 0)
        {
            System.out.println("Key is not invertible");
            return false;
        }
        else
        {
            return true;
        }
    }

    public static void main(String args[]) throws
IOException
    {
        hillcipher obj = new hillcipher();
        BufferedReader in = new BufferedReader(new
InputStreamReader(System.in));
```

```
        System.out.println("Menu:\n1: Encryption\n2:
Decryption");
        choice = Integer.parseInt(in.readLine());
        System.out.println("Enter the line: ");
        String line = in.readLine();
        System.out.println("Enter the key: ");
        String key = in.readLine();
        double sq = Math.sqrt(key.length());
        if (sq != (long) sq)
            System.out.println("Cannot Form a square
matrix");
        else
        {
            int size = (int) sq;
            if (obj.check(key, size))
            {

                System.out.println("Result:");
                obj.cofact(obj.km, size);
                obj.performDivision(line, size);


            }
        }
    }
}
```

ScreenShot:

```
C:\Users\Niranjana>java hillcipher
Menu:
1: Encryption
2: Decryption
1
Enter the line:
help
Enter the key:
ddcf
Result:
hiat
C:\Users\Niranjana>java hillcipher
Menu:
1: Encryption
2: Decryption
2
Enter the line:
hiat
Enter the key:
ddcf
Result:
help
```

5) **OTP:**

Program:

```
import java.util.*;

public class OTPCipher{
   public static void main(String[] args){
      String text ;
      Scanner scan = new Scanner(System.in);
      System.out.println("Enter a plain text");
      text =  scan.next();
      System.out.println("Enter the key");

      //String key = RandomAlpha(text.length());
      String key = scan.next();


      String enc = OTPEncryption(text,key);
      System.out.println("Plaintext : "+text);
      System.out.println("Encrypted : "+enc);
      System.out.println("Decrypted :
"+OTPDecryption(enc,key));
   }

   public static String RandomAlpha(int len){
      Random r = new Random();
      String key = "";
      for(int x=0;x<len;x++)
         key = key + (char) (r.nextInt(26) + 'A');
      return key;
   }

   public static String OTPEncryption(String text,String
key){
      String alphaU = "ABCDEFGHIJKLMNOPQRSTUVWXYZ";
      String alphaL = "abcdefghijklmnopqrstuvwxyz";

      int len = text.length();

      String sb = "";
      for(int x=0;x<len;x++){
         char get = text.charAt(x);
         char keyget = key.charAt(x);
         if(Character.isUpperCase(get)){
```

```
            int index = alphaU.indexOf(get);
            int keydex =
alphaU.indexOf(Character.toUpperCase(keyget));

            int total = (index + keydex) % 26;

            sb = sb+ alphaU.charAt(total);
         }
         else if(Character.isLowerCase(get)){
            int index = alphaL.indexOf(get);
            int keydex =
alphaU.indexOf(Character.toLowerCase(keyget));

            int total = (index + keydex) % 26;

            sb = sb+ alphaL.charAt(total);
         }
         else{
            sb = sb + get;
         }
      }

      return sb;
   }
   public static String OTPDecryption(String text,String
key){
      String alphaU = "ABCDEFGHIJKLMNOPQRSTUVWXYZ";
      String alphaL = "abcdefghijklmnopqrstuvwxyz";

      int len = text.length();

      String sb = "";
      for(int x=0;x<len;x++){
         char get = text.charAt(x);
         char keyget = key.charAt(x);
         if(Character.isUpperCase(get)){
            int index = alphaU.indexOf(get);
            int keydex =
alphaU.indexOf(Character.toUpperCase(keyget));

            int total = (index - keydex) % 26;
            total = (total<0)? total + 26 : total;

            sb = sb+ alphaU.charAt(total);
```

```
            }
            else if(Character.isLowerCase(get)){
                int index = alphaL.indexOf(get);
                int keydex =
alphaU.indexOf(Character.toLowerCase(keyget));

                int total = (index - keydex) % 26;
                total = (total<0)? total + 26 : total;

                sb = sb+ alphaL.charAt(total);
            }
            else{
                sb = sb + get;
            }
        }

        return sb;
    }

}
```

ScreenShot:

```
C:\Users\Niranjana>javac OTPCipher.java

C:\Users\Niranjana>java OTPCipher
Enter a plain text
HELLO
Enter the key
XMCKL
Plaintext : HELLO
Encrypted : EQNVZ
Decrypted : HELLO
```