

CRYPTOGRAPHY & NETWORK SECURITY LAB

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1. XOR a string with a Zero

AIM: Write a C program that contains a string (char pointer) with a value \Hello World'. The program should XOR each character in this string with 0 and display the result.

PROGRAM:

```
#include<stdlib.h>
main()
{
char str[]="Hello World";
char str1[11];
int i,len;
len=strlen(str);
for(i=0;i<len;i++)
{
str1[i]=str[i]^0;
printf("%c",str1[i]);
}
printf("\n");
}
```

Output:

Hello World

Hello World

2. XOR a string with a 127

AIM: Write a C program that contains a string (char pointer) with a value 'Hello World'. The program should AND or and XOR each character in this string with 127 and display the result.

PROGRAM:

```
#include <stdio.h>
#include<stdlib.h>
void main()
{
    char str[]="Hello World";
    char str1[11];
    char str2[11]=str[];
    int i,len;
    len = strlen(str);

    for(i=0;i<len;i++)
    {
        str1[i] = str[i]&127;
        printf("%c",str1[i]);
    }

    printf("\n");
    for(i=0;i<len;i++)
    {
        str3[i] = str2[i]^127;
        printf("%c",str3[i]);
    }

    printf("\n");
}
```

Output:

Hello World

Hello World

Hello World

3. Encryption & Decryption using Cipher Algorithms

AIM: Write a Java program to perform encryption and decryption using the following algorithms:

- a) Ceaser Cipher
- b) Substitution Cipher
- c) Hill Cipher

PROGRAM:

d) Ceaser Cipher

```
import java.io.BufferedReader;
import java.io.IOException;
import java.io.InputStreamReader;
import java.util.Scanner;

public class CeaserCipher {

    static Scanner sc=new Scanner(System.in);
    static BufferedReader br = new BufferedReader(new InputStreamReader(System.in));

    public static void main(String[] args) throws IOException {
        // TODO code application logic here

        System.out.print("Enter any String: ");
        String str = br.readLine();
        System.out.print("\nEnter the Key: ");
        int key = sc.nextInt();

        String encrypted = encrypt(str, key);
        System.out.println("\nEncrypted String is: " +encrypted);

        String decrypted = decrypt(encrypted, key);
        System.out.println("\nDecrypted String is: "
        +decrypted); System.out.println("\n");
    }

    public static String encrypt(String str, int key)
```

```

        { String encrypted = "";
for(int i = 0; i < str.length(); i++) {
int c = str.charAt(i);
if (Character.isUpperCase(c)) {
    c = c + (key % 26);
if (c > 'Z')
    c = c - 26;
}
else if (Character.isLowerCase(c)) {
    c = c + (key % 26);
if (c > 'z')
    c = c - 26;
}
encrypted += (char) c;
}
return encrypted;
}

public static String decrypt(String str, int key)
{ String decrypted = "";
for(int i = 0; i < str.length(); i++) {
int c = str.charAt(i);
if (Character.isUpperCase(c)) {
    c = c - (key % 26);
if (c < 'A')
    c = c + 26;
}
else if (Character.isLowerCase(c)) {
    c = c - (key % 26);
if (c < 'a')
    c = c + 26;
}
}
}

```

```
decrypted += (char) c;  
    }  
return decrypted;  
}  
}
```

Output:

Enter any String: Hello World

Enter the Key: 5

Encrypted String is: MjqqtBtwqi

Decrypted String is: Hello World

b) Substitution Cipher**PROGRAM:**

```

import java.io.*;
import java.util.*;

public class SubstitutionCipher {
    static Scanner sc = new Scanner(System.in);
    static BufferedReader br = new BufferedReader(new InputStreamReader(System.in));
    public static void main(String[] args) throws IOException {
        // TODO code application logic here
        String a = "abcdefghijklmnopqrstuvwxyz";
        String b = "zyxwvutsrqponmlkjihgfedcba";

        System.out.print("Enter any string: ");
        String str = br.readLine();
        String decrypt = "";
        char c;
        for(int i=0;i<str.length();i++)
        {
            c = str.charAt(i);
            int j = a.indexOf(c);
            decrypt = decrypt+b.charAt(j);
        }
        System.out.println("The encrypted data is: " +decrypt);
    }
}

