

CS 2810 Day 4

Return of linear systems:

- Visualizing vector spaces
- Motivating "row equivalence"

What is Machine learning?

Is Machine Learning a good thing?

- How I met my partner (and how you're more likely to meet yours)

VISUALIZING SOLUTION SPACE OF MANY SOLUTIONS SYSTEMS

$$\left[\begin{array}{ccc|c} 1 & 0 & -2 & 4 \\ 0 & 1 & 4 & 2 \\ 0 & 0 & 0 & 0 \end{array} \right]$$

$$\left[\begin{array}{ccc|c} 1 & 0 & 3 & 4 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{array} \right]$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 4 \\ 2 \\ 0 \end{bmatrix} + \begin{bmatrix} 0 \\ 4 \\ -1 \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 4 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} -2 \\ 1 \\ 0 \end{bmatrix} y + \begin{bmatrix} -3 \\ 0 \\ -1 \end{bmatrix} z$$

example 1:

https://technology.cpm.org/general/3dgraph/?graph3ddata=__blxmuw7kwG0dGGimw7kxmux1YdFh

example 2:

https://technology.cpm.org/general/3dgraph/?graph3ddata=__boxmuxBExQ0dGGi

DEMO

THERE'S SOMETHING FAMILIAR ABOUT THESE RREFS ...

$$\left[\begin{array}{ccc|c} 1 & 0 & 0 & -1 \\ 0 & 1 & 4 & 2 \\ 0 & 0 & 0 & 0 \end{array} \right]$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -1 \\ 2 \\ 0 \end{bmatrix} + \begin{bmatrix} -2 \\ -4 \\ -1 \end{bmatrix} z$$

$$\left[\begin{array}{ccc|c} 1 & 0 & 0 & 5 \\ 0 & 1 & 4 & 8 \\ 0 & 0 & 0 & 0 \end{array} \right]$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 5 \\ 8 \\ 0 \end{bmatrix} + \begin{bmatrix} -2 \\ -4 \\ -1 \end{bmatrix} z$$

THERE'S SOMETHING FAMILIAR ABOUT THESE RREFS ...

$$\left[\begin{array}{ccc|c} 1 & 0 & 2 & -1 \\ 0 & 1 & 4 & 0 \\ 0 & 0 & 0 & 0 \end{array} \right]$$

$$\left[\begin{array}{ccc|c} 1 & 0 & 2 & 5 \\ 0 & 1 & 4 & 8 \\ 0 & 0 & 0 & 0 \end{array} \right]$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -1 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} -2 \\ -4 \\ -1 \end{bmatrix} z$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 5 \\ 8 \\ 0 \end{bmatrix} + \begin{bmatrix} -2 \\ -4 \\ -1 \end{bmatrix} z$$

CONSTANT OFFSET DEPENDS ON AUGMENT COL

THERE'S SOMETHING FAMILIAR ABOUT THESE RREFS ...

$$\left[\begin{array}{ccc|c} 1 & 0 & 2 & -1 \\ 0 & 1 & 4 & 0 \\ 0 & 0 & 0 & 0 \end{array} \right]$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -1 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} -2 \\ -4 \\ 1 \end{bmatrix} z$$

$$\left[\begin{array}{ccc|c} 1 & 0 & 2 & 5 \\ 0 & 1 & 4 & 8 \\ 0 & 0 & 0 & 0 \end{array} \right]$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 5 \\ 8 \\ 0 \end{bmatrix} + \begin{bmatrix} -2 \\ -4 \\ 1 \end{bmatrix} z$$

