1: Programming 3

(a) Algorithm: Client

```
# -*-coding:utf-8-*-
import os
import random
import socket
from Crypto.Cipher import AES
from Crypto.Cipher import PKCS1_v1_5 as Cipher_pkcs1_v1_5
import base64
import threading
from Crypto.PublicKey import RSA

# client, server share password
dict = {}
dict[”server”] = ”12345678”


class prpcrypt():
    def __init__(self, key):
        if len(key) < 16:
            key = key + (16 - len(key)) * ”\0”
        self.key = key[:16]
        self.mode = AES.MODE_GCM

    def encrypt(self, text):
        cryptor = AES.new(self.key, self.mode, IV=self.key)
        length = 16
        count = len(text)
        add = count % length
        if add:
            text = text + ('\0' * (length - add))
        self.ciphertext = cryptor.encrypt(text)
        return base64.b64encode(self.ciphertext)

    def decrypt(self, text):
        cryptor = AES.new(self.key, self.mode, IV=self.key)
        plain_text = cryptor.decrypt(base64.b64decode(text))
        return plain_text.rstrip('\0')


def mytarget(connect):

    # authentication
    user = connect.recv(1024)
```

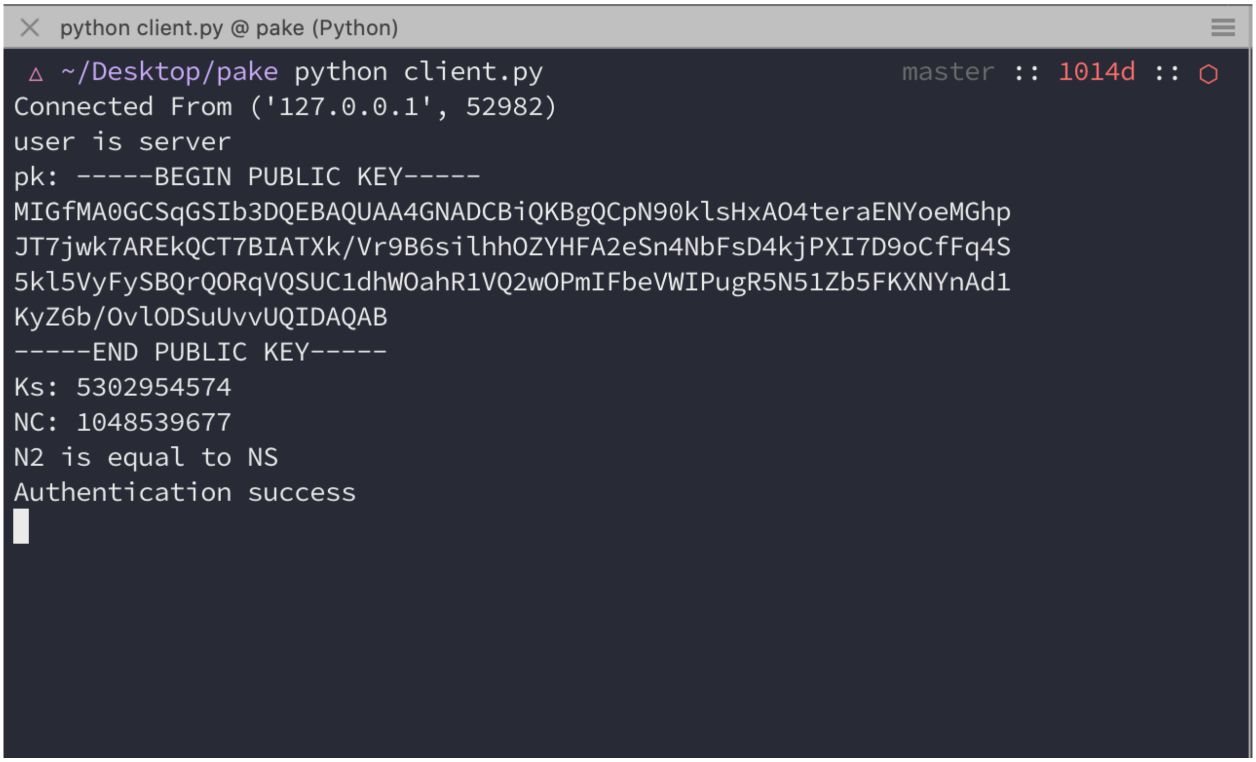
```
if user in dict:
    connect.send(”yes”)
    pw = dict[user]
    print ”user is ” + user
else:
    connect.send(”no”)
    print ”user error”
    connect.close()
    exit(−1)

# decrypt to get pk
ra = connect.recv(1024)
pc = prpcrypt(pw)
pk = pc.decrypt(ra)
print ’pk: ’ + pk

# randomly generate the session key Ks, and send it to the server with double e
a = [random.randint(0, 9) for _ in range(10)]
Ks = ’’.join(str(i) for i in a)
print ”Ks: ” + Ks
rsakey = RSA.importKey(pk)
cipher = Cipher_pkcs1_v1_5.new(rsakey)
cipher_text = base64.b64encode(cipher.encrypt(Ks))
pc = prpcrypt(pw)
e = pc.encrypt(cipher_text)
connect.send(e)

# decrypt NC, randomly generate NS
data = connect.recv(1024)
pc = prpcrypt(Ks)
NC = pc.decrypt(data)
print ’NC: ’ + NC
a = [random.randint(0, 9) for _ in range(10)]
NS = ’’.join(str(i) for i in a)

# encrypt NC || NS with Ks and send to server
NC_B = NC + NS
pc = prpcrypt(Ks)
e = pc.encrypt(NC_B)
connect.send(e)

# decrypt N2, judge whether N2 is equal to NS
data = connect.recv(1024)
pc = prpcrypt(Ks)
N2 = pc.decrypt(data)
if N2 == NS:
    print ”N2 is equal to NS”
    print ”Authentication success”
    else:
        print "Authentication faild"

    while True:
        try:
            data = connect.recv(1024)
        except Exception, e:
            print "User Abnormal Exit"
            exit(-1)
        if data == "quit":
            print "User " + user + " quit!"
            break
        print "User " + user + " say: " + data
        connect.send("receive " + data)
    connect.close()


address = ('127.0.0.1', 8088)
socket = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
socket.bind(address)
socket.listen(5)

while True:
    connect, addr = socket.accept()
    print 'Connected From', addr
    chat = threading.Thread(target=mytarget, args=(connect,))
    chat.start()
```

