Day 1: Introduction

Welcome to Math 2568: Linear Algebra

I am Prof. Enic Katz. You can call me Prof. Katz or Dr. Katz or Enic. Just don't call me Mr. Katz. That's my dad.

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OH: TBA.

This class is on Linear Algebra which involves the study of systems of linear equations. You'll have to be able to solve problems, but you will also have to understand mathematical concepts. Some of the concepts are quite difficult, especially towards the end of the semester. Please don't let the matieral get ahead of you.

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I'm going to try to be clear w/ my expectations in this class. If you can do all the homework problems and do the practice exam problems without looking at the solutions, you should be able to get at least a B+ or A- in this class.

Read p. 1 of syllabus

Technology: just don't be rude or distracting.

HW: Homework will be collected at the beginning of class next Fridays beginning next week. The two lowest homework scores will be dropped.

Exams:

Grading: HW 20%
Midterms 40%
Final 40%

I included a statement on disability accommodations, academic misconduct,

Okay, take a look around and make sure you know someone in class. Take a minute to introduce yourselves. Exchange email addresses if you feel comfortable. I encourage you to form study groups. You may work together but please

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be aware of academic misconduct. You must write up your homework individually.

Notecards

Name:
Hometown:
Year in School:
Major:
Math Classes you've taken:
Why you're taking this class:

About me: I've been at OSU since 2016, but I was an undergrad here. I'm from the Cleveland area (Solon and Beachwood). My hobbies include math, running and reading dumb stuff on the internet.

Plan for class

1) Matrices and Systems of Linear Eqns
2) Vectors in 2- and 3-dim space
3) $\mathbb{R}^n$ and its subspaces
4) Abstract Vector Spaces and Linear Transformations
5) Eigenvalues & Eigenvectors

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Q What is a linear equation?

A Sum of (constants $\times$ Indeterminates) = Constant

Ex $2x + 7y = 4$

$2x + y + 15z = 0.$

If I have more than 3 variables, I'll call them x_1, x_2, x_3, etc instead of x, y, z.

$$2x_1 + \pi x_2 + 15x_3 - 3x_4 + 21x_5 = 6.$$

Non-examples

$y^2 - x^3 - 2x = 7$

$y - \sin(x) = 2$

These use higher powers and functions. Not linear.

Q What is a linear system?

A A collection of linear eqns

Ex (i) $3x + 4y = -5$

(ii) $4x - y = 6$

We will want to solve this: find (x, y) making both eqns true.

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Algebraically

Solve for y in terms of x using (ii)

$$(*)\quad y = 4x - 6$$

We substitute this into (i):

$$3x + 4y = -5$$

$$3x + 4(4x - 6) = -5$$

$$3x + 16x - 24 = -5$$

$$19x = 19$$

$$x = 1$$

Plug into (*) to get $y = -4$, so

$$(x, y) = (1, -2).$$

This satisfies (i) and (ii):

$$3(1) + 4(-2) = -5$$

$$4(1) - (-2) = 6$$

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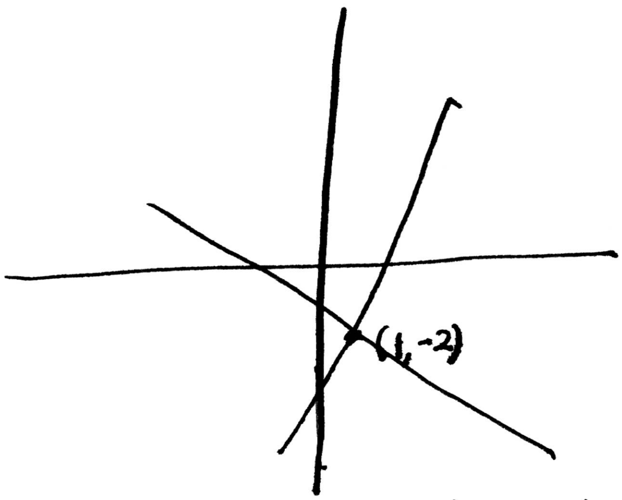
Geometrically

Eqn (i) and (ii) describe lines



The solution is the intersection of the two lines.

Issues

1) The linear system may have no solns.
2) The linear system may have infinitely many solns.

Example of no solns

(i) $x + 2y = 3$

(ii) $2x + 4y = 8.$

Using (i), we solve for x: $x = 3 - 2y.$

Substitute into (ii) to get

$$2(3-2y) + 4y = 8$$
$$6 = 8.$$

This is impossible.

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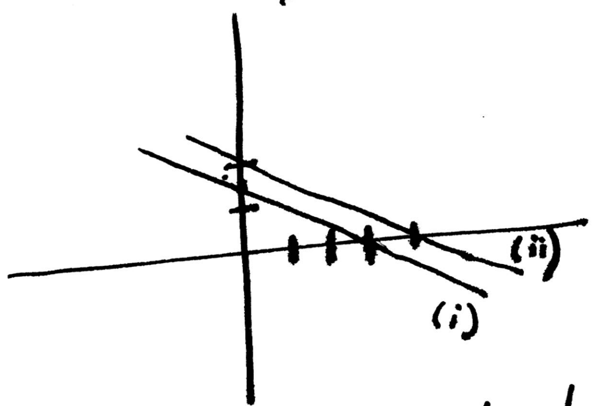
Geometrically, this corresponds to two parallel lines:



There are no points that belong to both lines.

Example of ∞ly many solns

(i) $x + 2y = 3$

(ii) $2x + 4y = 6$

Use (i) to solve for x: $x = 3 - 2y$.

Sub into (ii)

$$2(3 - 2y) + 4y = 6$$
$$6 = 6$$

Always true. Eqn (ii) doesn't add anything new.

In fact, eqn (ii) is $2 \times$(eqn (i)).

Any soln is of the form

$$(x,y) = (3 - 2y_0, y_0) \text{ for } y_0 \in \mathbb{R}.$$

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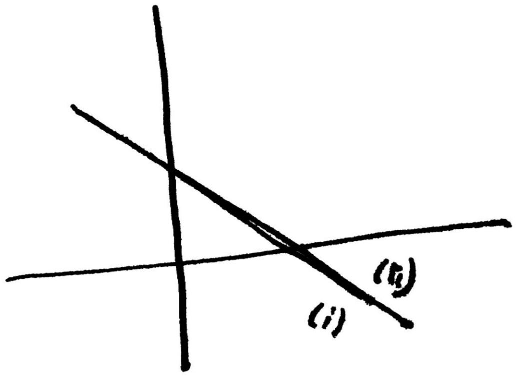
Geometrically, the two lines are identical.



Any point (x, y) on the line satisfies the system.

Questions

1) How do we do this with more variables and more eqns?
   Geometrically: higher dim'l space
2) How do you recognize when a system has no solns?
3) How do you describe the set of solns when there are ∞ly many?