Laboratory Report Cover Sheet

SRM Institute of Science and Technology
College of Engineering and Technology
Department of Electronics and Communication Engineering

18ECC303J Computer Communication and Networks

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Project based Experiment Report

On

Implementation of RC4 Encryption and Decryption Algorithms Using Python.

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Proposal	05			
Demonstration	10			
Presentation	10			
Report	10			
Viva	05			
Total	**40**			

REPORT VERIFICATION

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Signature :

Title of the project:

Implementation of RC4 Encryption and Decryption Algorithms Using Python.

Name of the members of the Group with Reg. Nos.:

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Introduction:

The RC4 algorithm is a symmetric stream cipher used for encryption and decryption of data. It was developed by Ron Rivest in 1987 and was initially used for secure communication in the Internet Engineering Task Force (IETF). The algorithm is known for its simplicity and speed and is widely used in various applications.

Software used: Python 3.8, Pycharm IDE

RC4 algorithm Theory/Explanation:

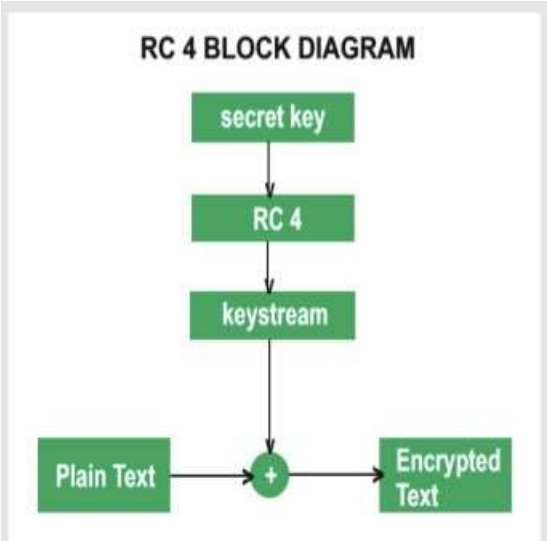
RC4 (Rivest Cipher 4) is a symmetric stream cipher algorithm that is widely used in various applications, such as secure socket layer (SSL), wireless network encryption, and Bluetooth. It operates on bytes of data and generates a stream of pseudo-random bytes, which are XOR-ed with the plaintext to produce the ciphertext. RC4 encryption and decryption is achieved by using a secret key of arbitrary length between 40 and 2048 bits.

The RC4 algorithm consists of two main stages: key-scheduling and stream generation. In the key-scheduling stage, the algorithm creates a permutation of the 256-byte array, based on the secret key and an initialization vector (IV). The permutation is achieved by performing a series of swaps between elements of the array, depending on the key and IV. In the stream generation stage, the algorithm generates a pseudo-random stream of bytes by repeatedly swapping

elements of the array and generating a byte from the array index, based on the current state of the algorithm. This stream is XOR-ed with the plaintext to produce the ciphertext, and vice versa for decryption.

Overall, RC4 is a simple, fast, and widely-used stream cipher that provides a good level of security for various applications. However, it is vulnerable to certain attacks, such as key recovery attacks and related key attacks, and therefore should not be used as the sole security mechanism for critical applications.

To encrypt a plaintext message using RC4, the pseudorandom stream is XORed with the plaintext to produce the ciphertext. To decrypt the ciphertext, the same pseudorandom stream is XORed with the ciphertext to recover the original plaintext.



Implementation Methodology or steps :

RC4 algorithm can be implemented using Python by following these steps:

1. Define a function to perform the key-scheduling stage, which takes the secret key as input and generates the permutation of the 256-byte array. 2. Define a function to generate the pseudo-random stream of bytes, which takes the permutation array as input and generates a stream of bytes to XOR with the plaintext.

3. Define a function to perform the encryption, which takes the plaintext and secret key as input, and generates the ciphertext by XOR-ing the plaintext with the stream of bytes generated in step 2.

4. Define a function to perform the decryption, which takes the ciphertext and secret key as input, and generates the plaintext by XOR-ing the ciphertext with the same stream of bytes generated in step 2.

5. Test the encryption and decryption functions with sample plaintext and secret key, and verify that the output matches the expected ciphertext and plaintext, respectively.

