Fall 2020 CIS 3362 Week One Assignment Solutions
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1) You can write up a program that can brute force all possible shift values printing their decrypted values. You can see an example of a possible code solution (hmk1-1.c), when 10 is added to the encrypted cipher text we get the output:

Welcome to virtual cryptography.

The encryption key was k = 16, we get this value because 16 ≡ -10 (mod 26)

2) Using the same code from problem 1, when 18 is added to the encrypted cipher text (mod 26) we get the output:

Mathematics and considering all possibilities will be important in this course.

The encryption key was k = 8, we get this value because 18 ≡ -8 (mod 26)

3) Simplest way to solve this problem is by brute force, since a is restricted to only coprime numbers there are 312 possible keys for the affine cipher. Writing a function that goes through each possible key, see (hmk1-3), we eventually find that the keys a=7 and b=24 decrypt the ciphertext:

Though the affine cipher is easy to break with a computer it allows me to introduce you to quite a few important ideas in cryptography such as the Extended Euclidean Algorithm.

We can find the keys that were used to encrypt the plaintext by finding the mod inverse:

\[ f(x) = (7x + 24) \mod 26 \]
\[ (x-24) = 7f^{-1}(x) \mod 26 \]
\[ 15(x-24) = 15(7f^{-1}(x)) \mod 26 \]
\[ f^{-1}(x) = (15x – 360) \mod 26 \]
\[ f^{-1}(x) = 15x + 4 \mod 26 \]

Therefore the encryption keys are a = 15 and b = 4

4) We can create a program that can encrypt the plaintext with the keys a=7 and b=22, so our function would be \( f(x) = 7x + 22 \mod 26 \). The program (hmk1-4) gives us the encrypted cipher text:

kwjiqgkqcygxadwregyszaqjqlhqvoyztwzsvvztyvyzzylsajwpqquaztwfqbmalwffyqlngvzgly