```

Output:

Enter any string: aceho

The encrypted data is: zxvsl

a) Hill Cipher**PROGRAM:**

```

import java.io.*;
import java.util.*;
import java.io.*; public
class HillCipher {
static float[][] decrypt = new float[3][1];
static float[][] a = new float[3][3]; static
float[][] b = new float[3][3]; static
float[][] mes = new float[3][1]; static
float[][] res = new float[3][1];
static BufferedReader br = new BufferedReader(new
InputStreamReader(System.in)); static Scanner sc = new Scanner(System.in);
public static void main(String[] args) throws IOException {
    // TODO code application
    logic here getkeymes();
    for(int i=0;i<3;i++) for(int j=0;j<1;j++)
    for(int k=0;k<3;k++) {
        res[i][j]=res[i][j]+a[i][k]*mes[k][j]; }
    System.out.print("\nEncrypted string is :
"); for(int i=0;i<3;i++) {
        System.out.print((char)(res[i][0]%26+97));
        res[i][0]=res[i][0];

    }
    inverse();
    for(int i=0;i<3;i++)
    for(int j=0;j<1;j++)
    for(int k=0;k<3;k++) {
        decrypt[i][j] = decrypt[i][j]+b[i][k]*res[k][j]; }
    System.out.print("\nDecrypted string is : ");

```



```

for(int i=0;i<3;i++){
    System.out.print((char)(decrypt[i][0]%26+97));
        }
    System.out.print("\n");
        }
    public static void getkeymes() throws IOException {
        System.out.println("Enter 3x3 matrix for key (It should be inversible): ");
        for(int i=0;i<3;i++)
            for(int j=0;j<3;j++)
                a[i][j] = sc.nextFloat();
        System.out.print("\nEnter a 3 letter string: ");
        String msg = br.readLine();
        for(int i=0;i<3;i++)
            mes[i][0] = msg.charAt(i)-97;
        }
    public static void inverse() {
        float p,q;
        float[][] c = a;
        for(int i=0;i<3;i++)
            for(int j=0;j<3;j++) {
                // a[i][j]=sc.nextFloat();
                if(i==j)
                    b[i][j]=1;
                else b[i][j]=0;
            }
        for(int k=0;k<3;k++) {
            for(int i=0;i<3;i++) {
                p = c[i][k];
                q = c[k][k];
                for(int j=0;j<3;j++) {
                    if(i!=k) {

```

```

c[i][j] = c[i][j]*q-p*c[k][j];
b[i][j] = b[i][j]*q-p*b[k][j];
        } } } }
for(int i=0;i<3;i++)
for(int j=0;j<3;j++) {
b[i][j] = b[i][j]/c[i][i]; }

System.out.println("");
System.out.println("\nInverse Matrix is : ");
for(int i=0;i<3;i++) {
for(int j=0;j<3;j++)
System.out.print(b[i][j] + " ");
System.out.print("\n"); }
    } }

```

Output:

Enter a 3 letter string: hai

Encrypted string is :fdx

Inverse Matrix is :

```

0.083333336 0.41666666 -0.33333334
-0.41666666 -0.083333336 0.66666667
0.58333333 -0.083333336 -0.33333334

```

Decrypted string is: hai

4. Java program for DES algorithm logic

AIM: Write a Java program to implement the DES algorithm logic.

