9. Summary

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Summarize

Big Picture

1. Solving a linear system means **solving several linear equations simultaneously**. Alternatively, we may view solving a linear system as **solving for $\vec{x}$ in the equation $A\vec{x} = \vec{b}$**.

2. One method is **elimination**. This involves multiplying and adding equations together to elicit a solution.

3. Another method is to compute an **inverse matrix**, and do a matrix multiplication $\vec{x} = A^{-1}\vec{b}$.

4. Graphically, 3×3 linear systems can be visualized as finding the intersection of planes in space. Three planes can **either have a unique point of intersection, intersect at infinitely many points, or not intersect at all.**

Mechanics

1. The **inverse of a 2×2 matrix** is obtained by the formula

$$A^{-1} = \frac{1}{ad-bc}\begin{pmatrix} d & -b \\ -c & a \end{pmatrix} \tag{5.84}$$

2. The number $ad - bc$ is called the **determinant** of A. If this number is zero, then the matrix cannot be inverted.

3. In recitation, you will learn how to compute the determinant of a 3×3 matrix.

Ask Yourself

What makes the determinant useful?

The determinant's primary purpose is to tell us if a matrix has an inverse. Equivalently, it can tell us if a system of equations is solvable uniquely, or not.

A secondary application of the determinant is to computing the area of a parallelogram whose sides are given by vectors.

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If I have three equations and three unknowns, is there always a solution?

Not always. Three equations and three unknowns means you are looking for the intersection of three planes. But the three planes could have no intersection, which means no solution. A simple example would be parallel planes, but there are others.

It could also happen that we have infinitely many solutions, if one of the equations is redundant.

You can figure out which case you are in by solving the system by elimination. Or you can compute a 3×3 determinant (see recitation).

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