**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:**



