BIOE 210, Spring 2022

Homework 3

Due Monday, 2/7/2022 by 5:00pm.
You must upload your answers to Compass and assign each question.

1. Solve the following linear systems using Gaussian elimination.

   (a)

   $$4x_1 - 3x_3 = 5$$
   $$x_2 + 5x_3 = 8$$
   $$x_1 + x_2 + x_3 = 6$$

   (b)

   $$\begin{pmatrix} 1 & a \\ 2 & -2 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$$

2. Four apples, two bananas, and one orange cost \$2.50. An apple and a banana costs \$0.75. Two bananas and two oranges cost \$0.50. How much does each type of fruit cost assuming there are no taxes or discounts for buying multiple items? Use Gaussian elimination to solve this problem.

3. You want to characterize the effects of four upstream *regulatory elements* on the expression of a bacterial gene. You collected data from four strains of bacteria by measuring gene expression. Based on the genome sequences of the strains, you know what combination of regulatory elements appear in each strain. The data are summarized in the following table.

element 1	element 2	element 3	element 4	expression
yes	no	yes	no	0.63
yes	yes	no	no	1.25
yes	yes	yes	yes	2.78
yes	no	no	yes	1.44

   Assuming that each regulatory element acts independently, write a system of linear equations that describes how the gene's expression depends on the presence or absence of the regulatory elements. Let the unknown variables x_1, x_2, x_3, and x_4 represent the contribution each regulatory element makes toward gene expression. Solve your linear system to find the contributions of each element.