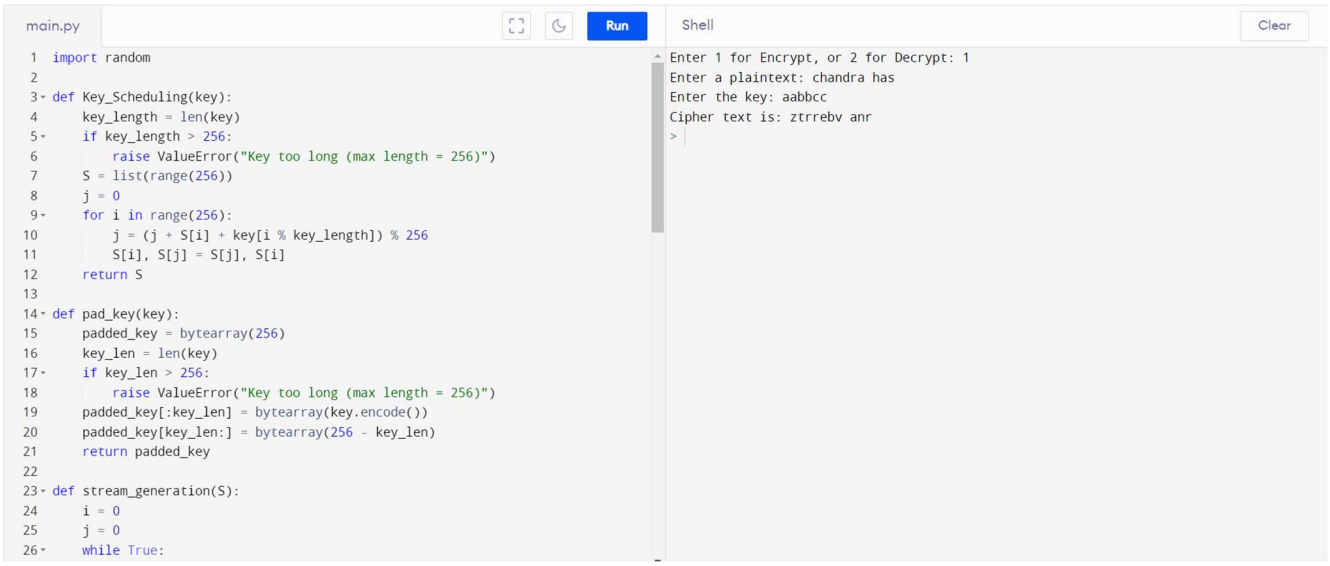
Programme:

