RankNet, MART

$$\lambda_{ij} = -\frac{\alpha}{1+e^{\alpha(s_i - s_j)}}$$

$\equiv$ $f(x_i) = s_i$, $f(x_j) = s_j$

$\in$

LambdaRank, LambdaMART

$$\lambda_{ij} = -\frac{\alpha \cdot |\Delta \text{Metric}_{ij}|}{1+e^{\alpha(s_i - s_j)}} = \frac{\partial C_{ij}}{\partial s_i} = -\frac{\partial C_{ij}}{\partial s_j}$$

$\div \sigma(\alpha(s_j - s_i))$

$$\frac{\partial^2 C_{ij}}{\partial s_i^2} = \alpha^2 \cdot \sigma(\cdot)\left(1-\sigma(\cdot)\right) = \alpha^2 \cdot \frac{|\Delta M_{ij}|}{1+e^{--}} \cdot \frac{e^{--}}{1+e^{--}}$$

$|\Delta M_{ij}|$

$X = \{\bar{x}_n\}_{n=1}^{N}$, $Z = \{\bar{z}_n\}_{n=1}^{N}$

$\bar{z}_n = (\cdots z_{nk} \cdots)_{k=1}^{K}$ $\quad \bar{z}_n \in \{0,1\}^K$

$$Q(\bar{\theta}, \bar{\theta}^{(m)}) = \mathbb{E}_{z \sim p(z|x,\bar{\theta}^{(m)})}\left[\log p(x, z|\bar{\theta})\right] =$$

$$= \mathbb{E}_z\left[\sum_n \sum_k \left(z_{nk} \log \pi_k + z_{nk} \log p(\bar{x}_n|\bar{\theta}_k)\right)\right]$$

$$\prod_{n=1}^{N} \prod_{k=1}^{K} \left[\pi_k \cdot p(\bar{x}_n|\bar{\theta}_k)\right]^{z_{nk}}$$

$$= \sum_n \sum_k \mathbb{E}_{\theta^{(m)}}[z_{nk}] \cdot \left(\log \pi_k + \log p(\bar{x}_n|\bar{\theta}_k)\right)$$

$$p(z_{nk} = 1 | \bar{\theta}^{(m)}) = \frac{\quad}{\quad}$$