Lecture 4

- HW1 posted!
- Gradescope + Ed Discussion / Ed Stem.
- TA office hours after class. 12:30–2pm
- I'm gone next Thursday.

- Candyland

  ↳ $p_2 = T t_{140}$

  Should this be

  $p_2 = T(i,k)\, t_{140}(k)$

- How is Julia fast w/ Special matrices?
- Other properties of M-Matrices? ✓
- When is [:] an Error vector? ✓

- Example of

  $A = S + K$

  Symmetric ↗   Skew ↗

  v

- Why is p_{80} ~~ti~~ an given by ~~$\bar{S}$ steps~~ $T^4\, t_{140}$

- Why not just store Indices of non-zero ~ Coordinate vs. CSR?

-symmet

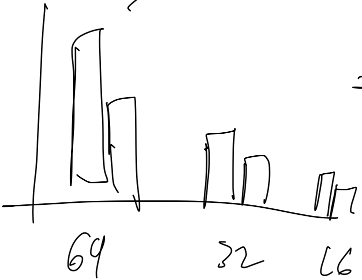
✓

Step 5

?

format)

✓ · float 64 vs.
float 16 time
w/ sparse vs.
dense matrices.



150 × 150
22500 × 8 byte
= 160kb.

$$\underline{t}_{140} = \begin{bmatrix} 0 \\ \vdots \\ 0 \\ 1 \\ 0 \\ \vdots \\ 0 \end{bmatrix} \begin{matrix} \\ \\ \\ \leftarrow 140 \\ \\ \\ \\ \end{matrix}$$

$$\boxed{\underline{e}_{140}}$$

$$\sum_k T(i,k)\, t_{140}(k)$$

$$[T t_{140}]_i =$$ Prob of being at State i after 1 Step.

$$\underline{e} = \begin{bmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{bmatrix}$$

Soln

[[C.

$$\underline{e}^{(k)} = \underline{X}^{(k)} -$$

Skew-Symmetric

$A = -A^T$

vs. Symmetric

$A = A^T$.

$A_{ij} \in \mathbb{C}$

Hermitian

$A^H = A$

$\overline{A_{ij}} = A_{ji} \iff A^* = A$

Complex Symmetric

$A^T = A$ but $A_{ij} \in \mathbb{C}$

after steps

true sol

$\underline{X}$

If

Then

Pf

A is Skew-symmet

iA is Hermitian!

$(iA)^H \Rightarrow$

$$(i\underset{\sim}{A})^H_{ij} = \overline{(iA)_{ji}}$$

$$= (-iA)_{ji}$$

$$= (iA)_{ij}$$

$$A = \overset{\text{Sym}}{S} + \overset{\text{Skew Sym}}{K}$$

Works for Any Matrix!

$$S = \frac{A+A^T}{2}$$ Sym ✓

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

$$((A-A^T)^T) = (A^T - A) = ($$

ⓓ

$$\overset{A}{\begin{bmatrix} 0 & 2 & 4 \\ 6 & 8 & 10 \\ 12 & 14 & 16 \end{bmatrix}} \text{ vs. } \overset{A^T}{\begin{bmatrix} 0 & 6 & 12 \\ 2 & 8 & 14 \\ 4 & 10 & 16 \end{bmatrix}}$$

$$\frac{A+A^T}{2} = \begin{bmatrix} 0 & 4 & 8 \\ 4 & 8 & 12 \\ 8 & 12 & 16 \end{bmatrix}$$

$$\frac{A-A^T}{2} = \begin{bmatrix} 0 & -2 & -4 \\ 2 & 0 & -2 \\ 4 & 2 & 0 \end{bmatrix}$$

$-1)(A-A^T)$

Neat Conjecture here!

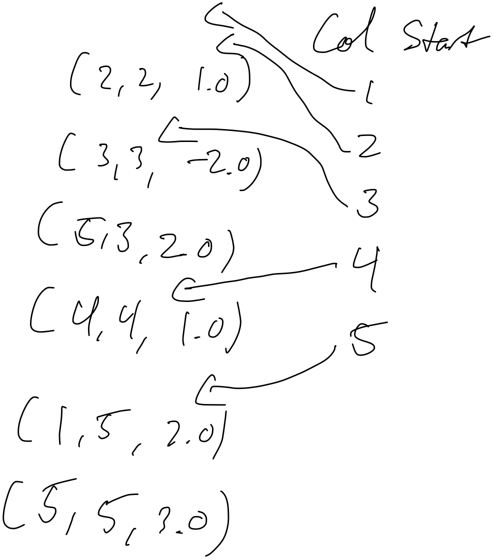
CSC vs. Indexed:

Pros

Columns are contiguous.	Simple to think about.

I	J	Val.
5	3	2.0
1	5	2.0
3	3	-2.0
5	5	3.0
2	2	1.0
4	4	1.0

→



(2, 2, 1.0)
(3, 3, -2.0)
(5, 3, 2.0)
(4, 4, 1.0)
(1, 5, 2.0)
(5, 5, 3.0)