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(Autonomous College Affiliated to the University of Mumbai)
NAAC ACCREDITED with "A" GRADE (CGPA : 3.18)

DEPARTMENT OF INFORMATION TECHNOLOGY

COURSE CODE: DJ19ITL501 **DATE: 22/10/22**

COURSE NAME: Cryptography and Network Security Lab **Class: A3**

LAB EXPERIMENT NO. 1

AIM: Design and Implementation of RSA

DESCRIPTION OF EXPERIMENT:

The RSA cryptosystem is a public key cryptography algorithm used to encrypt a message without the need to exchange a secret key separately. The RSA algorithm can be used for both public key encryption and digital signatures. Its security is based on the difficulty of factoring large integers. Party A can send an encrypted message to party B without any prior exchange of secret keys. A just uses B's public key to encrypt the message and B decrypts it using his own private key, which only he knows. RSA can also be used to sign a message, so A can sign a message using their private key and B can verify it using A's public key.

ALGORITHM:

Key Generation Algorithm:

1.Choose prime numbers p and q.[private, chosen] $p!=q$

1.Recommended size 512 bits (almost 154 decimal digits)

2.Compute $n= pq$. [public, calculated]1.1024 bits (309 digits)

3.Compute $\varphi(n) = \varphi(p)\varphi(q) = (p- 1)(q- 1)$ [Euler Totient function]

4.Choose an integer e such that $1 < e< \varphi(n)$ and $\gcd(e, \varphi(n)) = 1$ (relatively prime, mutually prime, or co-prime) [public, chosen]

5.Determine $d(<\varphi(n))$as $d\equiv e-1(\text{mod } \varphi(n))$, i.e., d is the multiplicative inverse of e(modulo $\varphi(n)$).This is more clearly stated as: solve for,d given $d\cdot e\equiv 1 \ (\text{mod } \varphi(n))$. d is kept as the private key exponent. (Known to receiver only)[private, calculated]

6.Public key PU= {e, n}

7.Private key PR={d,n}

Encryption

1.Plaintext $M<n$

2.Turns M into an integer m, such that 0≤m<n by using an agreed-upon reversible protocol known as a padding scheme.

3.Compute the ciphertext C=m^e mod n

Decryption

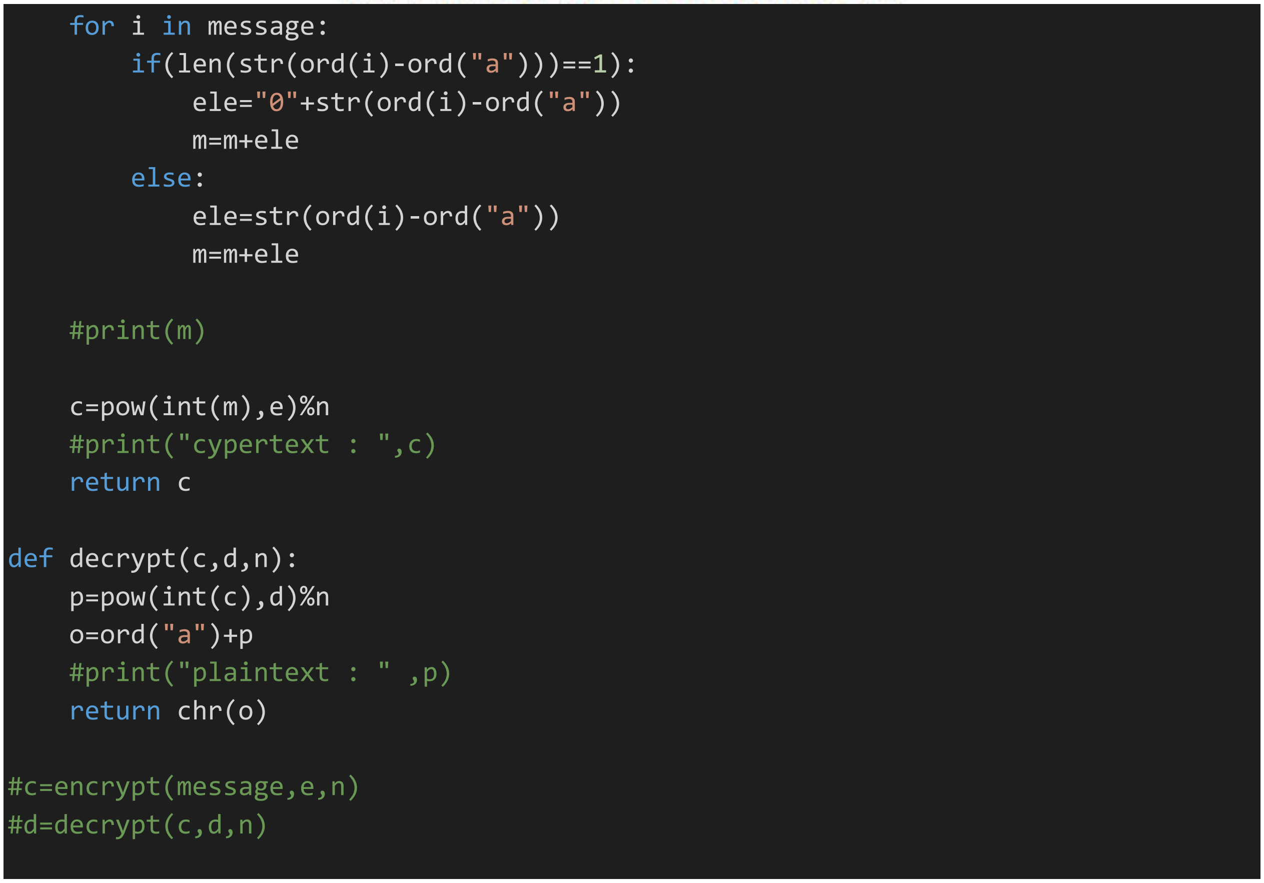
1. Cipher text C
2. Plaintext M=C^d mod n

