

HW 3 CMSC 389. DUE Jan 6

1. (15 points) Look up on the web an easy formula for finding the inverse of a 2×2 matrix. Present the formula.
2. (25 points) For each of the following domains give (1) an example of a 2×2 matrix that DOES have an inverse using numbers from that domain, and give the inverse, and (2) an example of a 2×2 matrix that DOES NOT have an inverse using numbers from that domain (no proof needed). IF you think either one of the desired matrix DOES NOT EXIST then tell us so and tell us why.
 - (a) REALS
 - (b) INTEGERS
 - (c) $\{0, \dots, 25\} \text{ MOD } 26$
3. (20 points) Find ALL pairs of numbers $a, b \in \{0, \dots, 25\}$ such that the coding and decoding table for x goes to $ax + b \pmod{26}$ are the same.
4. (20 points) (In this problem the alphabet is the usual $\{0, \dots, 25\}$ so all arithmetic is mod 26.) You are Eve. You know that Alice and Bob are using a 2×2 matrix cipher. You know that the message $(1, 4, 20, 8)$ mapped to $(0, 1, 2, 3)$. Write down the equations needed to find the matrix (you do not need to solve them).
5. (20 points) There is a website that claims that if you input a sentence and a shift it will do that shift to the sentence. The website is:

<http://rumkin.com/tools/cipher/caesar.php>

There are some sentences that we have looked at where the program they have DOES NOT WORK. Find them.

HINT: Try to input "CMSC 389T Rocks!"