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Homework 1

Task 1:

a)This is a violation of confidentiality because the passwords that were supposed to be private but are now public. This is also a violation of data integrity because if the hacker wants to change something on your yahoo account they have that ability, however due to the volume of the hack, probably not all accounts would be changed. Having the password would also possibly allow the hacker to register a new computer with trusted certificates to other sites, or send emails from the account to others, violating source integrity. This would be similar to a recent ucsb umail attack where spam emails were being sent from hacked accounts to unhacked accounts serving the agenda of an unknown 3rd party.

b)This is a violation of data integrity because if there was information being written to a moving disk hard drive (which there probably was because this is a server room) then data would be lost. This would also be a violation of availability, because the information/services being hosted by the servers would not be able to send and receive with the power out.

c)This is a violation of confidentiality because the NSA could possibly view anything that is encrypted using AES. This is also a violation of data integrity because if the NSA can break AES, then they can change it and re-encrypt it to appear as if nothing had been changed, allowing their possibly malicious changes to go unnoticed.

d)Availability is the primary violation because John Smith cannot access the domain name that he represents. This is also potentially a violation of source integrity because if a 3rd party wants to interact with john smith they might assume they must visit JohnSmith.com, and interact with Anna, allowing her to assume John Smith’s identity which can be used maliciously.

e) Availability is the primary violation, because the victim no longer has their data available to them because they cannot decrypt their own hard drive. Since the malicious user has the key to the hard drive, this is also a violation of confidentiality and data integrity because the malicious user can use the key to view/change data potentially.

f) This is a violation of confidentiality because the conversations and information sent and received are available to the NSA as well as the users they were intended for.

g)This is a violation of confidentiality because the foreign state actor can view who individuals voted for. This is also a violation of data integrity because the foreign state actor could possibly modify the votes that were sent in. This is a violation of source integrity because the people receiving the votes think they are receiving votes from citizens when they could actually be receiving votes from a foreign state actor.

Task 2:

1. Plaintext: IFYOUTRYANDTAKEACATAPARTTOSEEHOWITWORKSTHEFIRSTTHINGYOUHAVEONYOURHANDSISANONWORKINGCATX

This plaintext was recovered using a brute force method of solving the Caesar cypher by trying all possible rotations to the alphabet until a readable decryption appears.

1. Plaintext:

This plaintext was discovered using a mix of frequency analysis, reasoning about common words in English, and using this information to make initial mappings until enough of the words became clear and could be recognized. The most common letters in this string are GQAOLKSBPHTW.

Task 3:

1. Yes, this is a valid block cipher because it is a one-to-one mapping of plaintext to ciphertext blocks per key value. The length of the ciphertext blocks is the same as the plaintext blocks, and for each key, there is only one ciphertext per plaintext, therefore ensuring this is a valid block cipher.
2. E’ : {0,1}n x {0,1}n -> {0,1}n defines a mapping such that the key length is as long as the plaintext and ciphertext. The resulting substitution box will have 2n rows and columns. Since E’(K,X) = X, the encryption is not reliant upon the key, making this block cipher an insecure substitution, despite technically being a valid block cipher because every number maps one-to-one to itself (e.g. 110 -> 110, 101->101, etc.)
3. E’’: {0,1}n x {0,1}n -> {0,1}n defines a mapping such that the key length is as long as the plaintext and ciphertext, and the resulting substitution box will have 2n rows and columns. Since E’(K,X) = Xnot xor K, is the encryption function, and since bitwise xor of two strings produces a one-to-one mapping, each row will have a one-to-one mapping, and each row will be different because each key will produce different results when xor’d with the same plaintext.
4. E’ is not a secure block cipher with any amount of bits, as the encryption function is a one to one mapping that doesn’t modify the plaintext. However, with a 128-bit block length n, Xnot xor K can become any possibility with probability 1/(2^128), making this block cipher a secure block cipher.

Task 4:

1. With a pseudorandom iv, CBC mode, and using the pycrypto library, I encrypted the message X with itself as the key to be: ad77a337eadd6e56c1ee3477a15e2f38145867089548ef0247782eb8197046f4
2. I’m not sure if this is a trick question because due to the pseudo randomness of AES/CBC, the encryption of the message should be different each time it is encrypted or else it would violate the right definition of semantic security as stated by Goldwasser-Micali which means that nothing can be revealed about the message for it to be encrypted. So if a certain message would end in 00 each time it is encrypted, then that would reveal something about the message, because other messages would not be the same when encrypted. If the goal is purely to have the encryption end in 00, then the only thing you have to do is encrypt the same message multiple times until the randomness of the encryption encrypts the last byte to 00, but this is independent of the message.
3. There is no 16 byte key that always maps the last byte of an encrypted message to be 00, because this would break the encryption, because it would reveal information about the message, as stated by the right definition of semantic security by Goldwasser-Micali.