PROGRAM:

```
import java.util.*;
import java.io.BufferedReader;
import java.io.InputStreamReader;
import java.security.spec.KeySpec;
import javax.crypto.Cipher;
import javax.crypto.SecretKey;
import javax.crypto.SecretKeyFactory;
import javax.crypto.spec.DESedeKeySpec;
import sun.misc.BASE64Decoder;
import sun.misc.BASE64Encoder;
public class DES {
private static final String UNICODE_FORMAT = "UTF8";
public static final String DESEDE_ENCRYPTION_SCHEME = "DESEde";
private KeySpec myKeySpec;
private SecretKeyFactory mySecretKeyFactory;
private Cipher cipher;
byte[] keyAsBytes;
private String myEncryptionKey;
private String myEncryptionScheme;
SecretKey key;
static BufferedReader br = new BufferedReader(new
InputStreamReader(System.in)); public DES() throws Exception {
// TODO code application logic here myEncryptionKey
= "ThisIsSecretEncryptionKey"; myEncryptionScheme =
DESEDE_ENCRYPTION_SCHEME; keyAsBytes =
myEncryptionKey.getBytes(UNICODE_FORMAT); myKeySpec
```

```

= new DESedeKeySpec(keyAsBytes);
mySecretKeyFactory = SecretKeyFactory.getInstance(myEncryptionScheme);
cipher = Cipher.getInstance(myEncryptionScheme);
key = mySecretKeyFactory.generateSecret(myKeySpec);

    }
public String encrypt(String unencryptedString)
    { String encryptedString = null;
    try {
    cipher.init(Cipher.ENCRYPT_MODE, key);
    byte[] plainText = unencryptedString.getBytes(UNICODE_FORMAT);
    byte[] encryptedText = cipher.doFinal(plainText);
        BASE64Encoder base64encoder = new BASE64Encoder();
    encryptedString = base64encoder.encode(encryptedText); }
    catch (Exception e) {
    e.printStackTrace(); }
    return encryptedString; }
public String decrypt(String encryptedString)
    { String decryptedText=null;
    try {
    cipher.init(Cipher.DECRYPT_MODE, key);
        BASE64Decoder base64decoder = new BASE64Decoder();
    byte[] encryptedText = base64decoder.decodeBuffer(encryptedString);
    byte[] plainText = cipher.doFinal(encryptedText); decryptedText=
    bytes2String(plainText); }
    catch (Exception e) {
    e.printStackTrace(); }
    return decryptedText; }
private static String bytes2String(byte[] bytes)
{ StringBuffer stringBuffer = new
StringBuffer(); for (int i = 0; i < bytes.length;

```

```
i++) { stringBuffer.append((char) bytes[i]); }  
return stringBuffer.toString(); }  
public static void main(String args []) throws Exception  
{ System.out.print("Enter the string: ");  
    DES myEncryptor= new DES();  
    String stringToEncrypt = br.readLine();  
    String encrypted = myEncryptor.encrypt(stringToEncrypt); String decrypted =  
    myEncryptor.decrypt(encrypted); System.out.println("\nString To Encrypt: "  
    +stringToEncrypt); System.out.println("\nEncrypted Value : " +encrypted);  
    System.out.println("\nDecrypted Value : " +decrypted);  
    System.out.println("");  
    }  
}
```

OUTPUT:

Enter the string: Welcome

String To Encrypt: Welcome

Encrypted Value : BPQMwc0wKvg=

Decrypted Value : Welcome

5. Program to implement BlowFish algorithm logic

AIM: Write a C/JAVA program to implement the BlowFish algorithm logic.

PROGRAM:

```
import java.io.*;
import java.io.FileInputStream;
import java.io.FileOutputStream;
import java.security.Key;
import javax.crypto.Cipher;
import javax.crypto.CipherOutputStream;
import javax.crypto.KeyGenerator;
import sun.misc.BASE64Encoder;

public class BlowFish {
    public static void main(String[] args) throws Exception {
        // TODO code application logic here
        KeyGenerator keyGenerator =
            KeyGenerator.getInstance("Blowfish");
        keyGenerator.init(128);
        Key secretKey = keyGenerator.generateKey();
        Cipher cipherOut = Cipher.getInstance("Blowfish/CFB/NoPadding");
        cipherOut.init(Cipher.ENCRYPT_MODE, secretKey);
        BASE64Encoder encoder = new BASE64Encoder();
        byte iv[] = cipherOut.getIV();
        if (iv != null) {
            System.out.println("Initialization Vector of the Cipher: " + encoder.encode(iv));
        }
        FileInputStream fin = new FileInputStream("inputFile.txt");
        FileOutputStream fout = new FileOutputStream("outputFile.txt");
        CipherOutputStream cout = new CipherOutputStream(fout, cipherOut);
        int input = 0;
        while ((input = fin.read()) != -1) {
```

```
fin.close(); cout.close(); } }
```

OUTPUT:

Initialization Vector of the Cipher: dI1MXzW97oQ=

Contents of inputFile.txt: Hello World

Contents of outputFile.txt: ùJÖ~ NâI“

6. Program to implement Rijndael algorithm logic

AIM: Write a C/JAVA program to implement the Rijndael algorithm logic.

