HW 01 CMSC 456. Morally DUE Sep 21

NOTE- THE HW IS FIVE PAGES LONG

NOTE- THE HW HAS A PROG ASSIGNMENT THAT IS NOT IN THIS DOCUMENT

IT IS ON THE COURSE WEBSITE

1. (0 points but you should really do it)
   (a) When is the untimed part of the midterm due?
   (b) When is the timed midterm? Where will you be taking it?
   (c) What is the day and time of the final? (I don't know yet so you don't need to answer this one.)
   (d) What is the *dead-cat policy*?
   (e) What is the policy about *wearing a mask in class*?

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2. (20 points) How many $x \in \{0, \ldots, 99\}$ satisfy the equation

$$x^2 + 17x + 16 \equiv 0 \pmod{100}$$

No justification needed. (Hence your grade will be either 0 or 20.)

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3. (0 points. This problem was also on hw00 for 0 points.) Given a, b we want to find if $a^{-1} \pmod{b}$ exists.

   (a) Look up *The Euclidean Algorithm* which is for this problem.

   (b) Code up the algorithm in Python 3 (it will be used in many later assignments and may be useful for the next problem).

   DO NOT hand anything in, but DO THIS and I will, in the future, assume that you did this and can use it within other assignments.

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4. (20 points) Let $n \in \mathbb{N}$. Let $a, b \in \mathbb{N}$. (a, b) is *cool relative to* n if $a, b \in \{0, \ldots, n-1\}$ and a is rel prime to n (there is no condition on b). Note that these are the (a, b) such that the affine cipher that maps x to $ax + b \pmod{n}$ works.

   (a) (10 points) How many $a, b \in \{0, \ldots, 29\}$ are cool relative to 30.

   (b) (10 points) A student picks an $a, b \in \{0 \ldots, 29\}$ at random. What is the probability that (a, b) is cool relative to 30?

   Give the answer to four decimal places.

   (c) (0 points but DO IT) How many (a, b) are cool relative to 31?

   (d) (0 points but DO IT) A student picks an $a, b \in \{0 \ldots, 30\}$ at random. What is the probability that (a, b) is cool rel to 31?

   Give the answer to four decimal places.

   (e) (0 points but DO IT) What types of numbers n are such that the prob of picking an (a, b) that is cool rel to n is close to 1? Give an example of a number between 1000 and 1200 where the prob is close to 1. What is the prob? Give it to 4 places.

   (f) (0 points but think about) What types of numbers n are such that the prob of picking an (a, b) that is cool rel to n is far from 1? Give an example of a number between 1000 and 1200 where the prob is far from 1. Give an example of a number between 1000 and 1200 where the prob is close to 1. What is the prob? Give it to 4 places.

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5. (10 points) Alice and Bob are using a 26-letter alphabet. Alice and Bob are going to use the affine cipher. Bob has an idea! Bob says they should pick a, b so that the encode-key and the decode-key are the same!

   (a) List all a, b so that the encode-key and the decode-key are the same.

   (b) Give a reason why Bob's idea is a good idea.

   (c) Give a reason why Bob's idea is a bad idea.

6. (50 points) Do the programming assignment that is next to this on the website.