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Niranjana S

Data Encryption Standard(DES)

Program:

```
import java.util.*;

class Main {
     private static class DES {

          int[] IP = { 58, 50, 42, 34, 26, 18,
                         10, 2, 60, 52, 44, 36, 28, 20,
                         12, 4, 62, 54, 46, 38,
                         30, 22, 14, 6, 64, 56,
                         48, 40, 32, 24, 16, 8,
                         57, 49, 41, 33, 25, 17,
                         9, 1, 59, 51, 43, 35, 27,
                         19, 11, 3, 61, 53, 45,
                         37, 29, 21, 13, 5, 63, 55,
                         47, 39, 31, 23, 15, 7 };


          int[] IP1 = { 40, 8, 48, 16, 56, 24, 64,
                         32, 39, 7, 47, 15, 55,
                         23, 63, 31, 38, 6, 46,
                         14, 54, 22, 62, 30, 37,
                         5, 45, 13, 53, 21, 61,
                         29, 36, 4, 44, 12, 52,
                         20, 60, 28, 35, 3, 43,
                         11, 51, 19, 59, 27, 34,
                         2, 42, 10, 50, 18, 58,
                         26, 33, 1, 41, 9, 49,
                         17, 57, 25 };


          int[] PC1 = { 57, 49, 41, 33, 25,
                         17, 9, 1, 58, 50, 42, 34, 26,
                         18, 10, 2, 59, 51, 43, 35, 27,
                         19, 11, 3, 60, 52, 44, 36, 63,
                         55, 47, 39, 31, 23, 15, 7, 62,
                         54, 46, 38, 30, 22, 14, 6, 61,
                         53, 45, 37, 29, 21, 13, 5, 28,
                         20, 12, 4 };

          int[] PC2 = { 14, 17, 11, 24, 1, 5, 3,
                         28, 15, 6, 21, 10, 23, 19, 12,
                         4, 26, 8, 16, 7, 27, 20, 13, 2,
                         41, 52, 31, 37, 47, 55, 30, 40,
                         51, 45, 33, 48, 44, 49, 39, 56,
                         34, 53, 46, 42, 50, 36, 29, 32 };
```

```
        int[] EP = { 32, 1, 2, 3, 4, 5, 4,
                     5, 6, 7, 8, 9, 8, 9, 10,
                     11, 12, 13, 12, 13, 14, 15,
                     16, 17, 16, 17, 18, 19, 20,
                     21, 20, 21, 22, 23, 24, 25,
                     24, 25, 26, 27, 28, 29, 28,
                     29, 30, 31, 32, 1 };

        int[] P = { 16, 7, 20, 21, 29, 12, 28,
                    17, 1, 15, 23, 26, 5, 18,
                    31, 10, 2, 8, 24, 14, 32,
                    27, 3, 9, 19, 13, 30, 6,
                    22, 11, 4, 25 };

        int[][][] sbox = {
             { { 14, 4, 13, 1, 2, 15, 11, 8, 3, 10, 6, 12, 5, 9,
0, 7 },
               { 0, 15, 7, 4, 14, 2, 13, 1, 10, 6, 12, 11, 9, 5, 3,
8 },
               { 4, 1, 14, 8, 13, 6, 2, 11, 15, 12, 9, 7, 3, 10, 5,
0 },
               { 15, 12, 8, 2, 4, 9, 1, 7, 5, 11, 3, 14, 10, 0, 6,
13 } },

               { { 15, 1, 8, 14, 6, 11, 3, 4, 9, 7, 2, 13, 12, 0,
5, 10 },
               { 3, 13, 4, 7, 15, 2, 8, 14, 12, 0, 1, 10, 6, 9, 11,
5 },