PROGRAM:

```
import java.security.*;
import javax.crypto.*;
import javax.crypto.spec.*;
import java.io.*;

public class AES {
    public static String asHex (byte buf[]) {
        StringBuffer strbuf = new StringBuffer(buf.length *
        2); int i;
        for (i = 0; i < buf.length; i++) {
            if (((int) buf[i] & 0xff) < 0x10)
                strbuf.append("0");
            strbuf.append(Long.toString((int) buf[i] & 0xff, 16)); }
        return strbuf.toString(); }

    public static void main(String[] args) throws Exception
    { String message="AES still rocks!!";
        // Get the KeyGenerator
        KeyGenerator kgen = KeyGenerator.getInstance("AES");
        kgen.init(128); // 192 and 256 bits may not be available
        // Generate the secret key specs.
        SecretKey skey = kgen.generateKey();
        byte[] raw = skey.getEncoded();
        SecretKeySpec skeySpec = new SecretKeySpec(raw, "AES");
        // Instantiate the cipher
        Cipher cipher = Cipher.getInstance("AES");
        cipher.init(Cipher.ENCRYPT_MODE, skeySpec);
        byte[] encrypted = cipher.doFinal((args.length == 0 ? message :
```



```
args[0]).getBytes()); System.out.println("encrypted string: " +  
asHex(encrypted)); cipher.init(Cipher.DECRYPT_MODE,  
skeySpec); byte[] original = cipher.doFinal(encrypted); String  
originalString = new String(original);  
System.out.println("Original string: " + originalString + " " + asHex(original));  
}  
}
```

OUTPUT:

Input your message: Hello KGR CET

Encrypted text: 3000&&(*&*4r4

Decrypted text: Hello KGR CET

7. Encrypt a string using BlowFish algorithm

AIM: Using Java Cryptography, encrypt the text “Hello world” using BlowFish.
Create your own key using Java keytool.

PROGRAM:

```
import javax.crypto.Cipher;
import javax.crypto.KeyGenerator;
import javax.crypto.SecretKey;
import javax.swing.JOptionPane;
public class BlowFishCipher {
public static void main(String[] args) throws Exception {
    // create a key generator based upon the Blowfish cipher
    KeyGenerator keygenerator = KeyGenerator.getInstance("Blowfish");
    // create a key
    // create a cipher based upon Blowfish Cipher
    cipher = Cipher.getInstance("Blowfish");
    // initialise cipher to with secret key
    cipher.init(Cipher.ENCRYPT_MODE, secretkey);
    // get the text to encrypt
    String inputText = JOptionPane.showInputDialog("Input your message:");
    // encrypt message
    byte[] encrypted = cipher.doFinal(inputText.getBytes());
    // re-initialise the cipher to be in decrypt mode
    cipher.init(Cipher.DECRYPT_MODE, secretkey);
    // decrypt message
    byte[] decrypted = cipher.doFinal(encrypted);
    // and display the results
```

```
JOptionPane.showMessageDialog(JOptionPane.getRootFrame(),  
    "\nEncrypted text: " + new String(encrypted) + "\n" +  
    "\nDecrypted text: " + new String(decrypted));  
System.exit(0);  
}}
```

OUTPUT:

Input your message: Hello world

Encrypted text: 3ooo&&(*&*4r4

Decrypted text: Hello world

8. RSA Algorithm

AIM: Write a Java program to implement RSA Algorithm.

