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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

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

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

Let \mathbf{Y} be defined as

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

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, \mathbf{U} and \mathbf{V} are initialized as $\mathbf{U}^{(0)} = [6, 0, 3, 6]^T$, and $\mathbf{V}^{(0)} = [4, 2, 1]^T$.

1. (a)

1.0/1 point (graded)

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

(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,`



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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 \mathbf{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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You have used 3 of 3 attempts

1. (c)

0/1 point (graded)

Suppose θ_0 is kept fixed. Run one step of the algorithm to find the new estimate θ_1 .Enter the θ_1 as a list of numbers, $[\theta_1^{(0)}, \theta_1^{(1)}, \theta_1^{(2)}, \theta_1^{(3)}]$:

[1.5000, 0.8000, 0.9411, 1.2000]

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You have used 3 of 3 attempts

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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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