               { 0, 14, 7, 11, 10, 4, 13, 1, 5, 8, 12, 6, 9, 3, 2,
15 },
               { 13, 8, 10, 1, 3, 15, 4, 2, 11, 6, 7, 12, 0, 5, 14,
9 } },
               { { 10, 0, 9, 14, 6, 3, 15, 5, 1, 13, 12, 7, 11, 4,
2, 8 },
               { 13, 7, 0, 9, 3, 4, 6, 10, 2, 8, 5, 14, 12, 11, 15,
1 },
               { 13, 6, 4, 9, 8, 15, 3, 0, 11, 1, 2, 12, 5, 10, 14,
7 },
               { 1, 10, 13, 0, 6, 9, 8, 7, 4, 15, 14, 3, 11, 5, 2,
12 } },
               { { 7, 13, 14, 3, 0, 6, 9, 10, 1, 2, 8, 5, 11, 12,
4, 15 },
               { 13, 8, 11, 5, 6, 15, 0, 3, 4, 7, 2, 12, 1, 10, 14,
9 },
               { 10, 6, 9, 0, 12, 11, 7, 13, 15, 1, 3, 14, 5, 2, 8,
4 },
```

```
                { 3, 15, 0, 6, 10, 1, 13, 8, 9, 4, 5, 11, 12, 7, 2,
14 } },
                { { 2, 12, 4, 1, 7, 10, 11, 6, 8, 5, 3, 15, 13, 0,
14, 9 },
                { 14, 11, 2, 12, 4, 7, 13, 1, 5, 0, 15, 10, 3, 9, 8,
6 },
                { 4, 2, 1, 11, 10, 13, 7, 8, 15, 9, 12, 5, 6, 3, 0,
14 },
                { 11, 8, 12, 7, 1, 14, 2, 13, 6, 15, 0, 9, 10, 4, 5,
3 } },
                { { 12, 1, 10, 15, 9, 2, 6, 8, 0, 13, 3, 4, 14, 7,
5, 11 },
                { 10, 15, 4, 2, 7, 12, 9, 5, 6, 1, 13, 14, 0, 11, 3,
8 },
                { 9, 14, 15, 5, 2, 8, 12, 3, 7, 0, 4, 10, 1, 13, 11,
6 },
                { 4, 3, 2, 12, 9, 5, 15, 10, 11, 14, 1, 7, 6, 0, 8,
13 } },
                { { 4, 11, 2, 14, 15, 0, 8, 13, 3, 12, 9, 7, 5, 10,
6, 1 },
                { 13, 0, 11, 7, 4, 9, 1, 10, 14, 3, 5, 12, 2, 15, 8,
6 },
                { 1, 4, 11, 13, 12, 3, 7, 14, 10, 15, 6, 8, 0, 5, 9,
2 },
                { 6, 11, 13, 8, 1, 4, 10, 7, 9, 5, 0, 15, 14, 2, 3,
12 } },
                { { 13, 2, 8, 4, 6, 15, 11, 1, 10, 9, 3, 14, 5, 0,
12, 7 },
                { 1, 15, 13, 8, 10, 3, 7, 4, 12, 5, 6, 11, 0, 14, 9,
2 },
                { 7, 11, 4, 1, 9, 12, 14, 2, 0, 6, 10, 13, 15, 3, 5,
8 },
                { 2, 1, 14, 7, 4, 10, 8, 13, 15, 12, 9, 0, 3, 5, 6,
11 } }
          };
          int[] shiftBits = { 1, 1, 2, 2, 2, 2, 2, 2,
                                    1, 2, 2, 2, 2, 2, 2, 1 };


          String hextoBin(String input)
          {
               int n = input.length() * 4;
               input = Long.toBinaryString(
                    Long.parseUnsignedLong(input, 16));
               while (input.length() < n)
                    input = "0" + input;
               return input;
```

```
}


String binToHex(String input)
{
      int n = (int)input.length() / 4;
      input = Long.toHexString(
            Long.parseUnsignedLong(input, 2));
      while (input.length() < n)
            input = "0" + input;
      return input;
}

String permutation(int[] sequence, String input)
{
      String output = "";
      input = hextoBin(input);
      for (int i = 0; i < sequence.length; i++)
            output += input.charAt(sequence[i] - 1);
      output = binToHex(output);
      return output;
}


String xor(String a, String b)
{

      long t_a = Long.parseUnsignedLong(a, 16);

