

Hugh Coleman - 04/22/2024

FINAL EXERCISE: 04-16-24

Prof. Myers

Analysis of Algorithms SP24

Trinity University

```

#main.py

from ascii import encodeAscii, decodeAscii
from rsa import totient, public_exponent, modinv, rsa_encrypt, rsa_decrypt

print(encodeAscii("k"))
p = 923978444369
q = 496509772799
n = p * q
phi = totient(p, q)

e = public_exponent(phi)
d = modinv(e, phi)

print("enter message to be sent: ")
P = input()

print("p : " + str(p))
print("q : " + str(p))
print("n : " + str(n))

print("phi : " + str(phi))
print("e : " + str(e))
print("d : " + str(d))
print("")

print("Public key (E, n):", (e, n))
print("Private key (d, n):", (d, n))

encodedText = int(encodeAscii(P))
print("The message to be sent: " + P)
print("text after ascii encoding as integer : " + str(encodedText))
ciphertext = rsa_encrypt(encodedText, e, n)

print("Ciphertext: " + str(ciphertext))

decrypted_text = rsa_decrypt(ciphertext, d, n)

decodedText = decodeAscii(decrypted_text)

print("Decrypted text: " + str(decodedText))

```

**#rsa.py**

```
def totient(p, q):  
    return (p - 1) * (q - 1)  
  
def gcd(a, b):  
    while b != 0:  
        a, b = b, a % b  
    return a  
  
def egcd(a, b):  
    if a == 0:  
        return (b, 0, 1)  
    g, y, x = egcd(b%a,a)  
    return (g, x - (b//a) * y, y)  
  
def modinv(a, m):  
    g, x, y = egcd(a, m)  
    if g != 1:  
        raise Exception('No modular inverse')  
    return x%m  
  
def public_exponent(phi):  
    E = 2  
    while gcd(E, phi) != 1:  
        E += 1  
    return E  
  
def rsa_encrypt(plaintext, E, n):  
    return pow(plaintext, E, n)  
  
def rsa_decrypt(ciphertext, d, n):  
    return pow(ciphertext, d, n)
```

**#ascii.py**

```
def encodeAscii(m):
    text = ''
    for x in m:
        organ = str(ord(x))
        if(len(organ) == 1):
            organ = "90" + organ
        if(len(organ) == 2):
            organ = "9" + organ
        text = text + organ
    return(text)

def decodeAscii(m):
    # Iterate over the string in steps of 3
    number_str = str(m)
    text = ''
    for i in range(0, len(number_str), 3):
        text = text + chr(int(number_str[i:i+3]) % 900)

    return(text)

# These functions turn the ascii into a sequence of ascii.
# I use 9's for placeholders for leading 0's.
```

**# Running on "Hello!"**

```
$ python main.py
```

```
107
```

```
enter message to be sent:
```

```
Hello!
```

```
p : 923978444369
```

```
q : 923978444369
```

```
n : 458764327484825650918831
```

```
phi : 458764327483405162701664
```

```
e : 3
```

```
d : 305842884988936775134443
```

```
Public key (E, n): (3, 458764327484825650918831)
```

```
Private key (d, n): (305842884988936775134443, 458764327484825650918831)
```

```
The message to be sent: Hello!
```

```
text after ascii encoding as integer : 972101108108111933
```

```
Ciphertext: 322776738291196976750205
```

```
Decrypted text: Hello!
```

**# Running on "a"**

```
$ python main.py
```

```
107
```

```
enter message to be sent:
```

```
a
```

```
p : 923978444369
```

```
q : 923978444369
```

```
n : 458764327484825650918831
```

```
phi : 458764327483405162701664
```

```
e : 3
```

```
d : 305842884988936775134443
```

```
Public key (E, n): (3, 458764327484825650918831)
```

```
Private key (d, n): (305842884988936775134443, 458764327484825650918831)
```

```
The message to be sent: a
```

```
text after ascii encoding as integer : 997
```

```
Ciphertext: 991026973
```

```
Decrypted text: a
```