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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

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

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

Let  $oldsymbol{Y}$  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 <code>[[2,1],[1,0],[3,-1]]</code> for a  $3\times 2$  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,

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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  $m{X}$ .

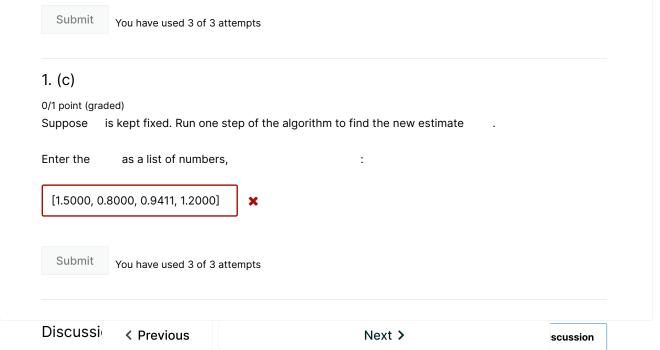
Enter the squared error term (including the factor 1/2):

255.5

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

51

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**Topic:** Unit 2. Nonlinear Classification, Linear regression, Collaborative Filtering (2 weeks):Homework 2 / 1. Collaborative Filtering, Kernels, Linear Regression

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