

Vectorization : Low Rank Matrix Factorization

Movie	Alice	Bob	Carol	Dave	
Love at last	5	5	0	0	$\begin{bmatrix} 5 & 5 & 0 & 0 \\ 5 & ? & ? & 0 \\ ? & 4 & 0 & ? \\ 0 & 0 & 5 & 4 \\ 0 & 0 & 5 & ? \end{bmatrix}$
Romance forever	5	?	?	0	$Y =$
Cute puppies of love	?	4	0	?	
Nonstop car chases	0	0	5	4	
Swords vs. karate	0	0	5	?	

Predicted ratings : $(i, j) \rightarrow (\theta^{(j)})^T (x^{(i)})$

$$\left[\begin{array}{cccc} (\theta^{(1)})^T (x^{(1)}) & (\theta^{(2)})^T (x^{(1)}) & \dots & (\theta^{(n_m)})^T (x^{(1)}) \\ (\theta^{(1)})^T (x^{(2)}) & (\theta^{(2)})^T (x^{(2)}) & \dots & (\theta^{(n_m)})^T (x^{(2)}) \\ \vdots & \vdots & \vdots & \vdots \\ (\theta^{(1)})^T (x^{(n_m)}) & (\theta^{(2)})^T (x^{(n_m)}) & \dots & (\theta^{(n_m)})^T (x^{(n_m)}) \end{array} \right]$$

$$X = \left[\begin{array}{c} -(x^{(1)})^T - \\ -(x^{(2)})^T - \\ \vdots \\ -(x^{(n_m)})^T - \end{array} \right]$$

$$\Theta = \left[\begin{array}{c} -(\theta^{(1)})^T - \\ -(\theta^{(2)})^T - \\ \vdots \\ -(\theta^{(n_m)})^T - \end{array} \right]$$

$$X \Theta^T$$

Finding related movies

For each product i , we learn a feature vector $\chi^{(i)} \in \mathbb{R}^n$

$\chi_1 = \text{romance}$, $\chi_2 = \text{action}$, $\chi_3 = \text{comedy}$, $\chi_4 = \dots$

How to find movie j related to movie i ?

$\|\chi^{(i)} - \chi^{(j)}\|$ 이 작으면 similar

Implementational detail: Mean normalization

Movie	Alice	Bob	Carol	Dave	Eve
Love at last	5	5	0	0	?
Romance forever	5	?	?	0	?
Cute puppies of love	?	4	0	?	?
Nonstop car chases	0	0	5	4	?
Swords vs karate	0	0	5	?	?

$$n=2 \quad \theta^{(S)} \in \mathbb{R}^2$$

$\theta^{(S)}$ 의 regularization term

$$\frac{\lambda}{2} \left[(\theta_1^{(S)})^2 + (\theta_2^{(S)})^2 \right] \text{ 최소화}$$

$$\theta^{(S)} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

Mean normalization

$$Y = \begin{bmatrix} 5 & 5 & 0 & 0 & ? \\ 5 & ? & ? & 0 & ? \\ ? & 4 & 0 & ? & ? \\ 0 & 0 & 5 & 4 & ? \\ 0 & 0 & 5 & ? & ? \end{bmatrix} \quad \mu = \begin{bmatrix} 2.5 \\ 2.5 \\ 2 \\ 2.25 \\ 1.25 \end{bmatrix} \rightarrow Y = \begin{bmatrix} 2.5 & 2.5 & -2.5 & 2.5 & ? \\ 2.5 & ? & ? & -2.5 & ? \\ ? & 2 & -2 & ? & ? \\ -2.25 & -2.25 & 2.25 & 1.75 & ? \\ -1.25 & -1.25 & 3.75 & -1.25 & ? \end{bmatrix}$$

Normalizing each movie to have average rating of 0

Y로 학습

For user j , on movie i predict:

$$(\theta^{(s)})^T(x^{(i)}) + \underline{\mu_i}$$

add back

위 학습과 달리,

User 5 (Eve)

$\hookrightarrow \theta^{(s)} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$ 이므로 μ_i 를 predicted rating으로 가질 것