SHRI VILEPARLE KELAVANI MANDAL'S
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC ACCREDITED with "A" GRADE (CGPA : 3.18)
DEPARTMENT OF INFORMATION TECHNOLOGY

COURSE CODE: DJ19ITL501 **DATE: 5/11/22**

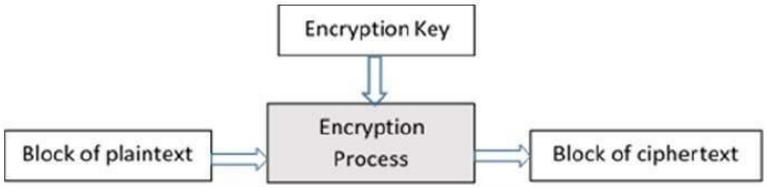
COURSE NAME: Cryptography and Network Security Lab **Class: A3**

LAB EXPERIMENT NO. 4

AIM: Design Analysis of Modern Block Ciphers (use crypt APIs)

DESCRIPTION OF EXPERIMENT:

A block cipher takes a block of plaintext bits and generates a block of ciphertext bits, generally of same size. The size of block is fixed in the given scheme. The choice of block size does not directly affect to the strength of encryption scheme. The strength of cipher depends up on the key length.



Analysis:

1. Use crypt API to encrypt/decrypt a plaintext block using AES, DES
2. Avalanche Effect: Change in Plaintext
3. Avalanche Effect: Change in key

TECHNOLOGY STACK : Python

DESIGN AND IMPLEMENTATION CODE:

Aes:

```
from Crypto.Cipher import AES

def encrypt(message,key):
    obj = AES.new(key, AES.MODE_CBC, 'This is an IV456')
    #message = "The answer is no"
    ciphertext = obj.encrypt(message)
```

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```
    print(ciphertext)
    return ciphertext

def decrypt(ciphertext,key):
    obj2 = AES.new(key, AES.MODE_CBC, 'This is an IV456')
    pt=obj2.decrypt(ciphertext)
    print(pt)
    return pt
```

des:

```
from Crypto.Cipher import DES

def encrypt(message,key):
    obj = DES.new(key, DES.MODE_OFB,'ThiIV456')
    #message = "The answer is no"
    ciphertext = obj.encrypt(message)
    print(ciphertext)
    return ciphertext

def decrypt(ciphertext,key):
    obj2 = DES.new(key, DES.MODE_OFB,'ThiIV456')
    pt=obj2.decrypt(ciphertext)
    print(pt)
    return pt
```

3-des:

```
from Crypto.Cipher import DES3

def encrypt(message,key):
    obj = DES3.new(key, DES3.MODE_OFB,'ThiIV456')
    #message = "The answer is no"
    ciphertext = obj.encrypt(message)
    print(ciphertext)
    return ciphertext

def decrypt(ciphertext,key):
    obj2 = DES3.new(key, DES3.MODE_OFB,'ThiIV456')
    pt=obj2.decrypt(ciphertext)
    print(pt)
    return pt
```

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Avalanche Effect: Change in key

```
import aes
import des

#avalanch key

keya='This is a key123'
bitchangedkey='This is a kfy123'
print("\n\navalanch in aes key changed from ",keya,"to ",bitchangedkey," : ")
message = "123456xxxxxxxxxx"
c1=aes.encrypt(message,keya)
c2=aes.encrypt(message,bitchangedkey)

keyd='key12345'
bitchangedkey='kfy12345'
print("\n\navalanch in des key changed from ",keyd,"to ",bitchangedkey," : ")
message = "123456xxxxxxxxxx"
c1=des.encrypt(message,keyd)
c2=des.encrypt(message,bitchangedkey)
```

Avalanche Effect: Change in plaintext

```
import aes
import des
#avalanch message

keya='This is a key123'
keyd='key12345'

message = "123456xxxxxxxxxx"
bitchangedmssg="223456xxxxxxxxxx"
print("\n\navalanch in aes message changed from ",message,"to ",bitchangedmssg,"
: ")
c1=aes.encrypt(message,keya)
c2=aes.encrypt(bitchangedmssg,keya)

message = "123456xxxxxxxxxx"
bitchangedmssg="223456xxxxxxxxxx"
```

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```
print("\n\navalanch in des message changed from ",message,"to ",bitchangedmssg,"
: ")
c1=des.encrypt(message,keyd)
c2=des.encrypt(bitchangedmssg,keyd)
```

Avalanche Effect: 3des

```
import tdes

keya='This is a key123'
message = "123456xxxxxxxxxx"
bitchangedmssg="223456xxxxxxxxxx"
bitchangedkey='This is a kfy123'
print("\n\navalanch in 3-des message changed from ",message,"to
",bitchangedmssg," : ")
c1=tdes.encrypt(message,keya)
c2=tdes.encrypt(bitchangedmssg,keya)


print("\n\navalanch in 3-des key changed from ",keya,"to ",bitchangedkey," : ")
c1=tdes.encrypt(message,keya)
c2=tdes.encrypt(message,bitchangedkey)
```

OUTPUT:

```
aes on plaintext  123456xxxxxxxxxx with key This is a key123   :
b'\xfc\t\x8d\x98\x01\xda\x0b\xcdc\xf4\x0f\xcc6\x80v\xbc'


des on plaintext  123456xxxxxxxxxx with key key12345   :
b'EY\x9b\xbc\x9f9\n\x1eJ\xe4\xf8\x80\x9c\xb7\xad\xb8'
```

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```
3-des on plaintext  123456xxxxxxxxxx with key This is a key123   :
b'\x8d\xad\x04\x1f3I\x10\xc5\xbb\xb4\r\x0e\xfcM>_'
```

