EECS 16A Designing Information Devices and Systems I
Fall 2021 Homework 1

1. Reading Assignment

For this homework, please read Note 0, Note 1A, and Note 1B. This will provide an overview of linear equations and augmented matrices. You are always welcome and encouraged to read ahead as well. Write a few sentences about how the content in these notes relates to what you have learned before and what content is new.

2. Reading Reflection

Our modern world is filled with information devices and systems, and we want to get you thinking about them! Think about your favorite devices. If you're stuck, here are a few examples: cell phone camera, voice-activated speaker, heart rate monitor, vocal microphone, RADAR scanner. Write a short paragraph identifying the following:

(a) How does this device physically sense and measure the real world?

(b) What does it do with the information it senses?

(c) Does this device have any actuators or other ways to respond what it senses?

(d) What are some applications where this device is used? Are there any alternate options we can use?

(e) What do you hope to learn about this device in this class?

We hope this inspires your learnings and curiosities in this class!

3. Counting Solutions

Learning Goal: *(This problem is designed to illustrate the different types of systems of equations. Some sub-parts will have a unique solution and others have no solutions or infinitely many solutions. In this class, we will build up the mathematical machinery to systematically determine which case applies.)*

Directions: For each of the following systems of linear equations, determine if there is a unique solution, no solution, or an infinite number of solutions. If there is a unique solution, find it. If there is an infinite number of solutions, explicitly state this, describe the set of all solutions, and then write one of such solutions. If there is no solution, explain why. **Show your work**.

Example: The below example shows how to methodically solve systems of linear equations using the substitution method.

$$\begin{aligned} 2x + 3y &= 5 \\ x + y &= 2 \end{aligned}$$

Example Solution

$$2x+3y = 5 \tag{1}$$

$$x+ y = 2 \tag{2}$$

Subtract: (1) - 2*(2)

$$y = 1 \tag{3}$$

Now we plug in (3) into (2) and solve for x

$$\begin{aligned} x + 1 &= 2 \\ \rightarrow \quad x &= 1 \end{aligned} \tag{4}$$

From (3) and (4), we get the unique solution:

$$\begin{aligned} x &= 1 \\ y &= 1 \end{aligned}$$

(a)

$$\begin{array}{rcrcrl} x & + & y & + & z & = 3 \\ 2x & + & 2y & + & 2z & = 5 \end{array}$$

(b)

$$\begin{array}{rcrcrl} & - & y & + & 2z & = 1 \\ 2x & & & + & z & = 2 \end{array}$$

(c)

$$\begin{array}{rcrl} x & + & 2y & = 5 \\ 2x & - & y & = 0 \\ 3x & + & y & = 5 \end{array}$$

(d)

$$\begin{array}{rcrl} x & + & 2y & = 3 \\ 2x & - & y & = 1 \\ x & - & 3y & = -5 \end{array}$$

4. Magic Square

In an $n \times n$ "magic square," all of the sums across each of the n rows, n columns, and 2 diagonals equal magic constant k. For example, in the below magic square, each row, column, and diagonal sums to 34.

4	14	15	1
9	7	6	12
5	11	10	8
16	2	3	13

The magic square is a classic math puzzle, and some of you may have solved these as children by guessing. However, it turns out they can be solved systematically by setting up a system of linear equations!

(a) How many linear equations can you write for an $n \times n$ magic square?

(b) For the generalized magic square below, write out a system of linear equations.
Hint: Set the sum of entries in each row, column, and diagonal equal to k.

x_{11}	x_{12}	x_{13}
x_{21}	x_{22}	x_{23}
x_{31}	x_{32}	x_{33}

(c) Now consider the following square, with some entries filled in. Substitute the known entries into the linear equations you wrote in part (b) to solve for the missing entries x_{11}, x_{12}, x_{32}. Please show the equations you use to solve; credit will not be given for solving by inspection.

x_{11}	x_{12}	8
9	5	1
2	x_{32}	6