Lecture 3

Notes from Survey

- CS - 13
- ECE - 5
- Math - 1
- Civil - 1
- Business 2
- ME - 1
- Biomed Eng - 1

Please turn in Q's on paper in front!

Why

- Physics simulation
- MA 511 was full…
- HPC
- Understand matrix-based papers
- Solving linear systems
- Solving difficult problems
- Sparse tensor computations
- Applications of optimizaiton (tion)
- "fun and interesting"
- ML
- improve understanding of NLA (a few)
- "relevant to research"
- improve programming skills
- ML and Physics
- real world applications of matrices
- ML
- Math requirement for ECE
- foundation of numerical computing
- learn more about linear algebra
- help implement better solvers

To improve

- A brief summary of important take-away points from each lecture would be helpful.
- Practice exam
- Wifi during class
- Real world problems
- Submit questions digitally
- Math concepts beyond what is taught
- Timely feedback
- More about Julia
- More clear structure for videos and readings
- I don't know what videos to watch.
- More sample questions and answers
- Upload scripts written during class.

Languages

Julia — all but 2
Python/Numpy - 2

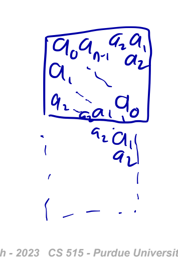
Late policy
- Doesn't mention zero points, ahh! Will fix that!

Q's: why $A^TAx = A^Tb$ for least squares?

(why Hankel?)

Toeplitz vs Circulant?

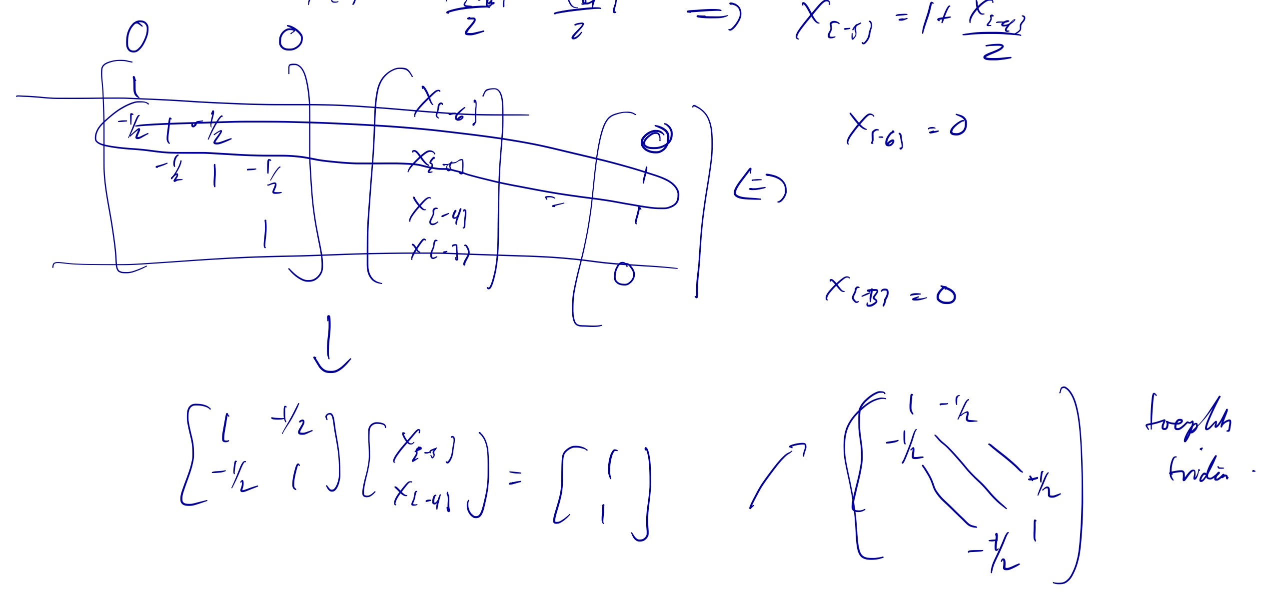
HW 1???



- What of other ops (non-linear algebra) make a matrix meaningful?
- $\min \|Cx\|_0$ s.t. $Ax \le b$. Does sparse matrix theory help solve this?
- How many 0's? 30% 40%, 50%? Do sparse matrix algs work better than dense algs?
- Where does $x_{\{-3\}} = 1 + \frac{1}{2} x_{\{-4\}} + \frac{1}{2} x_{\{-2\}}$ come from?
- Where do M matrices appear?
- How to "use" S of Hankel/Circulant/Toeplitz to solve $Ax = b$?
- When not to use sparse matrices?
- Are types of structure just subsets? tridiag = sparse + toeplitz. Spd? M-matrices?
- Why is $\|Ax-b\|$ / squared loss so popular? vs. $\|Ax-b\|_4$?
- Where do toeplitz matrices show up?
- Where else do Hankel matrices show up?
- How to solve LS w/o Hankel structure?

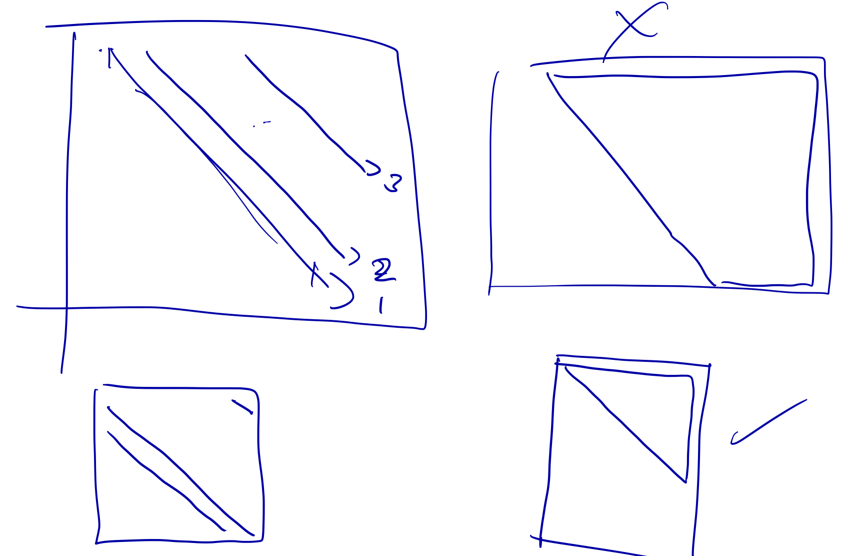
Is A^TA always Hankel? No!

$x_{\{5\}} = 1 + \frac{x_{\{-6\}}}{2} + \frac{x_{\{-4\}}}{2}$ $x_{\{-6\}} = 0 \Rightarrow x_{\{-5\}} = 1 + \frac{x_{\{-4\}}}{2}$



$x_{\{-6\}} = 0$

$x_{\{-3\}} = 0$

$$\begin{bmatrix} 1 & -1/2 \\ -1/2 & 1 \end{bmatrix} \begin{bmatrix} x_{\{-5\}} \\ x_{\{-4\}} \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

toeplitz tridiag.