```
avalanch in aes key changed from  This is a key123 to  This is a kfy123  :
b'\xfc\t\x8d\x98\x01\xda\x0b\xcdc\xf4\x0f\xcc6\x80v\xbc'
b'Q\x9e\xa23D\xe9K\xa1&\xc8X\x98_9\xb1#'


avalanch in des key changed from  key12345 to  kfy12345  :
b'EY\x9b\xbc\x9f9\n\x1eJ\xe4\xf8\x80\x9c\xb7\xad\xb8'
b'%s\xe0\xd0pc\xbf\x85\xa2\xcd\\\x1f\xd1\xbc\x13\xdb'
```

```
avalanch in aes message changed from  123456xxxxxxxxxx to  223456xxxxxxxxxx  :
b'\xfc\t\x8d\x98\x01\xda\x0b\xcdc\xf4\x0f\xcc6\x80v\xbc'
b'%\x02\xd5\xa0-\x17]c\x82\xb9I.\x971\xe5z'


avalanch in des message changed from  123456xxxxxxxxxx to  223456xxxxxxxxxx  :
b'EY\x9b\xbc\x9f9\n\x1eJ\xe4\xf8\x80\x9c\xb7\xad\xb8'
b'FY\x9b\xbc\x9f9\n\x1eJ\xe4\xf8\x80\x9c\xb7\xad\xb8'
```

```
avalanch in 3-des message changed from  123456xxxxxxxxxx to  223456xxxxxxxxxx  :
b'\x8d\xad\x04\x1f3I\x10\xc5\xbb\xb4\r\x0e\xfcM>_'
b'\x8e\xad\x04\x1f3I\x10\xc5\xbb\xb4\r\x0e\xfcM>_'


avalanch in 3-des key changed from  This is a key123 to  This is a kfy123  :
b'\x8d\xad\x04\x1f3I\x10\xc5\xbb\xb4\r\x0e\xfcM>_'
b'\xd8,\xac\x15\xb4\xd0m\xcad4\xc5\x951\xb1\\1'
```

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OBSERVATIONS:

Avalanche effect (change in plaintext)	DES	Triple DES	AES-128	AES-192	AES-256
key	key12345	This is a key123	This is a key 123	This is a key123 of aes2	This is a key123 of aes2 1234567
Original plaintext	123456xxxxxxxxxx				
ciphertext	'EY\x9b\xbc\x9f9\n\x1eJ\xe4\xf8\x80\x9c\xb7\xad\xb8'	'\x8d\xad\x04\x1f3I\x10\xc5\xbb\xb4\r\x0e\xfcM>_'	'\xfc\t\x8d\x98\x01\xda\x0b\xcdc\xf4\x0f\xcc6\x80v\xbc'	'\xcap\xa4\xd1\xe5\xa2\x93\x90\x9au\x8e\xf2\xf5\x0e\x08\xf8'	'\x15\xcfGT\xf5\x1f\xbd\xb90\xa4\x7f\x92Bt\x9f\x97'
Changed plaintext	223456xxxxxxxxxx				
New CT	'FY\x9b\xbc\x9f9\n\x1eJ\xe4\xf8\x80\x9c\xb7\xad\xb8'	'\x8e\xad\x04\x1f3I\x10\xc5\xbb\xb4\r\x0e\xfcM>_'	'%\x02\xd5\xa0-\x17]c\x82\xb9I.\x971\xe5z'	'\x12\x02\x052q\xeb>\n\xe4Aw\xf24\xc7\xc4\xb7'	'\xab\x01!\xf1\xda\xecJ\n\xedk\xe3\xed\xadV\xe5p'

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Avalanche effect (change in key)	DES	Triple DES	AES-128	AES-192	AES-256
key	key12345	This is a key123	This is a key 123	This is a key123 of aes2	This is a key123 of aes2 1234567
Original plaintext	123456xxxxxxxxxx				
ciphertext	'EY\x9b\xbc\x9f9\n\x1eJ\xe4\xf8\x80\x9c\xb7\xad\xb8'	'\x8d\xad\x04\x1f3I\x10\xc5\xbb\xb4\r\x0e\xfcM>_'	'\xfc\t\x8d\x98\x01\xda\x0b\xcdc\xf4\x0f\xcc6\x80v\xbc'	'\xcap\xa4\xd1\xe5\xa2\x93\x90\x9au\x8e\xf2\xf5\x0e\x08\xf8'	'\x15\xcfGT\xf5\x1f\xbd\xb90\xa4\x7f\x92Bt\x9f\x97'
Changed key	kfy12345	This is a kfy123	This is a kfy 123	This is a kfy123 of aes2	This is a kfy123 of aes2 1234567
New CT	'%s\xe0\xd0pc\xbf\x85\xa2\xcd\\\x1f\xd1\xbc\x13\xdb'	'\xd8,\xac\x15\xb4\xd0m\xcad4\xc5\x951\xb1\\1'	'Q\x9e\xa23D\xe9K\xa1&\xc8X\x98_9\xb1#'	\x82\x9a=\xe6\xe3V\xb3\xb5\xb7!\xbb\xa8k\x1c\xfd\xa7'	'\x8a\xb0W\x00\x89F\xeb\xe0\xc2\xf6(\xeeH\xa5\xe3\xc1'

CONCLUSION:

Thus it can observed that Avalanche Effect with respect to change in message produces minimal change in cipher text for DES, 3DES but produces huge changes for AES

Avalanche Effect with respect to change in key produces noticeable change in cipher text for all block ciphers.

Therefore AES produces more Avalanche Effect because of having superior diffusion and confusion.

Thus, we have studied and implemented AES and DES, 3-DES block ciphers.