

An aerial photograph of a city, likely Madison, Wisconsin, taken from a high vantage point. The city is situated on a peninsula, with a large body of water (Monona Lake) in the foreground and background. The sun is setting behind a hill in the distance, creating a warm, golden glow over the entire scene. Several sailboats are visible on the water. A large, semi-transparent rectangular box is overlaid on the center of the image, containing the course title in black text.

CS/ECE/ME 532 Matrix Methods in Machine Learning

Welcome!



Announcements

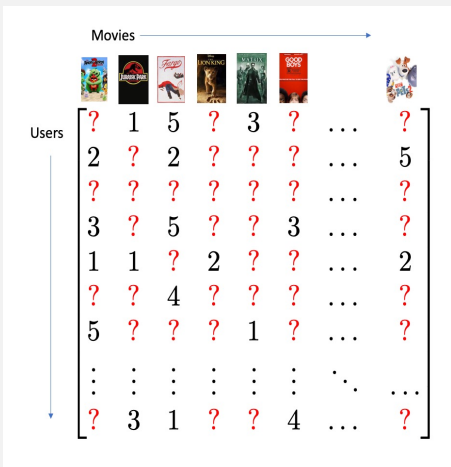


- Mid Course Feedback Survey
- This week:
 - Today: finish Unit 4
 - Thursday: start Unit 5
- Next week: spring break
- After spring break:
 - Tuesday: Assessment 3 review
 - Thursday: Assessment 3
- Assignment 7 is due the week after Assessment 3, but:
 - Q1 on the Eigendecomposition (attempt before the assessment)

Activity 15



Matrix Completion



$$A = U\Sigma V^T$$

$$\text{diag}(\sigma) = \Sigma$$

Goal: find the matrix of minimum rank that agrees on all known entries.

Let $\mathcal{S} = \{A : A_{i,j} = X_{i,j} \forall (i,j) \in \Omega\}$

$$\hat{X} = \arg \min_{A \in \mathcal{S}} \text{rank}(A) \quad \text{Hard!}$$

relaxation

$$\hat{X} = \arg \min_{A \in \mathcal{S}} \|\sigma\|_1 \quad \text{Tractable!}$$

nuclear norm $\|A\|_*$

[1] Guaranteed Minimum-Rank Solutions of Linear Matrix Equations via Nuclear Norm Minimization, B. Recht et. al.

Iterative Singular Value Thresholding

0. Set unknown entries to zero.

1. find best rank r approximation

take SVD and truncate

2. reset known entries to original values

3. repeat steps 1-2 ...

[2] A Singular Value Thresholding Algorithm for Matrix Completion, Cai et. al.

Item 3 is an (optional) preview of Activity 16

3a) Hint: $X^T X$ is positive definite...

3b, 3c) Equation of an ellipse:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

