CS/ECE/ME 532
Period 9

- Unit 2 Quiz – Tuesday next week (March 2nd), in class
  - 60 minutes
  - Unit 2 (including ridge regression)
  - no interaction with anyone besides instructors
  - must sit at your table, **video must be on**
- Unit 2 Integrative Summary assignment due Tuesday evening
- Unit 2 Practice Problems now open (end of week 5)
- Unit 3 on Thursday
  - Videos 3.1 – 3.3 (K-means and the SVD)
  - Activity – k-means and the intro to SVD

Today – Ridge regression

$\boldsymbol{Ax} = \boldsymbol{b}$ *Engineering*

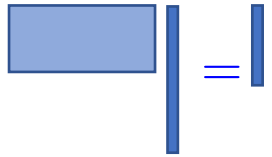
$\boldsymbol{Xw} = \boldsymbol{y}$ *ML, this activity*

$\boldsymbol{Aw} = \boldsymbol{d}$ *Lecture*

$X\beta = Y$ *statistics*

Problem 1)

$$\boldsymbol{Xw} = \boldsymbol{y}$$



not enough equations

Too many unknowns

- infinite number of solutions to both

$$\boldsymbol{Xw} = \boldsymbol{y} \qquad \min_{\boldsymbol{w}} ||\boldsymbol{Xw} - \boldsymbol{y}||^2$$

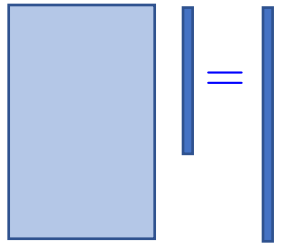
- Find an *interesting* solution -- small $||\boldsymbol{w}||^2$

$$\min_{\boldsymbol{w}} ||\boldsymbol{Xw} - \boldsymbol{y}||^2 + \lambda||\boldsymbol{w}||^2$$

Regularizer!

$$\boldsymbol{w}^* = (\boldsymbol{X}^T\boldsymbol{X} + \lambda\boldsymbol{I})^{-1}\boldsymbol{X}^T\boldsymbol{y}$$

Problem 2)



Enough equations, but maybe linearly dependent columns, or wide range in column norms numbers

$\boldsymbol{X}^T\boldsymbol{X}$ is ill conditioned

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>> inv(X'*X)
Warning: Matrix is close to singular or b
scaled. Results may be inaccurate. RCOND
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- *Same trick:*

$$\min_{\boldsymbol{w}} ||\boldsymbol{Xw} - \boldsymbol{y}||^2 + \lambda||\boldsymbol{w}||^2$$