PROGRAM:

```
import java.io.BufferedReader;
import java.io.InputStreamReader;
import java.math.*;
import java.util.Random;
import java.util.Scanner;

public class RSA {
    static Scanner sc = new Scanner(System.in);
    public static void main(String[] args) {
        // TODO code application logic here
        System.out.print("Enter a Prime number: ");
        BigInteger p = sc.nextBigInteger(); // Here's one prime
        number.. System.out.print("Enter another prime number:
        "); BigInteger q = sc.nextBigInteger(); // ..and another.
        BigInteger n = p.multiply(q);
        BigInteger n2 = p.subtract(BigInteger.ONE).multiply(q.subtract(BigInteger.ONE));
        BigInteger e = generateE(n2);
        BigInteger d = e.modInverse(n2); // Here's the multiplicative inverse

        System.out.println("Encryption keys are: " + e + ", " + n);
        System.out.println("Decryption keys are: " + d + ", " + n);
    }
    public static BigInteger generateE(BigInteger fofn) {
        int y, intGCD;
        BigInteger e;
        BigInteger gcd;
        Random x = new Random();
        do {
```

```
y = x.nextInt(fiofn.intValue()-1);
String z = Integer.toString(y);
e = new BigInteger(z);
gcd = fiofn.gcd(e);
intGCD = gcd.intValue();
}
while(y <= 2 || intGCD != 1);
return e;
}
}
```

OUTPUT:

Enter a Prime number: 5
Enter another prime number: 11
Encryption keys are: 33, 55
Decryption keys are: 17, 55

9. Diffie-Hellman

AIM: Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript. Consider the end user as one of the parties (Alice) and the JavaScript application as other party (bob).

PROGRAM:

```
import java.math.BigInteger;
import java.security.KeyFactory;
import java.security.KeyPair;
import java.security.KeyPairGenerator;
import java.security.SecureRandom; import
javax.crypto.spec.DHParameterSpec; import
javax.crypto.spec.DHPublicKeySpec; public
class DiffeHellman { public final static int
pValue = 47;
public final static int gValue = 71;
public final static int XaValue = 9;
public final static int XbValue = 14;
public static void main(String[] args) throws
    Exception { // TODO code application logic here
    BigInteger p = new BigInteger(Integer.toString(pValue));
    BigInteger g = new BigInteger(Integer.toString(gValue));
    BigIntegerXa = new
    BigInteger(Integer.toString(XaValue)); BigIntegerXb =
    new BigInteger(Integer.toString(XbValue)); createKey();
    intbitLength = 512; // 512 bits
    SecureRandomrnd = new SecureRandom();
        p = BigInteger.probablePrime(bitLength, rnd);
        g = BigInteger.probablePrime(bitLength, rnd);
```

```

createSpecificKey(p, g);
    }
public static void createKey() throws Exception {
    KeyPairGeneratorkpg =
    KeyPairGenerator.getInstance("DiffieHellman"); kpg.initialize(512);
    KeyPairkp = kpg.generateKeyPair();
    KeyFactorykfactory = KeyFactory.getInstance("DiffieHellman");
    DHPublicKeySpeckspec = (DHPublicKeySpec) kfactory.getKeySpec(kp.getPublic(),
    DHPublicKeySpec.class);
    System.out.println("Public key is: " +kspec);
    }
public static void createSpecificKey(BigInteger p, BigInteger g) throws
Exception { KeyPairGeneratorkpg =
    KeyPairGenerator.getInstance("DiffieHellman"); DHParameterSpecparam = new
    DHParameterSpec(p, g); kpg.initialize(param);
    KeyPairkp = kpg.generateKeyPair();
    KeyFactorykfactory = KeyFactory.getInstance("DiffieHellman");
    DHPublicKeySpeckspec = (DHPublicKeySpec) kfactory.getKeySpec(kp.getPublic(),
    DHPublicKeySpec.class);
    System.out.println("\nPublic key is : " +kspec);
    }
}

```

OUTPUT:

Public key is: javax.crypto.spec.DHPublicKeySpec@5afd29

Public key is: javax.crypto.spec.DHPublicKeySpec@9971ad

10. SHA-1

AIM: Calculate the message digest of a text using the SHA-1 algorithm in JAVA.

