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Assignment - 10

Aim : To Implement ElGamal cryptosystem.

Theory:

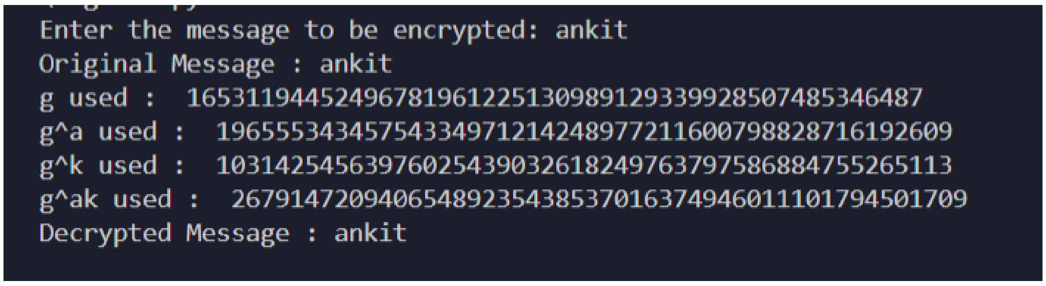
In cryptography, the ElGamal encryption system is an asymmetric key encryption algorithm for public-key cryptography which is based on the Diffie–Hellman key exchange. It was described by Taher Elgamal in 1985. ElGamal encryption is used in the free GNU Privacy Guard software, recent versions of PGP, and other cryptosystems.

Program:

```
import random
from math import pow

a = random.randint(2, 10)

def gcd(a, b):
	if a < b:
		return gcd(b, a)
	elif a % b == 0:
		return b;
	else:
		return gcd(b, a % b)

# Generating large random numbers
def gen_key(q):

	key = random.randint(pow(10, 20), q)
	while gcd(q, key) != 1:
		key = random.randint(pow(10, 20), q)

	return key

# Modular exponentiation
def power(a, b, c):
	x = 1
	y = a

	while b > 0:
		if b % 2 == 0:
			x = (x * y) % c;
```

```
        y = (y * y) % c
        b = int(b / 2)

    return x % c

# Asymmetric encryption
def encrypt(msg, q, h, g):

    en_msg = []

    k = gen_key(q)# Private key for sender
    s = power(h, k, q)
    p = power(g, k, q)

    for i in range(0, len(msg)):
        en_msg.append(msg[i])

    print("g^k used : ", p)
    print("g^ak used : ", s)
    for i in range(0, len(en_msg)):
        en_msg[i] = s * ord(en_msg[i])

    return en_msg, p

def decrypt(en_msg, p, key, q):

    dr_msg = []
    h = power(p, key, q)
    for i in range(0, len(en_msg)):
        dr_msg.append(chr(int(en_msg[i]/h)))

    return dr_msg

# Driver code
def main():

    msg = input ("Enter the message to be encrypted: ");
    print("Original Message :", msg)

    q = random.randint(pow(10, 20), pow(10, 50))
    g = random.randint(2, q)

    key = gen_key(q)# Private key for receiver
    h = power(g, key, q)
    print("g used : ", g)
    print("g^a used : ", h)

    en_msg, p = encrypt(msg, q, h, g)
    dr_msg = decrypt(en_msg, p, key, q)
    dmsg = ''.join(dr_msg)
    print("Decrypted Message :", dmsg);

# call the main function
main()
```

Output:



```
Enter the message to be encrypted: ankit
Original Message : ankit
g used :  16531194452496781961225130989129339928507485346487
g^a used :  19655534345754334971214248977211600798828716192609
g^k used :  10314254563976025439032618249763797586884755265113
g^ak used :  26791472094065489235438537016374946011101794501709
Decrypted Message : ankit
```