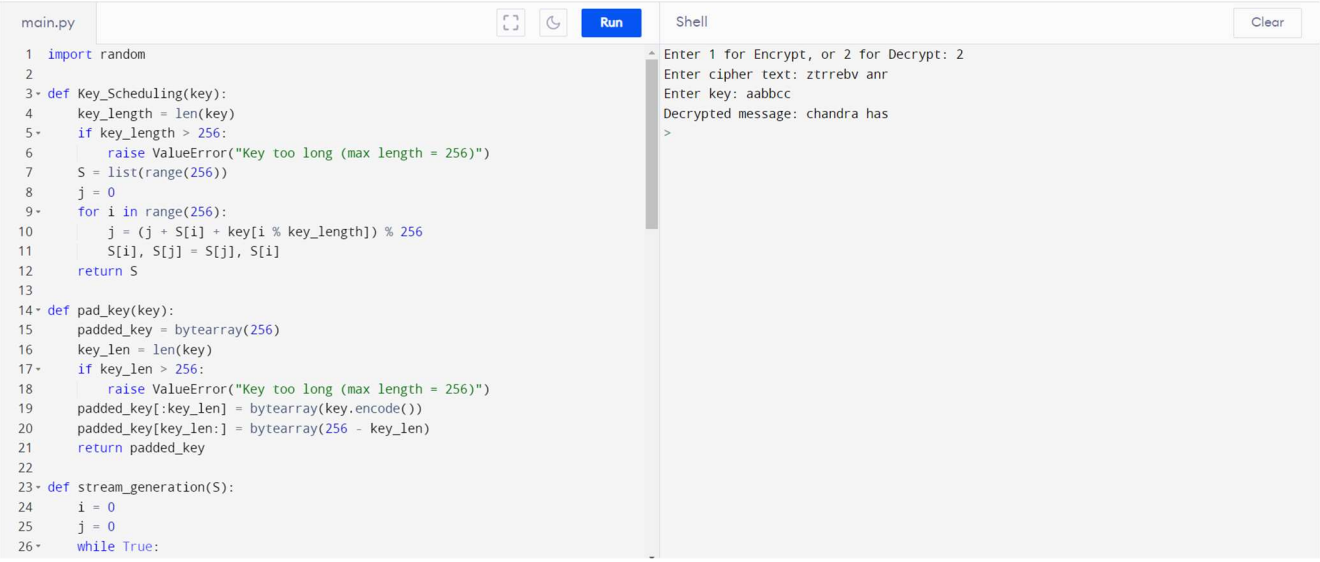
```
import random

def Key_Scheduling(key):
    key_length = len(key)
    if key_length > 256:
        raise ValueError("Key too long (max length = 256)")
    S = list(range(256))
    j = 0
    for i in range(256):
        j = (j + S[i] + key[i % key_length]) % 256
        S[i], S[j] = S[j], S[i]
    return S

def pad_key(key):
    padded_key = bytearray(256)
    key_len = len(key)
    if key_len > 256:
        raise ValueError("Key too long (max length = 256)")
    padded_key[:key_len] = bytearray(key.encode())
    padded_key[key_len:] = bytearray(256 - key_len)
    return padded_key
```

```
def stream_generation(S):
    i = 0
    j = 0
    while True:
        i = (i + 1) % 256
        j = (j + S[i]) % 256
        S[i], S[j] = S[j], S[i]
        K = S[(S[i] + S[j]) % 256]
        yield K

def encrypt(plaintext, key):
    key = pad_key(key)
    S = Key_Scheduling(key)
    keystream = stream_generation(S)
    encrypted_text = ""
    for c in plaintext:
        if c.isalpha():
            if c.islower():
                c = chr((ord(c) + next(keystream) - 97) % 26 + 97)
            elif c.isupper():
                c = chr((ord(c) + next(keystream) - 65) % 26 + 65)
        elif c.isnumeric():
            c = str((int(c) + next(keystream)) % 10)
        encrypted_text += c
    return encrypted_text

def decrypt(ciphertext, key):
    key = pad_key(key)
    S = Key_Scheduling(key)
    keystream = stream_generation(S)
    decrypted_text = ""
    for c in ciphertext:
        if c.isalpha():
            if c.islower():
                c = chr((ord(c) - next(keystream) - 97) % 26 + 97)
            elif c.isupper():
```

```
                c = chr((ord(c) - next(keystream) - 65) % 26 + 65)
            elif c.isnumeric():
                c = str((int(c) - next(keystream)) % 10)
            decrypted_text += c
        return decrypted_text

ed = input('Enter 1 for Encrypt, or 2 for Decrypt: ').upper()
if ed == '1':
    text= input("Enter a plaintext: ")
    key=input("Enter the key: ")
    encrypted_text = encrypt(text, key)
    print("Cipher text is:", encrypted_text)
elif ed == '2':
    TEXT = input("Enter cipher text: ")
    KEY = input("Enter key: ")
    decrypted_text = decrypt(TEXT, KEY)
    print("Decrypted message:", decrypted_text)
else:
    print('Error in input - try again.')
```

Demonstration Result and Screenshots:





Tabulation: **Key** : **aabbcc**

S.No	Plain text	Cipher Text
1	Asish	xezwi
2	Akhil	xwymm
3	gowtam	danxbw
4	Chandrahas	Ztrrebvanr
5	Sangam	Pmekbw

Conclusion:

The RC4 algorithm is a widely used stream cipher for encryption and decryption of data. It is known for its simplicity and speed. In this report, we have explained the theory behind the RC4 algorithm, its implementation using Python and the software used. And the functions that provides a convenient and easy-to-use interface for implementing the RC4 algorithm in Python.

Reference List:

1. Data communications and networking I Behrouz A Forouzan
2. https://www.youtube.com/watch?v=Pl-ySf5abv8