VECTORS DEFINING REMAINING SOLUTION SPACE
DEPEND ONLY ON MATRIX OF AUGMENTED MAT

→ HAVING SOME SOLUTION

IF TWO CONSISTENT LINEAR SYSTEMS

DIFFER ONLY BY AUGMENT COL, THEN SOLUTIONS

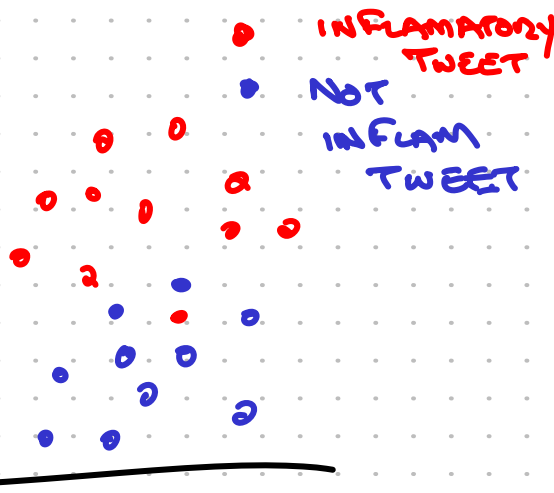
SPACES DIFFER ONLY BY SOME CONSTANT

OFFSET

Row equivalence: When one matrix may be row reduced into another
(note: the full augmented matrix needn't have same rref, only the "matrix" on its left)

Machine Learning: twitter inflammatory speech detection

	FEAT 0	FEAT 1	INFLAMMATORY?
TWEET 0			YES
TWEET 1			NO
⋮			



Machine Learning: twitter inflammatory speech detection

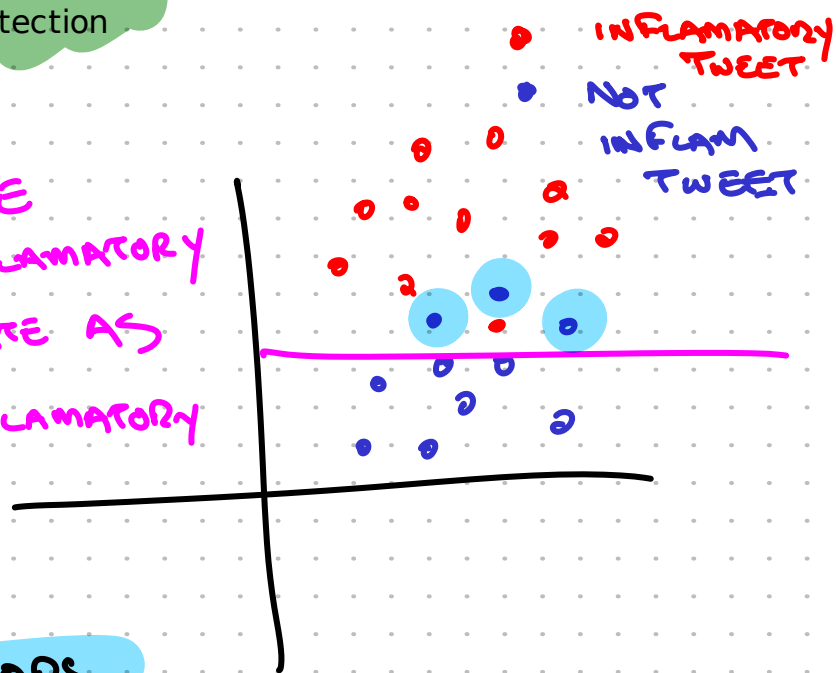
CLASSIFIER

ABOVE LINE → ESTIMATE AS INFLAMMATORY

BELOW LINE → ESTIMATE AS NOT INFLAMMATORY

"LEARNING"

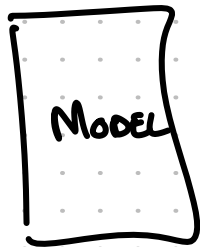
UPDATE LINE TO DO BETTER ON ERRORS



MACHINE LEARNING IN ONE SIDE (SUPERVISED)

TRAINING

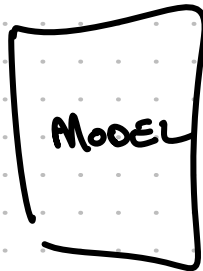
LABELLED
DATA



TWEET +
IF IT
WAS
INFLAM

ONLINE

DATA



NEW
TWEET



ESTIMATED
LABEL

ESTIMATE
OF NEW
TWEET
INFLAM

IS ML GOOD?

- how I met my partner

- how you'll meet yours (relative to my generation)

 - facebook

 - tinder

 - dating apps

 - tik tok?

What's incentivized and what's not in one's personality to make friends?

technology has allowed the last few generations to rebuild the social contexts in which we form and sustain relationships

how?

is this change good?

In Class Assignment 1

Give an example of machine learning you know of

- describe application

- how does it work?

- in a non-technical way, describe how the computer solves the problem