      long t_b = Long.parseUnsignedLong(b, 16);

      t_a = t_a ^ t_b;

      a = Long.toHexString(t_a);

      while (a.length() < b.length())
            a = "0" + a;
      return a;
}


String leftCircularShift(String input, int numBits)
{
      int n = input.length() * 4;
      int perm[] = new int[n];
      for (int i = 0; i < n - 1; i++)
            perm[i] = (i + 2);
```

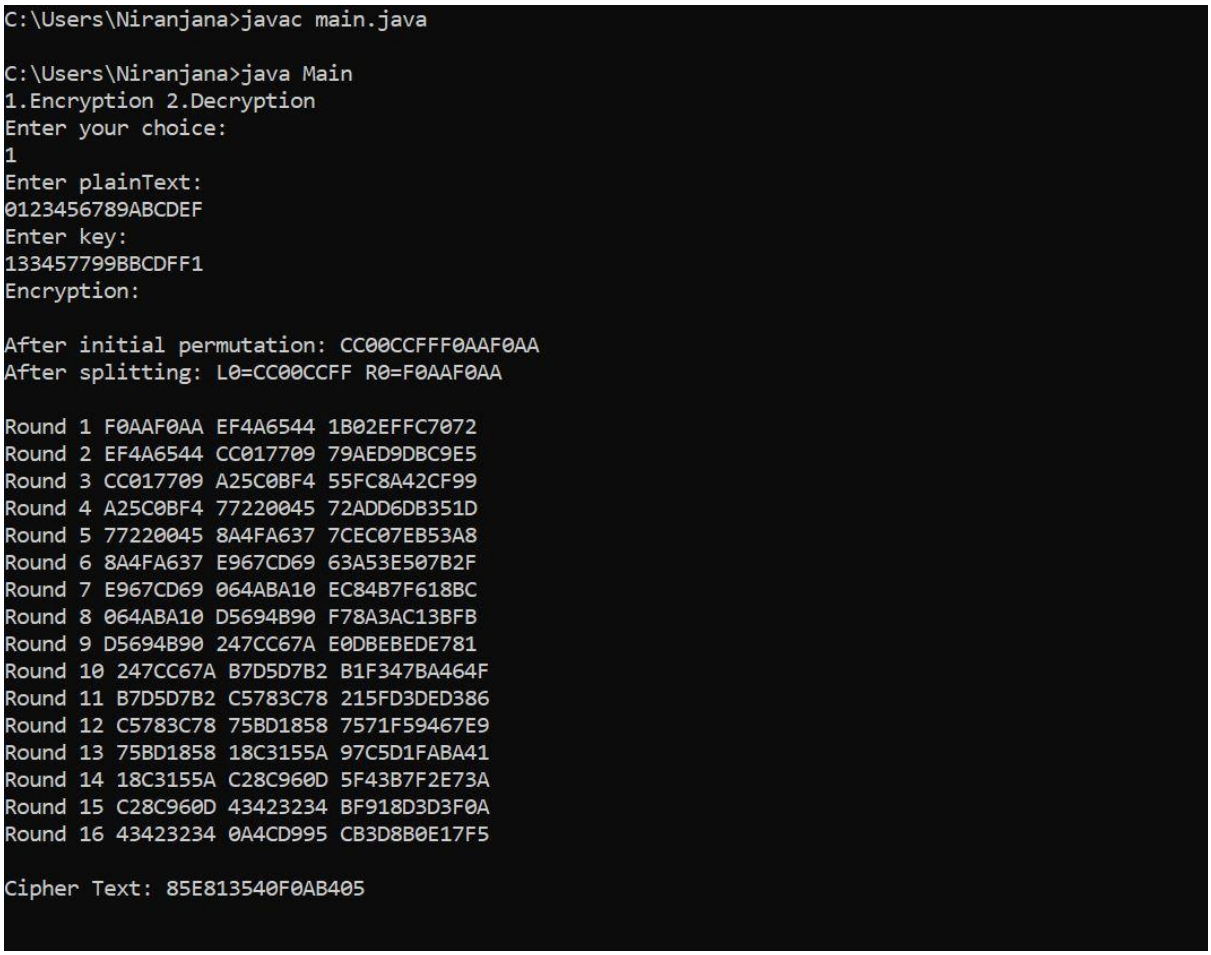
```
            perm[n - 1] = 1;
            while (numBits-- > 0)
                  input = permutation(perm, input);
            return input;
      }


      String[] getKeys(String key)
      {
            String keys[] = new String[16];

            key = permutation(PC1, key);
            for (int i = 0; i < 16; i++) {
                  key = leftCircularShift(
                              key.substring(0, 7), shiftBits[i])
                        + leftCircularShift(key.substring(7, 14),

shiftBits[i]);

                  keys[i] = permutation(PC2, key);
            }
            return keys;
      }


      String sBox(String input)
      {
            String output = "";
            input = hextoBin(input);
            for (int i = 0; i < 48; i += 6) {
                  String temp = input.substring(i, i + 6);
                  int num = i / 6;
                  int row = Integer.parseInt(
                        temp.charAt(0) + "" + temp.charAt(5), 2);
                  int col = Integer.parseInt(
                        temp.substring(1, 5), 2);
                  output += Integer.toHexString(
                        sbox[num][row][col]);
            }
            return output;
      }

      String round(String input, String key, int num)
      {

            String left = input.substring(0, 8);
            String temp = input.substring(8, 16);
```

```
            String right = temp;

            temp = permutation(EP, temp);

            temp = xor(temp, key);

            temp = sBox(temp);

            temp = permutation(P, temp);

            left = xor(left, temp);
            System.out.println("Round "
                               + (num + 1) + " "
                               + right.toUpperCase()
                           + " " + left.toUpperCase() + " "
                               + key.toUpperCase());


            return right + left;
      }

      String encrypt(String plainText, String key)
      {
            int i;

            String keys[] = getKeys(key);


            plainText = permutation(IP, plainText);
            System.out.println(
                  "After initial permutation: "
                  + plainText.toUpperCase());
            System.out.println(
                  "After splitting: L0="
                  + plainText.substring(0, 8).toUpperCase()
                  + " R0="
                  + plainText.substring(8, 16).toUpperCase() +
"\n");


            for (i = 0; i < 16; i++) {
                  plainText = round(plainText, keys[i], i);
            }


