5. Collaborative Filtering with Matrix Factorization
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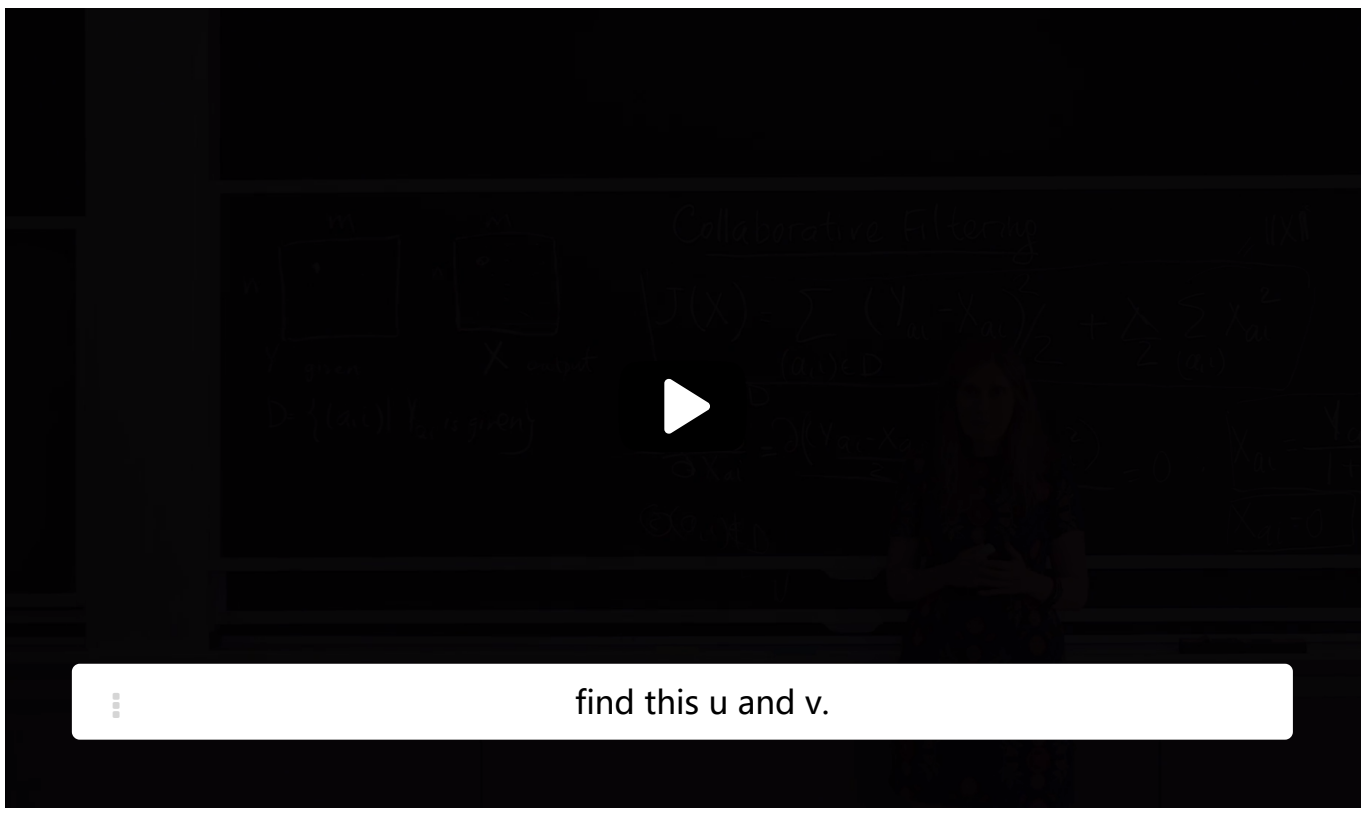

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same.
So now we will start by taking our objective,
the original objective that we had,
which is written over here--
we will take this objective and rewrite it
for the case where our x is just the multiplication of two
vectors u and v. And once we've done
that, our next question will how we can actually
find this u and v.

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Matrix Factorization Practice

1/1 point (graded)
We now use **collaborative filtering** to solve the movie recommender system problem.

As we saw in the previous problem, we ended up with an unsatisfactory and trivial solution of X by minimizing the objective alone:

$$J(X) = \sum_{a,i \in D} \frac{(Y_{ai} - X_{ai})^2}{2} + \frac{\lambda}{2} \sum_{(a,i)} X_{ai}^2.$$

In the collaborative filtering approach, we impose an additional constraint on X:

$$X = UV^T$$

for some $n \times d$ matrix U and $d \times m$ matrix V^T. The number d is the **rank** of the matrix X.

Suppose

$$X = \begin{bmatrix} 3 & 6 & 3 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix},$$

then what is the minimum possible d?

$d =$ 1 ✔ **Answer:** 1

Solution:

X can be decomposed as

$$X = \begin{bmatrix} 3 \\ 2 \\ 1 \end{bmatrix} \begin{bmatrix} 1 & 2 & 1 \end{bmatrix}$$

Remark: Note that imposing that a n by m matrix X has rank $k < \min(m, n)$ means that some of its rows (*resp.* columns) are linearly dependent on other rows (*resp.* columns).

Submit You have used 1 of 3 attempts

Answers are displayed within the problem

Intuition on the Vector Factors

1/1 point (graded)
Assume we have a 3 by 2 matrix X i.e. we have 3 users and 2 movies. Also, X is given by

$$X = \begin{bmatrix} \text{User 1's rating on movie 1} & \text{User 1's rating on movie 2} \\ \text{User 2's rating on movie 1} & \text{User 2's rating on movie 2} \\ \text{User 3's rating on movie 1} & \text{User 3's rating on movie 2} \end{bmatrix} = UV^T$$

for some $3 \times d$ matrix U and $d \times 2$ matrix V^T.

Now which of the following is true about U and V^T? (Choose all those apply.)

- [x] The first row of U represents information on user 1's rating tendency ✔
- [ ] The first row of U represents information on movie 1
- [ ] The first column of V^T represents information on user 1's rating tendency
- [x] The first column of V^T represents information on movie 1 ✔

✔

Solution:

U encodes information about the users, and V about the movies.

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Answers are displayed within the problem

Discussion

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Topic: Unit 2 Nonlinear Classification, Linear regression, Collaborative Filtering (2 weeks):Lecture 7. Recommender Systems / 5. Collaborative Filtering with Matrix Factorization