

CS 541

Assignment 4

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2. Learning.

$$\min_{U, V} F(U, V) := \frac{1}{2} \sum_{(i,j) \in \Omega_1} (M_{ij} - u_i \cdot v_j^T)^2 + \frac{\lambda}{2} (\|U\|_F^2 + \|V\|_F^2)$$

Where M_{ij} is the (i, j) -th entry of M , u_i and v_j are the i -th and j -th row of U and V respectively.

1. Derive the gradient $\frac{\partial F(U, V)}{\partial U}$ and $\frac{\partial F(U, V)}{\partial V}$.

$$\frac{\partial F(U, V)}{\partial u_i} = -(M_{ij} - u_i \cdot v_j^T) \cdot v_j + \lambda \cdot u_i$$

$$\frac{\partial F(U, V)}{\partial U} = \left(\frac{\partial F}{\partial u_1}, \frac{\partial F}{\partial u_2}, \dots, \frac{\partial F}{\partial u_i} \right)$$

$$\frac{\partial F(U, V)}{\partial v_j} = -(M_{ij} - u_i \cdot v_j^T) \cdot u_i + \lambda \cdot v_j$$

$$\frac{\partial F(U, V)}{\partial V} = \left(\frac{\partial F}{\partial v_1}, \frac{\partial F}{\partial v_2}, \dots, \frac{\partial F}{\partial v_j} \right)$$

