

INF 553 – Spring 2018

Quiz 5: UV decomposition (10 points), 15 minutes

Consider the following utility matrix M which records ratings from users: A, B, and C on movies: M1, M2, M3, and M4. **For all computations below, show how you derive the final result.**

	M1	M2	M3	M4
A		4	2	5
B	3	2		5
C	5		3	4

1. [4 points] Consider finding UV-decomposition of M with a **single** latent factor. Suppose in the initial guess, the values of elements in U and V are all 1's. What is the **squared error** of the guess?

$$UV = M' \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} * [1 \ 1 \ 1 \ 1] = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

$$\text{Total Squared Error} = 9 + 1 + 16 + 4 + 1 + 16 + 16 + 4 + 9 = 76$$

2. [4 points] Find a new value for U[1,1] (while holding all others constant) to minimize the error.

$$\begin{bmatrix} x \\ 1 \\ 1 \end{bmatrix} * [1 \ 1 \ 1 \ 1] = \begin{bmatrix} x & x & x & x \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

$$\text{1st Row Error} = (4-x)^2 + (2-x)^2 + (5-x)^2 \rightarrow x=11/3 \text{ to get minimum error}$$

3. [2 points] How much is the **reduction** in the **squared error** with the new value of U[1,1]?

$$\text{Squared Error Reduction} = (9+1+16) - (1/9+25/9+16/9) = 64/3$$