5. Collaborative Filtering with Matrix Factorization

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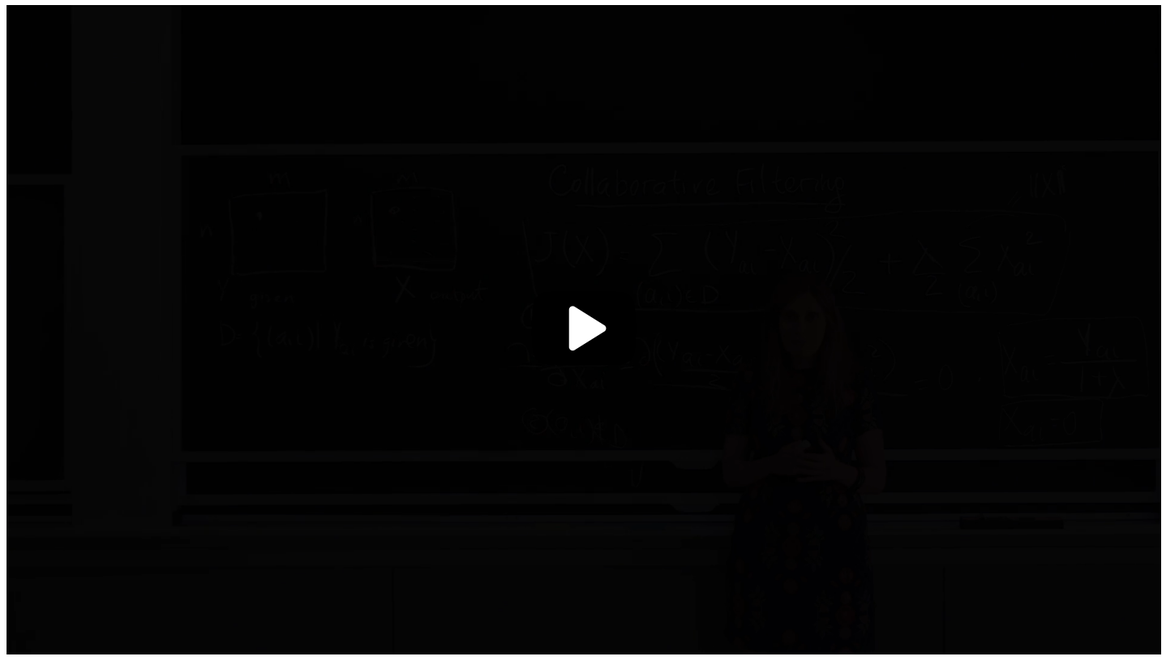

8:44 / 8:44 Speed 1.50x

But again, the key idea would be exactly the 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

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? Matrix Factorization Practice: the matrix X is m by n in the solution explanation 2

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