Lecture 3

- Survey Results

CS	11
ECE	11
Aero	2
Math	1
Aero Eng.	1
IE	1
Nuclear	1

HW1 (Tonight?)

For RW: What Happens if we remove upper bound? ↳ linear System?

How to Store Sparse Matrix? ⇒ Next Lecture!

Will we cover Hessians?

Circulant Hankel Matrices arise?

What does 1 represent in

$x_{[i]} \cdot 1 + p x_{[i-1]} (1-p) \cdot x_{[i+1]}$

What is a meaningful attempt?

Exam format?

Is identity a Circulant Matrix?

Real world problem w/ Hankel / Toeplitz Structure?

Least Sq w/ In dimension ⇒ 2x2 matrix.

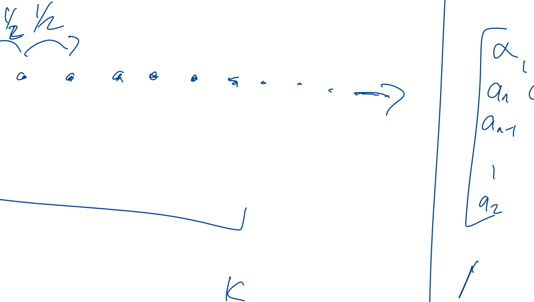
Sparse + Tridiag on Left Shift. ⇒ more Efficient than Tridiag/left Shift

How to make Algs w/ Toeplitz / Hankel Struct go faster in Julia. (There is a package to do this.)

$A = S + K$

Symm Skew-symm

is true for $A \in \mathbb{R}$, what if $A \in \mathbb{C}$?



P_K = Scenario w/ upper bound K.

Look @ limit P_K
$K \to \infty$

Circulant

$$\begin{bmatrix} a_1 & a_2 & \cdots & a_n \\ a_n & a_1 & a_2 & \cdots a_{n-1} \\ a_{n-1} & & & \\ \vdots & & & \\ a_2 & & a_n & a_1 \end{bmatrix}$$

Toeplitz (Right Shift)

$$\begin{bmatrix} \alpha_1 & \beta_2 & \cdots & \beta_n \\ \alpha_2 & & \ddots & \beta_2 \\ \vdots & & & a_1 \\ \alpha_n & & \alpha_2 & 1 \end{bmatrix}$$

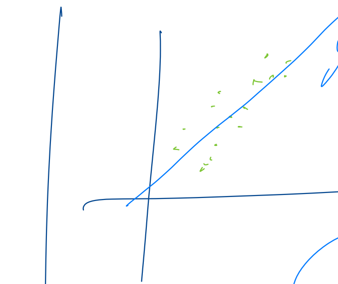
Constant Diag.

Hankel (Left Shift)

$$\begin{bmatrix} \alpha_1 & \cdots & \alpha_n \\ \alpha_2 & \cdots \alpha_n & \beta_1 \\ \alpha_3 & \cdots \alpha_n & \beta_1, \beta_2 \end{bmatrix}$$

Const. Reverse Diag.

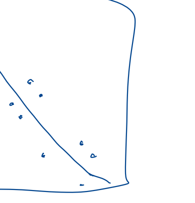
How to do things Efficient w/ these matrices, Use FFT!



$$\left\| \begin{bmatrix} y_1 \\ \vdots \\ y_n \end{bmatrix} - \begin{bmatrix} 1 & x_1 \\ 1 & x_2 \\ \vdots & \\ 1 & x_n \end{bmatrix} \begin{bmatrix} b \\ m \end{bmatrix} \right\|_2$$

$$A^T A = \begin{bmatrix} n & \Sigma x_i \\ \Sigma x_i & \Sigma x_i^2 \end{bmatrix}$$

Sparse + Tridiag



Suff. Sparsity ⇒ faster to treat w/ a special Routine!

Left Shift?

⇒ FFT is Really fast!

Highly non-zero!

Sym.

$A = A^T$

Skew-Sym

$A = -A^T$

$A \in \mathbb{R}^{n \times n}$

$S = \dfrac{A + A^T}{2}$

$K = \dfrac{A - A^T}{2}$

$A = S + K$

If $A \in \mathbb{C}^{n \times n}$

Then yes, this "works" but, Usually, you want

$H = \dfrac{A + A^H}{2}$ Hermitian Not- Complex symmetric

$K = \dfrac{A - A^H}{2}$ Skew-Hermitian. Not Complex Skew-Symmetric