TECHNOLOGY STACK : Python

DESIGN AND IMPLEMENTATION CODE:

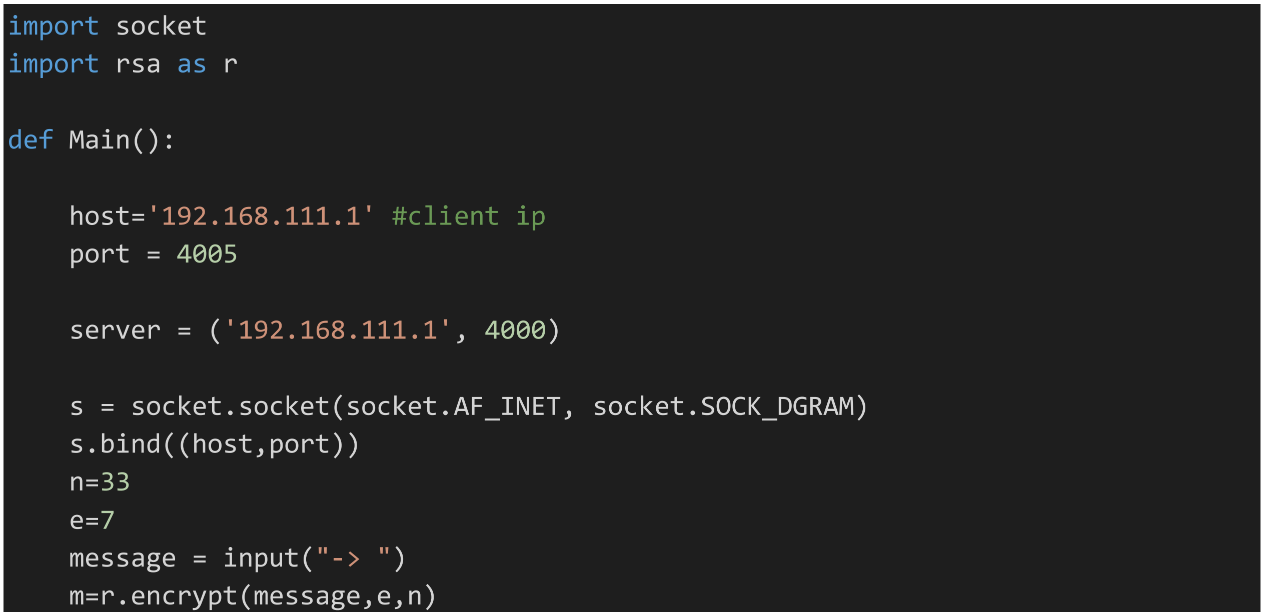
1) RSA:

```
import math
import random
'''
***key generation***
p=int(input("enter 1st prime number : "))
q=int(input("enter 2nd prime number : "))

n=p*q
phi=(p-1)*(q-1)
alle=[]
for i in range(2,phi):
    if(math.gcd(i,phi)==1):
        alle.append(i)
#print(alle)
e=random.choice(alle)
#e=3
#print("e = ",e)
ei=pow(e, -1, phi)
#print("einv = ",ei)
d=ei%phi
#print("d = ",d)

message="p"
'''
def encrypt(message,e,n):
    message=message.replace(" ","")
    m=""
```



```
    for i in message:
        if(len(str(ord(i)-ord("a")))==1):
            ele="0"+str(ord(i)-ord("a"))
            m=m+ele
        else:
            ele=str(ord(i)-ord("a"))
            m=m+ele

    #print(m)

    c=pow(int(m),e)%n
    #print("cypertext : ",c)
    return c

def decrypt(c,d,n):
    p=pow(int(c),d)%n
    o=ord("a")+p
    #print("plaintext : " ,p)
    return chr(o)

#c=encrypt(message,e,n)
#d=decrypt(c,d,n)
```

