CS5460 Assignment #1 Crypto Lab – Secret Key Encryption

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https://github.com/aderbique/cs5460/tree/master/assn3

3.1 Task 1: Encryption using different ciphers and modes

During this task, I spent time getting familiarized with openssl and how to encrypt and decrypt files. I practiced on the README file that is found in the openssl directory on the seed image. These are a couple of the commands I used for this task. The files can be found in the Task 1 directory of the github repo.

```
seed@ubuntu:~/openssl-1.0.1$ sudo openssl enc -camellia-128-ecb -e -in README -out
README_rc2-128-cfb -K 00112233445566778889aabbccddeeff -iv 0102030405060708
```

```
seed@ubuntu:~/openssl-1.0.1$ sudo openssl enc -camellia-128-ecb -e -in README -out
README_camellia-128-ecb -K 00112233445566778889aabbccddeeff -iv 0102030405060708
```

3.2 Task 2: Encryption Mode – ECB vs. CBC

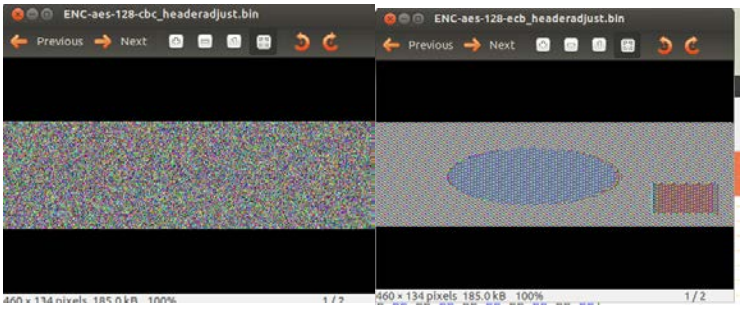
1. This task consisted of encrypting a given simple.bmp image file using ECB and CBC ciphers. To do this, the following commands are used:

```
seed@ubuntu:~/Desktop/cs5460/assn3/part1$ sudo openssl enc -aes-128-ecb -in simple.bmp
-out ENC-aes-128-ecb.bin -K 00112233445566778889aabbccddeeff -iv 0102030405060708
```

```
seed@ubuntu:~/Desktop/cs5460/assn3/part1$ sudo openssl enc -aes-128-cbc -in simple.bmp
-out ENC-aes-128-ccb.bin -K 00112233445566778889aabbccddeeff -iv 0102030405060708
```

The resulting files are encrypted binary files that must have the headers changed for them to be recognized as an image file. To do this, the first 54 bytes of the files are replaced with the first 54 bytes of the original image file using Bless. These files are available in the Task 2 section of the github repo.

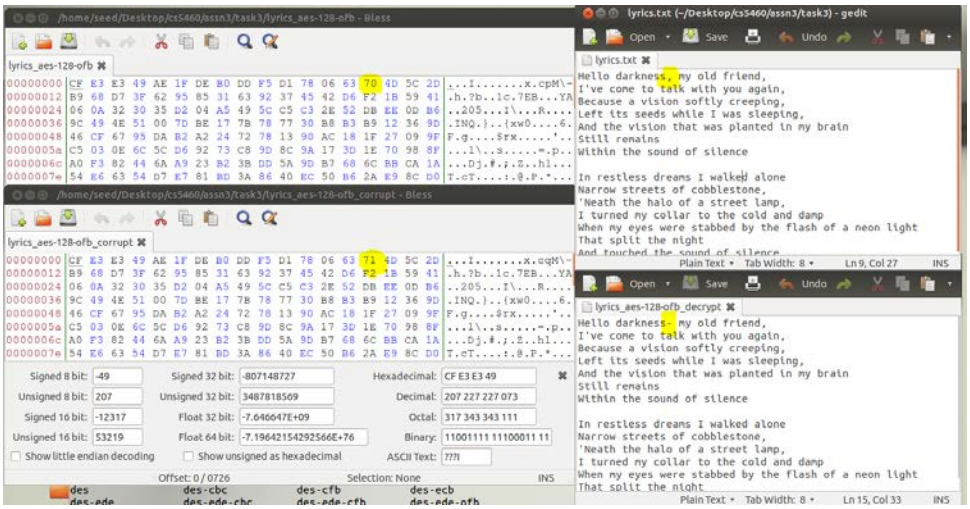
2. The CBC encryption completely scatters the image into a way that gives no information as to what the original image may have been. On the other hand, the ECB encryption shows a vague relation to the original image.



3. The task3.txt encrypted bmp image file is an encrypted version of the simple.bmp image using rc2-cbc cipher and a password of “cs5460”. This is available in the task 3 github repo.

3.3 Task 3: Encryption Mode – Corrupted Cipher Text

For this task, lyrics from a song were used and the input filename is lyrics.txt. The file was encrypted using AES-128-CBC cipher and saved as lyrics_aes-128-cbc with the corrupted file as lyrics_aes-128-cbc_corrupt. The 30th bit the corrupted file had its value changed from 1 to 2. This corrupted file was then decrypted to a file named lyrics_decrypt. A comparison of the before and after are shown below.



To answer the questions asked in the lab document, a majority of the information is recoverable. The only information that is changed is what came before the corrupted bit. I predict that this will change depending on the cipher used. For example, I predict that the CFB cipher will make this completely unrecoverable. To my surprise, the information in every document is mostly recoverable. There are slight differences between the files, but ultimately all are recoverable.