(b) Algorithm: Server

```
#-*-coding:utf-8-*-
import random
import socket
from Crypto import Random
from Crypto.PublicKey import RSA
from Crypto.Cipher import AES
from Crypto.Cipher import PKCS1_v1_5 as Cipher_pkcs1_v1_5
import base64

# client, server share password
pw = "12345678"

class prpcrypt():
    def __init__(self, key):
        if len(key)<16:
            key=key+(16-len(key))*"\0"
        self.key = key[:16]
        self.mode = AES.MODE_GCM

    def encrypt(self, text):
        cryptor = AES.new(self.key, self.mode, IV=self.key)
        length = 16
        count = len(text)
        add=count % length
        if add:
            text = text + (’\0’ * (length-add))
        self.ciphertext = cryptor.encrypt(text)
        return base64.b64encode(self.ciphertext)

    def decrypt(self, text):
        cryptor = AES.new(self.key, self.mode, IV=self.key)
        plain_text = cryptor.decrypt(base64.b64decode(text))
        return plain_text.rstrip(’\0’)

# random generate
random_generator = Random.new().read
rsa = RSA.generate(1024, random_generator)

# generate pk and sk
pk = rsa.publickey().exportKey()
skS = rsa.exportKey()

address = (’127.0.0.1’, 8088)
socket = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
socket.connect(address)

print ”pk: ” + pk

socket.send(’server’)
data = socket.recv(1024)
if data == ”no”:
    print ”connect error”
    socket.close()
    exit(-1)

# send pk encrypted with pw
pc = prpcrypt(pw)
e = pc.encrypt(pk)
socket.send(e)

# decrypte to get Ks
data = socket.recv(1024)
pc = prpcrypt(pw)
Ks1 = pc.decrypt(data)
rsakey = RSA.importKey(skS)
```

