

# CS/ECE/ME 532









## Activity 15

- Unit 3 + 4 Quiz, next week Thursday
  - Unit 3 and 4 practice problems are posted
- Today – Matrix Completion
  - Tuesday – Unit 5 (iterative methods)

# Activity 15 – Matrix Completion and Iterative Singular Value Thresholding

Movies →

Users ↓

								
1	?	1	5	?	3	?	...	?
2	?	?	2	?	?	?	...	5
3	?	?	?	?	?	?	...	?
4	?	?	?	?	?	?	...	?
5	?	?	?	?	?	?	...	?
6	?	?	?	?	?	?	...	?
7	?	?	?	?	?	?	...	?
8	?	?	?	?	?	?	...	?
9	?	?	?	?	?	?	...	?
10	?	?	?	?	?	?	...	?

What’s the matrix of minimum rank that agrees on all know entries?

## Iterative Singular Value Thresholding

take SVD and truncate

- 0. Set unknown entries to zero.
- 1. find best rank  $r$  approximation
- 2. reset known entries to original values
- 3. repeat steps 1-2 ...

$$\widehat{\mathbf{X}} = \arg \min_{\mathbf{A} \in \mathcal{S}} \text{rank}(\mathbf{A}) \quad \mathcal{S} = \{\mathbf{A} : A_{i,j} = X_{i,j} \ \forall \ (i,j) \in \Omega\}$$

$$\widehat{\mathbf{X}} = \arg \min_{\mathbf{A} \in \mathcal{S}} \|\sigma\|_0$$

number of non-zero  $\sigma_i$

$$\mathbf{A} = \mathbf{U}\Sigma\mathbf{V}^T$$
$$\text{diag}(\sigma) = \Sigma$$



Lagrange prize  
Now @ UC Berkeley

$$\widehat{\mathbf{X}} = \arg \min_{\mathbf{A} \in \mathcal{S}} \|\sigma\|_1$$

$\sum \sigma_i$ , nuclear norm  $\|\mathbf{A}\|_*$

[1] Guaranteed Minimum-Rank Solutions of Linear Matrix Equations via Nuclear Norm Minimization, B. Recht et. al.  
[2] A Singular Value Thresholding Algorithm for Matrix Completion, Cai et. al.