1. (10 points) What is your name? Write it clearly. Staple your HW.

2. (10 points) Let $\vec{p} = \{0.5, 0.2, 0.2, 0.1\}$ (we denote the $i$th element of $\vec{p}$ by $p_i$) and $\vec{q} = \{0.2, 0.2, 0.1, 0.5\}$ (we denote the $i$th element of $\vec{q}$ by $q_i$).
   
   (a) Compute $p_1* p_1 + p_2* p_2 + p_3* p_3 + p_4* p_4$.
   
   (b) Compute $p_1* q_1 + p_2* q_2 + p_3* q_3 + p_4* q_4$.
   
   (c) What point was I trying to make by having you do this?

3. (20 points) Assume that Alice and Bob are using a keyword mixed cipher. Assume the keyword is "telephone. Make the table to both encode and decode. (NOTE- THIS IS TWO TABLES- ONE TO ENCODE, ONE TO DECODE. ALSO NOTE- THE TABLE TO DECODE SHOULD TELL YOU HOW TO DECODE A, B, C, ETC, IN THAT ORDER, SO ITS USABLE BY ALICE AND BOB.) If Alice wants to send the message: I hope the midterm is easy. What does she send?

4. (10 points) Write $(2234)_{10}$ (that is 2234 in base 10, normal numbers you are used to) as a base 2 number. Show all work.

5. (10 points) Write the following base 2 numbers in base 10: 1,11,111,1111,11111. (Optional: Do you spot a pattern? what do you think 11⋯1 ($n$ 1’s) will be?)

6. (20 points) Alice and Bob are using the Vigenere Cipher. The key is DOG. Alice wants to send Bob the message

   *Cats are cool*

   What does Alice send?
7. (20 points) Alice and Bob are using the Matrix Cipher. The matrix is

\[ A = \begin{pmatrix} 2 & 3 \\ 7 & 5 \end{pmatrix} \]

Alice wants to send Bob the message

*The Young Scholars*

What does Alice send?

8. (0 points). (Optional) If you wrote a program that used the shift cipher yesterday then USE THAT PROGRAM to code, with shift 5, the message:

*CMSC 198? Its an awesome course!*

Did this example show a flaw in your code?

9. (0 points. If you know programming than do for fun.) Write a program that will, given a text and numbers \(m, s\), produce the output of the Affine Cipher with Multiplier \(m\) and a shift of \(s\). If the user inputs an \(m\) that is NOT rel prime to 26 then have the programs output

*Your \(m\) was not rel prime to 26 you moron!*

(or something similar).

Also write a program that decodes. Test them against each other.

10. (For your own benefit) Look up on the web how to find the inverse of a matrix in the normal numbers. Ponder how that might change mod 26.