# Linear Algebra – Day 4

MATH 220

**1. Milo:** I have a matrix $A$ that I need to put in reduced row echelon form.

**Ava:** I can do that! In fact, I can do it without using any fractions!

$$A = \left[\begin{array}{rrr|r} 2 & -2 & 6 & 4 \\ 6 & -3 & 3 & 0 \\ -1 & 3 & -1 & 2 \end{array}\right]$$

**Group chat:** Is Ava correct? Can this matrix be put in reduced row echelon form (RREF) without ever using a fraction!

**Milo:** Fantastic! Now I can read off the solution to the corresponding system!

**Group chat:** What is the solution?

**2.** Now put each of the following matrices in RREF.

$$B = \left[\begin{array}{rrr|r} 1 & -1 & 3 & 3 \\ 2 & 1 & 3 & 1 \\ -1 & -5 & 3 & 2 \end{array}\right] \qquad C = \left[\begin{array}{rrr|r} 0 & 3 & -5 & -4 \\ 1 & -1 & 3 & 2 \\ -1/3 & 1/3 & -1 & -2/3 \end{array}\right]$$

**3.** For each of the augmented matrices $A$, $B$, and $C$ on this page, is the corresponding solution set empty, a point, a line, or a plane?

**4.** A coffee merchant sells 3 coffee blends. One bag of each blend contains the following types of coffee beans:

- The House blend is 300g of Colombian and 200g of Guatemalan coffee beans.
- The Special blend is 200g of Colombian, 200g of Kenyan, and 100g of Guatemalan beans.
- The Gourmet blend is 100g of Colombian, 200g of Kenyan, and 200g of Guatemalan beans.

The merchant has on hand 30kg of Colombian, 15kg of Kenyan, and 25kg of Guatemalan beans.

(a) Write a system of equations whose solution tells you how many bags of each blend the merchant should prepare in order to use all the beans.

(b) Set up the augmented matrix associated with your system.

(c) What does the first row in your matrix represent?

(d) What does the first column in your matrix represent?

(e) Row reduce your matrix. What is the solution to the system?

**5.** Suppose that the echelon form of an augmented matrix has a pivot position in every column. How many solutions does the associated linear system have? Explain.

**6.** Suppose you have a homogeneous linear system with more variables than equations. How many solutions will it have? Why?