1. Collaborative Filtering, Kernels, Linear Regression

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Homework due Mar 8, 2023 08:59 -03 Completed

In this question, we will use the alternating projections algorithm for low-rank matrix factorization, which aims to minimize

$$J(U,V) = \underbrace{\frac{1}{2}\sum_{(a,i)\in D}\left(Y_{ai} - [UV^T]_{ai}\right)^2}_{\text{Squared Error}} + \underbrace{\frac{\lambda}{2}\sum_{a=1}^{n}\sum_{j=1}^{k}U_{aj}^2 + \frac{\lambda}{2}\sum_{i=1}^{m}\sum_{j=1}^{k}V_{ij}^2}_{\text{Regularization}}.$$

In the following, we will call the first term the squared error term, and the two terms with λ the regularization terms.

Let Y be defined as

$$Y = \begin{bmatrix} 5 & ? & 7 \\ ? & 2 & ? \\ 4 & ? & ? \\ ? & 3 & 6 \end{bmatrix}$$

D is defined as the set of indices (a,i), where $Y_{a,i}$ is not missing. In this problem, we let $k = \lambda = 1$. Additionally, U and V are initialized as $U^{(0)} = [6,0,3,6]^T$, and $V^{(0)} = [4,2,1]^T$.

1. (a)

1.0/1 point (graded)

Compute $X^{(0)}$, the matrix of predicted rankings UV^T given the initial values for $U^{(0)}$ and $V^{(0)}$.

(Enter your answer as a matrix, e.g., type **[[2,1],[1,0],[3,-1]]** for a 3×2 matrix $\begin{pmatrix} 2 & 1 \\ 1 & 0 \\ 3 & -1 \end{pmatrix}$. Note the square brackets, and commas as separators.)

[[24,12,6], [0, 0, 0], [12, 6, 3], [24, ✔

Submit You have used 1 of 3 attempts

1. (b)

2/2 points (graded)

Compute the squared error term, and the regularization terms in for the current estimate X.

Enter the squared error term (including the factor $1/2$):

255.5 ✔

Enter the regularization term (the sum of all the regularization terms):

51 ✔

Submit You have used 3 of 3 attempts

1. (c)

0/1 point (graded)

Suppose is kept fixed. Run one step of the algorithm to find the new estimate .

Enter the as a list of numbers, :

[1.5000, 0.8000, 0.9411, 1.2000] ✖

Submit You have used 3 of 3 attempts

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