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Problem 4

Midterm due Nov 9, 2020 18:59 EST

For simplicity, suppose our rating matrix is a $2x2$ matrix and we are looking for a rank-1 solution UV^T so that user and movie features U and V are both $2x1$ matrices. The observed rating matrix has only a single entry:

$$Y = \begin{bmatrix} ? & 1 \\ ? & ? \end{bmatrix} \tag{7.4}$$

In order to learn user/movie features, we minimize

$$J(U,V) = \left(\frac{1}{2} \sum_{(a,i) \in D} \left(Y_{ai} - [UV^T]_{ai} \right)^2 \right) + \lambda \left(U_1^2 + V_1^2 \right) \tag{7.5}$$

where U_1 and V_1 are the first components of the vectors U and V respectively (if $U = [u_1, u_2]$, then $U_1 = u_1$), the set D is just the observed entries of the matrix Y , in this case just $(1, 2)$.

Note that the regularization we use applies only to the first coordinate of

user/movie features . We will see how things get a bit tricky with this type of partial regularization.

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4. (1)

1 point possible (graded, results hidden)

If we initialize $U = \begin{bmatrix} u & 1 \end{bmatrix}^T$, for some $u > 0$, what is the solution to the vector $V = \begin{bmatrix} v_1 & v_2 \end{bmatrix}^T$ as a function of λ and u?

(Enter V as a vector, enclosed in square brackets, and components separated by commas, e.g. type `[u,lambda+1]` if $V = \begin{bmatrix} u & \lambda + 1 \end{bmatrix}^T$.)

$V =$

STANDARD NOTATION

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4. (2)

1 point possible (graded, results hidden)

What is the resulting value of $J\left(U, V\right)$ as a function of λ and u?

(Type `lambda` for λ).

STANDARD NOTATION

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4. (3)

1 point possible (graded, results hidden)

If we continue to iteratively solve for U and V, what would U and V converge to?

- U goes to $[0, 1]$, V goes to $[0, \infty]$
- U goes to $[0, 0]$, V goes to $[0, 0]$
- U goes to $[0, 1]$, V goes to $[0, 0]$
- U goes to $[0, \infty]$, V goes to $[1, 0]$

Submit You have used 0 of 3 attempts

4. (4)

3 points possible (graded, results hidden)

Not all rating matrices Y can be reproduced by UV^T when we restrict the dimensions of U and V to be 2×1.

For each matrix below, answer “Yes" or “No" according to whether it can be reproduced by such U and V of size 2×1.

$$Y = \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$

- yes
- no

$$Y = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

yes

no

$$Y = \begin{bmatrix} 1 & 1 \\ -1 & -1 \end{bmatrix}$$

yes

no

Submit You have used 0 of 3 attempts

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4.1 Solution to vector V Are we looking for the solution after the first iteraction or the final result after convergence? I ma...	1
Objective function	4
Typo in 2nd line of Q4?	1
[Staff] Clarification on question 4 [3] To my understanding, the loss function never depends a particular optimization variable, say u_i. ...	1
Is there an error in equation 7.5? Is there an error in equation 7.5?	2

Is equation 7.4, that describes the observed values accurate?

Equation 7.4, that describes the observed entries, says that Y = [[? 1] [? ?]]. There is some text a l...

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