Michael Lee

Assignment 2

3.1) Observation task – one-way hash and randomness

1. Created text file
2. Hash of file H1 = 3f03cd845ee8f5405d64055c08be02ca1c386b153e8f10ef19fdca85ffe406eb1c038fa4b9220ad414cc2cb88a1ef0e81b6c91339321d415808d2e0d0b7dd02d
3. 01010100 T -> 01010101 U
4. New hash of file H2 = a8ec5654b7a4b899465ff45a6b26eef75da9331756c39e91525ca22ffc782389b550250e12bda5d46d482dd5aab44ba2cb7dafe33864617a7aea8d1954b9a9a1
5. As you can see from above, the hashes are completely different using python counting the 1's of H1 XOR H2 there are 247 different bits
6. After flipping the four bits: the difference between H1 and H3 is: Sha256 – 138 bits, Sha512 – 269 bits.

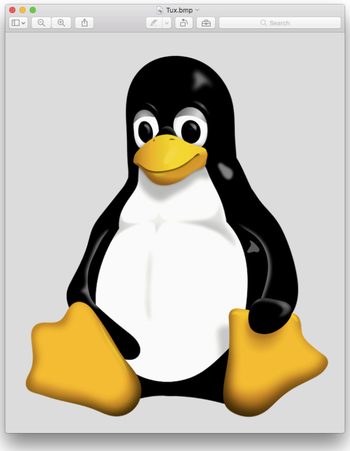
3.2) Observation task – Keyed hash and HMAC

Key length	HMAC-SHA256	HMAC-SHA512
128	0eb2f9a4f18df6da9651f76ce297f2ee73053894716cdeecb93293c03d68adad	a3ceb3b8d41d3f52a15b3fa47973e14307566da8bf99d03819b842759c6615cb7f40a4f76680d6a7d26e6c7d0ba589ef90f55602cf5dcfd0bb79939d9149a9d6
160	e0cf26b8d9a25ac6190783613fb9a6be446aeaf58fd765ee6c0b75c63b9df99f	28ec762dc6e13221b05f0585c7f2ce56bdea12f314d0825fafed94f9048b2c9dee91e011cd7288c25f760423136b8efcbdea344f6077b23b8a470c9906ed7c62
256	19bf321edcf1071da7519ccd1b559eb4dd1d31ad9e582792dd9de6cb922c094	0d8cd404df18be92682d72b8fc9c20a8d64d5d90e2a10ac51dd95ed3f727584bed7eb4f179a37090e79e1f8785568337d9d19ae2043fc838b532811d325944e0

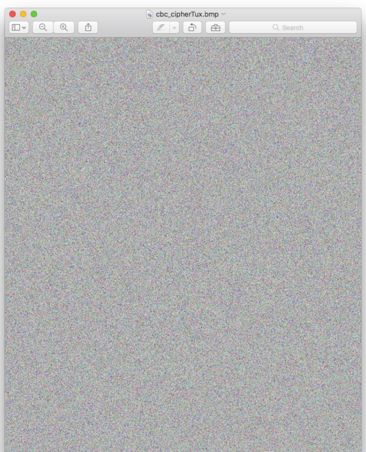
Judging from the keyed hashes that we get back in the table above, they are all distinct even though we aren't using a fixed key size. From research I've found that as long as the key is above 128 bits it is infeasible to crack in our lifetimes, and so as long as we hit this point the keyed hashes will be secure, and any longer than the bit size of the hash is unnecessary (256 bits for sha256 and 512 for sha512).

3.3) Encryption using different ciphers and modes

-on next page-



Original -



CBC -

ECB -

3.4) Observation Task: CBC Encryption using different IVs

1. Encrypt1.bin and Encrypt2.bin's contents are exactly the same because we used the same key, iv, and file contents. It's fairly obvious that this would result in the exact same output as the IV hasn't been change so there's no variability in the outcome.
2. Encrypt1.bin and Encrypt3.bin's contents do not match, because we changed the IV and so it changes because the IV is XORed to alter the output.

3.5) These set of questions are based on a real world vulnerability in an open source File Storage application called OwnCloud. Please refer to this blog post for the details about the vulnerability and answer the following questions in brief(less than 5 lines):

1. Data is encrypted and stored on the Owncloud server using their own encryption module, but it is stored with exact filenames and other header info. They use malleable encryption modes, like CFB and CTR, which allow a hacker to flip cipher-text bits which get flipped in the resulting decrypted data. The hacker uses this principle to gain control of certain bits in the user's uploaded file. Then the user then infects their own computer as Owncloud doesn't verify what the user is downloading.
2. The encryption mode they used was AES-256 in Cipher Feedback Mode.
3. CFB has malleability which means that any bit flipped in the cipher-text gets flipped in the decrypted code. This means that the hacker can XOR the cipher-text with their own code and insert what they want into the decrypted code.
4. As mentioned in the article and what they eventually upgraded to, they could use authenticated encryption to overcome the limitation of malleability with just encryption. The author mentions AEADs, Galois/Counter-Mode, etc.
5. Code reuse is the attack method and they allow attackers to execute arbitrary code using jump statements to bypass security measure that prevent execution from certain regions of memory.