            plainText = plainText.substring(8, 16)
                           + plainText.substring(0, 8);
```

```
                plainText = permutation(IP1, plainText);
                return plainText;
          }

          String decrypt(String plainText, String key)
          {
                int i;

                String keys[] = getKeys(key);


                plainText = permutation(IP, plainText);
                System.out.println(
                      "After initial permutation: "
                      + plainText.toUpperCase());
                System.out.println(
                      "After splitting: L0="
                      + plainText.substring(0, 8).toUpperCase()
                      + " R0=" + plainText.substring(8,
16).toUpperCase()
                      + "\n");


                for (i = 15; i > -1; i--) {
                      plainText = round(plainText, keys[i], 15 - i);
                }


                plainText = plainText.substring(8, 16)
                                  + plainText.substring(0, 8);
                plainText = permutation(IP1, plainText);
                return plainText;
          }
     }
     public static void main(String args[])
     {
          /*String text = "0123456789ABCDEF";
          String key = "133457799BBCDFF1";*/

          String text,key;
          Scanner scan = new Scanner(System.in);
          System.out.println("Enter plainText");
          text = scan.nextLine();
          System.out.println("Enter Key");
          key = scan.nextLine();
```

```
            DES cipher = new DES();
            System.out.println("Encryption:\n");
            text = cipher.encrypt(text, key);
            System.out.println(
                  "\nCipher Text: " + text.toUpperCase() + "\n");
            System.out.println("Decryption\n");
            text = cipher.decrypt(text, key);
            System.out.println(
                  "\nPlain Text: "
                  + text.toUpperCase());
      }
}
```

ScreenShot:



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Niranjana S

```
C:\Users\Niranjana>java Main
1.Encryption 2.Decryption
Enter your choice:
2
Enter CipherText:
85E813540F0AB405
Enter key:
133457799BBCDFF1
Encryption:

After initial permutation: 0A4CD99543423234
After splitting: L0=0A4CD995 R0=43423234

Round 1 43423234 C28C960D CB3D8B0E17F5
Round 2 C28C960D 18C3155A BF918D3D3F0A
Round 3 18C3155A 75BD1858 5F43B7F2E73A
Round 4 75BD1858 C5783C78 97C5D1FABA41
Round 5 C5783C78 B7D5D7B2 7571F59467E9
Round 6 B7D5D7B2 247CC67A 215FD3DED386
Round 7 247CC67A D5694B90 B1F347BA464F
Round 8 D5694B90 064ABA10 E0DBEBEDE781
Round 9 064ABA10 E967CD69 F78A3AC13BFB
Round 10 E967CD69 8A4FA637 EC84B7F618BC
Round 11 8A4FA637 77220045 63A53E507B2F
Round 12 77220045 A25C0BF4 7CEC07EB53A8
Round 13 A25C0BF4 CC017709 72ADD6DB351D
Round 14 CC017709 EF4A6544 55FC8A42CF99
Round 15 EF4A6544 F0AAF0AA 79AED9DBC9E5
Round 16 F0AAF0AA CC00CCFF 1B02EFFC7072

 PlainText: 0123456789ABCDEF
```