Source:

1 | new schedule today :/

2 | Systems of equations, matrix equations, and vectors

3 | in class work! See `./KBe20math530srcNull_space_and_column_space_intro.pdf`

3.1 | $A = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$

3.1.1 | How many solutions x satisfy $Ax = 0$?

The only solution is x=0, because $Ax = x$.

3.1.2 | When the answer is "infinitely many" what tools might we have to describe the size of that set?

N/A

3.1.3 | How many possible outcomes b are there for the equation $Ax = b$ for any x.

There can be infintely many vaules of b..? The vector space is dim 2

3.2 | $A = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \end{pmatrix}$

3.2.1 | How many solutions x satisfy $Ax = 0$?

Infinitely many (anything of the form $\begin{pmatrix} 0 \\ 0 \\ x \end{pmatrix}$)

3.2.2 | When the answer is "infinitely many" what tools might we have to describe the size of that set?

A column in the matrix is zero? Maybe the columns are linearly dependent. Input is dim 1

3.2.3 | How many possible outcomes b are there for the equation $Ax = b$ for any x.

Infinite with dim2?

3.3 | $A = \begin{pmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 0 \end{pmatrix}$

3.3.1 | How many solutions x satisfy $Ax = 0$?

Only one value of x makes the product zero.

3.3.2 | When the answer is "infinitely many" what tools might we have to describe the size of that set?

n/a

3.3.3 | How many possible outcomes b are there for the equation $Ax = b$ for any x.

column vector has dimension 3, but the vector space has dim 2

3.4 | $A = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{pmatrix}$

3.4.1 | How many solutions x satisfy $Ax = 0$?

infinite, same vectors as subproblem 2

3.4.2 | When the answer is "infinitely many" what tools might we have to describe the size of that set?

dimension 2? column vectors in the matrix are linearly dependent.

3.4.3 | How many possible outcomes b are there for the equation $Ax = b$ for any x.

infinite, dim 2 (but each vector is dim 3)

3.5 | $A = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 1 & 0 \end{pmatrix}$

3.5.1 | How many solutions x satisfy $Ax = 0$?

infinite, vectors of the form $\begin{pmatrix} 0 \\ a \\ -a \end{pmatrix}$ (columns linearly dependent)

3.5.2 | When the answer is "infinitely many" what tools might we have to describe the size of that set?

dimension 2 subspace of $\mathbb{F}^3$

3.5.3 | **How many possible outcomes b are there for the equation $Ax = b$ for any x.**

infinite, dim2 subspace of $\mathbb{F}^3$

3.6 | $A = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 3 \\ 0 & 0 & 0 \end{pmatrix}$

3.6.1 | **How many solutions x satisfy $Ax = 0$?**

infinite, vectors of the form $\begin{pmatrix} a \\ b \\ 0 \end{pmatrix}$ (columns linearly dependent)

3.6.2 | **When the answer is "infinitely many" what tools might we have to describe the size of that set?**

dim 2 subspace of $\mathbb{F}^3$

3.6.3 | **How many possible outcomes b are there for the equation $Ax = b$ for any x.**

output has dim 1

3.7 | $A = \begin{pmatrix} 1 & 2 & -1 \\ 1 & -1 & 0 \\ 3 & 3 & -2 \end{pmatrix}$

3.7.1 | **How many solutions x satisfy $Ax = 0$?**

Seems like the rows are linearly independent, so it should be just 1 solution $x = 0$? infinite, vectors of the form $\begin{pmatrix} a \\ b \\ 0 \end{pmatrix}$ (columns linearly dependent)

3.7.2 | **When the answer is "infinitely many" what tools might we have to describe the size of that set?**

dim 0

3.7.3 | **How many possible outcomes b are there for the equation $Ax = b$ for any x.**

output should be dim 3

4 | Then we talked about some stuff

4.1 | **see** `./KBrefHomogeneousEquations.org` **and** `./KBrefColumnVectors.org`