3.4 Task 4 : Padding

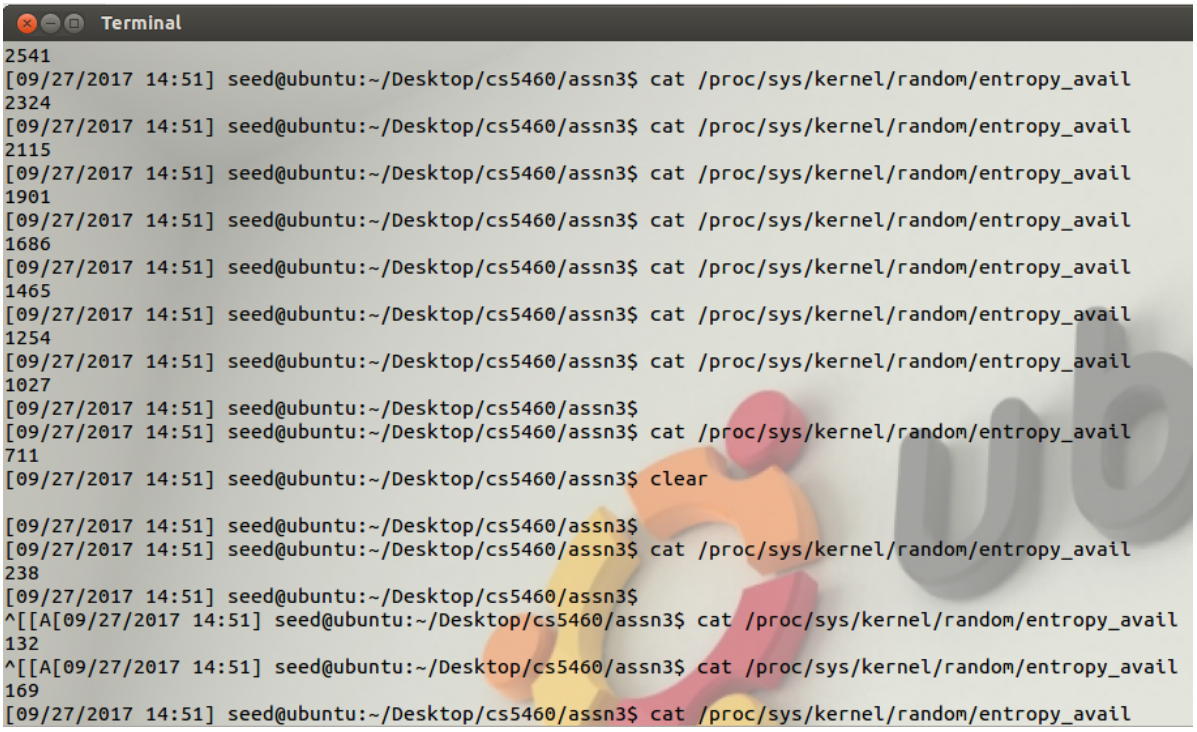
For this task, I created two text files, one containing 20 bytes and the other containing 32 bytes. The contents of these files were q's. Next, the two files were encrypted using aes ciphers with ECB, CBC, CFB, and OFB modes. Using Bless, I attempted to see how much padding there was for each file. An assumption was made that the shorter files would have more padding than the file with 32 bytes. Unfortunately, I could not determine if the files contained padding or note, despite the fact that the length of the new file was now larger, meaning padding must have been added. I believe that all of modes I tried used padding.

3.5 Task 5: Programming using the Crypto Library

For this task, the script find_password.py is used to try and find the password given relevant information of the plaintext and encrypted file. Given the situation, it is known that the key is based upon a dictionary value padded with whitespace to give the encryption a strength of 128 bits. The way find_password.py works is to loop through all values in the dictionary file and encrypt the plaintext file using the value as the key. Once this is complete, the script will attempt to compare this generated encrypted file and encrypted file we know to be true. If these two files are the same, we know that dictionary value is the key and we can break the script. NOTE: This script is written in python and requires no such additional libraries. It uses the os.system() command to call the existing openssl command installed on your computer. While I was not able to get this working, the concept appears to be correct and will output the secret password.

3.6 Task 6: Pseudo Random Number Generation

For Task 6.A, I moved the mouse and typed keys slowly and did not see a change in availability. This is when I realized that the value would only change when things happened fast. Decreasing the time in between calls led to a reduced availability. Below is a picture showing the time stamps and value recorded of entropy available.



For Task 6.B, I found the contrary to be true. Writing a script entropy_drain.py, I attempt to get random numbers as fast as possible. It is evident that the entropy drops to single digit numbers, but it is rarely zero. It appears to hang until a random number is generated and eventually gives a random number. You can see that the first few calls occur very fast while entropy is high but the entropy quickly drains and that is when the calls start slowing down. The figure below shows entropy dropping quickly to a point where the pseudo random numbers can no longer collect random numbers fast enough.

For the last part of Task 6, a script urandom.py is available in the GitHub repo to call "head -c 1600 /dev/urandom | hexdump" 100 times as fast as possible. It is observable that there is no wait time for these random numbers which can be explained by the background information given in the assignment description.

Conclusion

The purpose of this lab is to get familiar with the concepts of secret key encryption. The six different tasks associated with this lab give a general understanding to the different ciphers and modes of encryption as well as how to generate randomness for good security. While completing this lab, I have learned more about openssl and encryption protocols as a whole.