Recommender Systems

$n_u \equiv$ nº users

$n_m \equiv$ nº movies

$r(i,j) = 1 \iff$ user j has rated movie i

$y^{i,j} \equiv$ rating given by user j to movie i

		Movie	User 1	User 2	User 3	User 4	love mean	action mean
love	$x^1 \rightarrow$	M1					a	b
	$x^2 \rightarrow$	M2					c	d
	$x^3 \rightarrow$	M3					⋮	⋮
action	$x^4 \rightarrow$	M4					⋮	
	$x^5 \rightarrow$	M5						

$x^i \equiv$ feature vector for movie i

$x_0 = 1 \Rightarrow x^1 = \begin{bmatrix} 1 \\ a \\ b \end{bmatrix}, x^2 = \begin{bmatrix} 1 \\ c \\ d \end{bmatrix} \ldots$

$\boxed{x^i, \theta^j \in \mathbb{R}^{j+1}}$

$\theta^j \equiv$ parameter vector for user j

$m^j \equiv$ nº of movies rated by user j

$$\Rightarrow \text{minimize} \quad \underbrace{\frac{1}{2m^j} \sum_{i : r(i,j)=1} \left[(\theta^j)^T (x^i - y^{i,j}) \right]^2 + \frac{\lambda}{2m^j} \sum_{k=1}^{n} (\theta_k^j)^2}_{\equiv \alpha}$$

$$\Rightarrow \boxed{\frac{\partial}{\partial \theta^j} \alpha = 0}$$

It says we can remove the "m", but it says nothing of the 1/2, wtf, common denominator =

- Optimization objective

$$\forall \theta^j \quad \frac{\partial}{\partial \theta^j}\left[\frac{1}{2} \sum_{i:r(i,j)=1} \left(\theta^{j^T} \cdot x^i - y^{i,j}\right)^2 + \frac{\lambda}{2} \sum_{k=1}^{n} \left(\theta_k^j\right)^2 \right] = 0$$

$\forall \theta^1 \dots \theta^{n_u}$

- Gradient desent method

$$\theta_k^j := \underbrace{\theta_k^j - \alpha \sum_{i:r(i,j)=1} \left(\theta^{j^T} \cdot x^i - y^{i,j}\right) \cdot x_k^i}_{} \quad \forall k = 0$$

$$\theta_k^j := \left(\quad \right) + \lambda \theta_k^j \quad \forall k \neq 0$$

- Collaborative filtering algorithm

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