PROGRAM:

```
import java.security.*;
public class SHA1 {
    public static void main(String[] a) {
        try {
            MessageDigest md = MessageDigest.getInstance("SHA1");
            System.out.println("Message digest object info: ");
            System.out.println(" Algorithm = " +md.getAlgorithm());
            System.out.println(" Provider = " +md.getProvider());
            System.out.println(" ToString = " +md.toString());

            String input = "";
            md.update(input.getBytes());
            byte[] output = md.digest();
            System.out.println();
            System.out.println("SHA1(\""+input+"\") = " +bytesToHex(output));

            input = "abc";
            md.update(input.getBytes());
            output = md.digest();
            System.out.println();
            System.out.println("SHA1(\""+input+"\") = " +bytesToHex(output));

            input = "abcdefghijklmnopqrstuvwxyz";
            md.update(input.getBytes());
            output = md.digest();
            System.out.println();
            System.out.println("SHA1(\""+input+"\") = " +bytesToHex(output));
            System.out.println(""); }
        catch (Exception e) {
```



```

System.out.println("Exception: " +e);
    }
}

public static String bytesToHex(byte[] b) {
    char hexDigit[] = {'0', '1', '2', '3', '4', '5', '6', '7', '8', '9', 'A', 'B', 'C', 'D', 'E', 'F'};
    StringBuffer buf = new StringBuffer();
    for (int j=0; j<b.length; j++) {
        buf.append(hexDigit[(b[j] >> 4) & 0x0f]);
        buf.append(hexDigit[b[j] & 0x0f]); }
    return buf.toString(); }
}

```

OUTPUT:

Message digest object info:

Algorithm = SHA1

Provider = SUN version 1.6

ToString = SHA1 Message Digest from SUN, <initialized> SHA1("") =

DA39A3EE5E6B4B0D3255BFEF95601890AFD80709 SHA1("abc") =

A9993E364706816ABA3E25717850C26C9CD0D89D

SHA1("abcdefghijklmnopqrstuvwxyz")=32D10C7B8CF96570CA04CE37F2A19D8424
0D3A89

11. Message Digest Algorithm5 (MD5)

AIM: Calculate the message digest of a text using the SHA-1 algorithm in JAVA.

PROGRAM:

```
import java.security.*;

public class MD5 {

    public static void main(String[] a) {

        // TODO code application logic here

        try {
            MessageDigest md = MessageDigest.getInstance("MD5");
            System.out.println("Message digest object info: ");
            System.out.println(" Algorithm = " +md.getAlgorithm());
            System.out.println(" Provider = " +md.getProvider());
            System.out.println(" ToString = " +md.toString());

            String input = "";
            md.update(input.getBytes());
            byte[] output = md.digest();
            System.out.println();
            System.out.println("MD5(\""+input+"\") = " +bytesToHex(output));

            input = "abc";
            md.update(input.getBytes());
            output = md.digest();
            System.out.println();
            System.out.println("MD5(\""+input+"\") = " +bytesToHex(output));

            input = "abcdefghijklmnopqrstuvwxyz";
            md.update(input.getBytes());
            output = md.digest();
            System.out.println();
            System.out.println("MD5(\""+input+"\") = "
            +bytesToHex(output)); System.out.println("");

        }
    }
}
```

```

catch (Exception e) {
    System.out.println("Exception: " +e); }
}

public static String bytesToHex(byte[] b) {
    char hexDigit[] = {'0', '1', '2', '3', '4', '5', '6', '7', '8', '9', 'A', 'B', 'C', 'D', 'E', 'F'};
    StringBuffer buf = new StringBuffer();
    for (int j=0; j<b.length; j++) {
        buf.append(hexDigit[(b[j] >> 4) & 0x0f]);
        buf.append(hexDigit[b[j] & 0x0f]); }
    return buf.toString(); } }

```

OUTPUT:

Message digest object info:

Algorithm = MD5

Provider = SUN version 1.6

ToString = MD5 Message Digest from SUN, <initialized> MD5("") =

D41D8CD98F00B204E9800998ECF8427E MD5("abc") =

900150983CD24FB0D6963F7D28E17F72 MD5("abcdefghijklmnopqrstuvwxyz") =

C3FCD3D76192E4007DFB496CCA67E13B