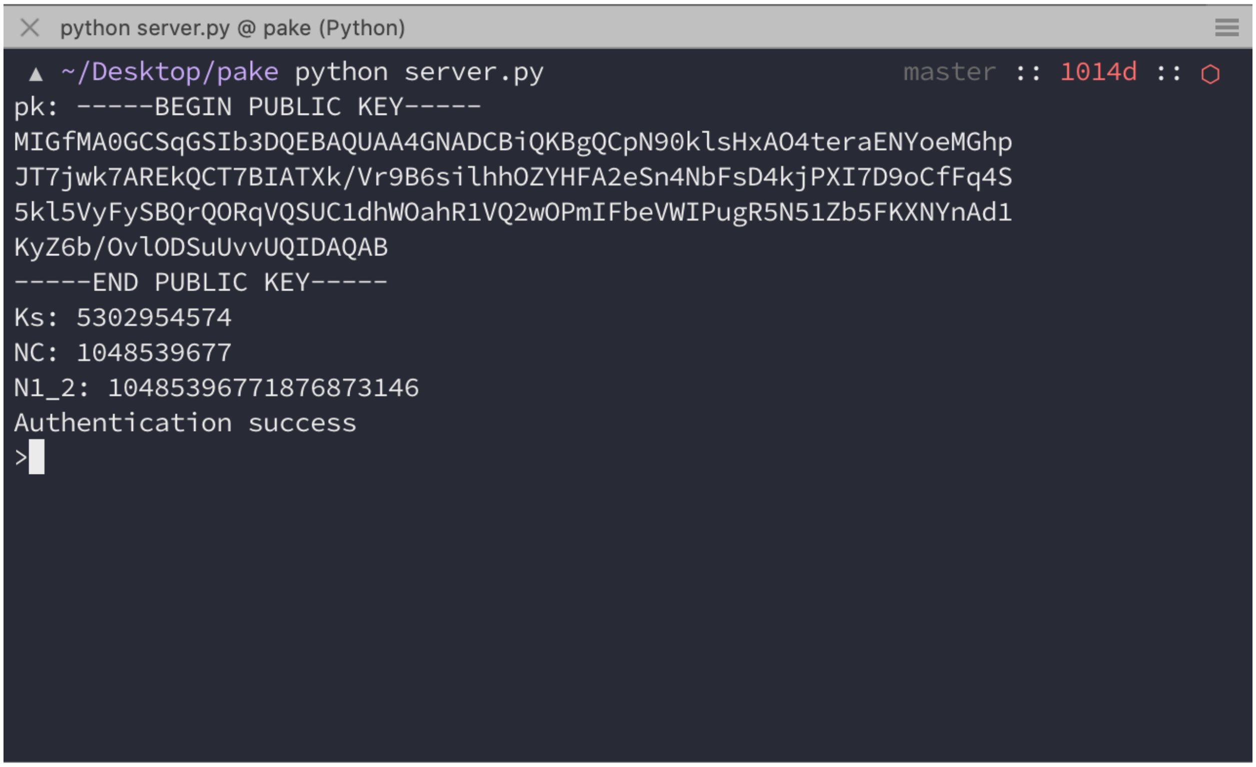
```
cipher = Cipher_pkcs1_v1_5.new(rsakey)
Ks = cipher.decrypt(base64.b64decode(Ks1), random_generator)
print "Ks: " + Ks

# randomly generate NC and send it to client with Ks encryption
a = [random.randint(0,9) for _ in range(10)]
NC = ''.join(str(i) for i in a)
print "NC: " + NC
pc = prpcrypt(Ks)
e = pc.encrypt(NC)
socket.send(e)

data = socket.recv(1024)
pc = prpcrypt(Ks)
N1_2 = pc.decrypt(data)
print 'N1_2: '+N1_2
if N1_2.find(NC) == 0:
    print "Authentication success"
else:
    print "Authentication faild"

# Ks encrypted N2 sent to client
N2 = N1_2[len(NC):]
pc = prpcrypt(Ks)
e = pc.encrypt(N2)
socket.send(e)

while True:
    data = raw_input(">")
    if data == "quit":
        socket.send(data)
        break
    try:
        socket.send(data)
    except Exception, e:
        print "Server Abnormal Exit"
        break
    data = socket.recv(1024)
    print "Server say: " + data
socket.close()
```

(c) Output:



```
△ ~/Desktop/pake python client.py                    master :: 1014d :: ⬡
Connected From ('127.0.0.1', 52982)
user is server
pk: -----BEGIN PUBLIC KEY-----
MIGfMA0GCSqGSIb3DQEBAQUAA4GNADCBiQKBgQCpN90klsHxAO4teraENYoeMGhp
JT7jwk7AREkQCT7BIATXk/Vr9B6silhhOZYHFA2eSn4NbFsD4kjPXI7D9oCfFq4S
5kl5VyFySBQrQORqVQSUC1dhWOahR1VQ2wOPmIFbeVWIPugR5N51Zb5FKXNYnAd1
KyZ6b/OvlODSuUvvUQIDAQAB
-----END PUBLIC KEY-----
Ks: 5302954574
NC: 1048539677
N2 is equal to NS
Authentication success
```

Figure 1: Client Output



```
▲ ~/Desktop/pake python server.py                    master :: 1014d :: ⬡
pk: -----BEGIN PUBLIC KEY-----
MIGfMA0GCSqGSIb3DQEBAQUAA4GNADCBiQKBgQCpN90klsHxAO4teraENYoeMGhp
JT7jwk7AREkQCT7BIATXk/Vr9B6silhhOZYHFA2eSn4NbFsD4kjPXI7D9oCfFq4S
5kl5VyFySBQrQORqVQSUC1dhWOahR1VQ2wOPmIFbeVWIPugR5N51Zb5FKXNYnAd1
KyZ6b/OvlODSuUvvUQIDAQAB
-----END PUBLIC KEY-----
Ks: 5302954574
NC: 1048539677
N1_2: 10485396771876873146
Authentication success
>
```

Figure 2: Server Output