2) Client:



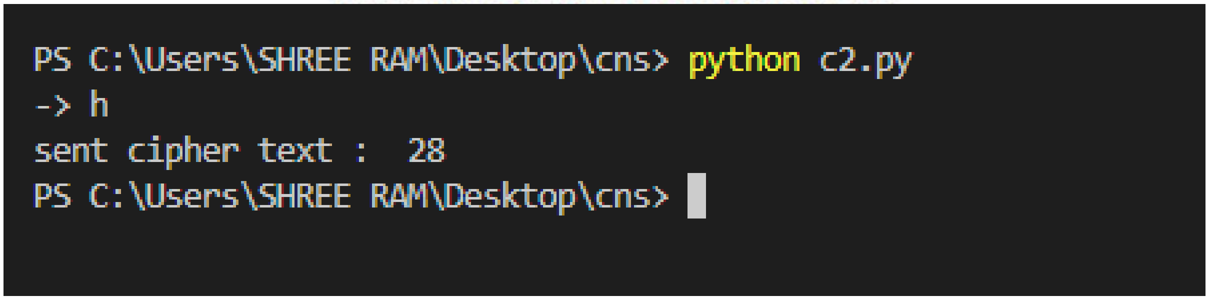
```
import socket
import rsa as r

def Main():

    host='192.168.111.1' #client ip
    port = 4005

    server = ('192.168.111.1', 4000)

    s = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
    s.bind((host,port))
    n=33
    e=7
    message = input("-> ")
    m=r.encrypt(message,e,n)
    m=str(m)
    s.sendto(m.encode('utf-8'), server)
    print("sent cipher text : ",m)
    s.close()

if __name__=='__main__':
    Main()
```

3) Server:

```
import socket
import rsa as r

def Main():

    host = '192.168.111.1' #Server ip
    port = 4000

    s = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
    s.bind((host, port))

    print("Server Started")
    while True:
        data, addr = s.recvfrom(1024)
        n=33
        d=3
        data = data.decode('utf-8')
        print("cipher text received : ",data)
        data= r.decrypt(int(data),d,n)
        print("Message from: " + str(addr))
        print("From connected user: " ,data)
    c.close()

if __name__=='__main__':
    Main()
```

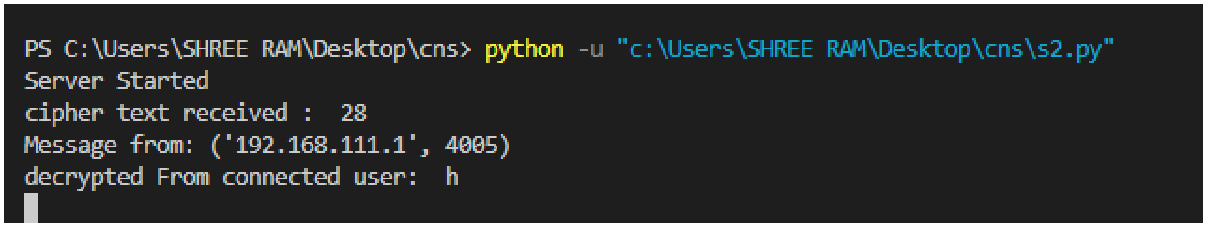
OUTPUT:

Client:



```
PS C:\Users\SHREE RAM\Desktop\cns> python c2.py
-> h
sent cipher text :  28
PS C:\Users\SHREE RAM\Desktop\cns>
```

Server:



```
PS C:\Users\SHREE RAM\Desktop\cns> python -u "c:\Users\SHREE RAM\Desktop\cns\s2.py"
Server Started
cipher text received :  28
Message from: ('192.168.111.1', 4005)
decrypted From connected user:  h
```

CONCLUSION:

RSA is a cryptosystem, which is known as one of the first practicable public-key cryptosystems and is widely used for secure data transmission. Thus, we have studied and implemented RSA algorithm.