

# BLOWFISH

## Java code

```
public class BlowFish {

    // Subkeys initialisation with digits of pi.
    String P[] = { "243f6a88", "85a308d3", "13198a2e", "03707344", "a4093822",
        "299f31d0", "082efa98", "ec4e6c89", "452821e6", "38d01377",
        "be5466cf", "34e90c6c", "c0ac29b7", "c97c50dd", "3f84d5b5",
        "b5470917", "9216d5d9", "8979fb1b" };

    String S[][] = {
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```

```
// to store 2^32(for addition modulo 2^32).
```

```
long modVal = 1;
```

```
// to convert hexadecimal to binary.
```

```
private String hexToBin(String plainText) {
```

```
String binary = "";
```

```
Long num;
```

```
String binary4B;
```



```

int n = plainText.length();

for (int i = 0; i < n; i++) {

    num = Long.parseUnsignedLong(plainText.charAt(i) + "", 16);
    binary4B = Long.toBinaryString(num);

    // each value in hexadecimal is 4 bits in binary.
    binary4B = "0000" + binary4B;

    binary4B = binary4B.substring(binary4B.length() - 4);
    binary += binary4B;
}

return binary;
}

// convert from binary to hexadecimal.
private String binToHex(String plainText) {

    long num = Long.parseUnsignedLong(plainText, 2);
    String hexa = Long.toHexString(num);

    while (hexa.length() < (plainText.length() / 4))

        // maintain output length same length
        // as input by appending leading zeroes.
        hexa = "0" + hexa;

    return hexa;
}

```

```

// xor two hexadecimal strings of the same length.

private String xor(String a, String b) {

    a = hexToBin(a);
    b = hexToBin(b);

    String ans = "";

    for (int i = 0; i < a.length(); i++)

        ans += (char) (((a.charAt(i) - '0') ^ (b.charAt(i) - '0')) + '0');

    ans = binToHex(ans);

    return ans;

}


// addition modulo  $2^{32}$  of two hexadecimal strings.

private String addBin(String a, String b) {

    String ans = "";

    long n1 = Long.parseUnsignedLong(a, 16);
    long n2 = Long.parseUnsignedLong(b, 16);

    n1 = (n1 + n2) % modVal;

    ans = Long.toHexString(n1);

    ans = "00000000" + ans;

    return ans.substring(ans.length() - 4);

}


// function F explained above.

private String f(String plainText) {

    String a[] = new String[4];

    String ans = "";

    for (int i = 0; i < 4; i++) {

```

```

String aString = plainText.substring(i, i + 1);

// the column number for S-box

// is 8-bit value(8*4 = 32 bit plain text)

long col = Long.parseUnsignedLong(hexToBin(aString), 2);

a[i] = S[i][(int) col];
}

ans = addBin(a[0], a[1]);

ans = xor(ans, a[2]);

ans = addBin(ans, a[3]);

return ans;
}

// generate subkeys.

private void keyGenerate(String key) {

int j = 0;

for (int i = 0; i < P.length; i++) {

// xor-ing 32-bit parts of the key

// with initial subkeys.

String substring = key.substring(j, j + 8);

P[i] = xor(P[i], substring);

j = (j + 8) % key.length();

}

}

// round function

private String round(int time, String plainText) {

String left, right;

```

```

left = plainText.substring(0, 4);
right = plainText.substring(4, 8);
left = xor(left, P[time]);

// output from F function
String fOut = f(left);

right = xor(fOut, right);

//System.out.println("round " + time + ": " + right + left);

// swap left and right
return right + left;
}

// encryption
private String encrypt(String plainText) {
    StringBuilder builder = new StringBuilder();
    int index = 0;

    System.out.println("Original String = " + plainText);
    System.out.println("Length of original string = " + plainText.length());

    // do padding with 0
    int paddingLength = 8 - (plainText.length() % 8);
    for (int i = 0; i < paddingLength; i++) {
        plainText = plainText + "0";
    }
}

```

```

while (index < plainText.length()) {
    String originalPlainTextBlock = plainText.substring(index, index + 8);
    String plainTextBlock = plainText.substring(index, index + 8);
    // Do the XOR operations on left and right 16 times with swapping
    for (int i = 0; i < 16; i++) {
        plainTextBlock = round(i, plainTextBlock);
    }

    // postprocessing
    String right = plainTextBlock.substring(0, 4);
    String left = plainTextBlock.substring(4, 8);
    right = xor(right, P[16]);
    left = xor(left, P[17]);

    builder.append(left + right);

    System.out.println("Plain text block = " + originalPlainTextBlock +
        "\nEncrypted value = " + (left+right));

    index = index + 8;
}

return builder.toString();
}

BlowFish() {
    // storing 2^32 in modVal
    // (<<1 is equivalent to multiply by 2)

```

```
for (int i = 0; i < 32; i++)

modVal = modVal << 1;


// Convert plain text to hexadecimal first - Hex of "Samarth Venkatesh Gowda"
String plainText = "53616d617274682056656e6b617465737420476f776461";


// Key has to be minimum 32 bits (8 bytes or 8 characters) and max 448 (56
characters) and should be multiples of 8


String key = "696c6f7665696e646961AAAA";


keyGenerate(key);


System.out.println("-----Encryption-----");

String cipherText = encrypt(plainText);

System.out.println("Cipher Text: " + cipherText);

}


public static void main(String args[]) {

new BlowFish();

}

}


// SAMARTH VENKATESH GOWDA
```