Chapter 7.3

Linear Algebra with applications to differential equations

College of the Atlantic. Winter 2019

1. (Re)introduce yourself to your partners. I dunno. How's your week ten going?

2. Consider the following linear system:

$$x_1' = 4x_1 + 2x_2 \,, \tag{1}$$

$$x_2' = 3x_1 - x_2 \,. \tag{2}$$

   (a) Find the general solution.

   (b) Hey! You did this last week. Look for it in your notes.

   (c) Find the solution for which $\vec{x}(0) = (2, -6)$. Plot the solutions. What is their long-term behavior?

   (d) Find the solution for which $\vec{x}(0) = (2, 1)$. Plot the solutions. What is their long-term behavior?

   (e) Find the solution for which $\vec{x}(0) = (0, -4)$. Plot the solutions. What is their long-term behavior?

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3. Consider the linear system:

$$x_1' = 6x_2 \,, \tag{3}$$

$$x_2' = -6x_1 \,. \tag{4}$$

   (a) Sketch the direction field for this differential equation.

   (b) Using eigenmethods, find the general solution to this system.

   (c) Find the solution for which $\vec{x}(0) = (2, 0)$. Plot the solutions. What is their long-term behavior?

   (d) Find the solution for which $\vec{x}(0) = (0, 2)$. Plot the solutions. What is their long-term behavior?

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4. Repeat the above question for

$$x_1' = -3x_1 + 6x_2 \,, \tag{5}$$

$$x_2' = -6x_1 - 3x_2 \,. \tag{6}$$

   If we're running short of time, which we probably will be, let's use wolfram alpha to make the direction field and find the eigenstuff.