A Support Vector Machine for Optimizing Average Precision

Yisong Yue, et al., SIGIR'07

RankingSVM

- Minimizing the pairwise loss

$$
\begin{aligned}
&\textit{minimize:} \quad V(\vec{w}, \vec{\xi}) = \frac{1}{2}\,\vec{w}\cdot\vec{w} + C\sum \xi_{i,j,k} \\
&\textit{subject to:} \\
&\forall (d_i, d_j) \in r_1^* : \vec{w}\Phi(q_1, d_i) \geq \vec{w}\Phi(q_1, d_j) + 1 - \xi_{i,j,1} \\
&\quad \ldots \\
&\forall (d_i, d_j) \in r_n^* : \vec{w}\Phi(q_n, d_i) \geq \vec{w}\Phi(q_n, d_j) + 1 - \xi_{i,j,n} \\
&\forall i \forall j \forall k : \xi_{i,j,k} \geq 0
\end{aligned}
$$

Loss defined on the number of mis-ordered document pairs

SVM-MAP

- Minimizing the structural loss

$$
\begin{aligned}
&\min_{\mathbf{w},\xi \geq 0} \frac{1}{2}\|\mathbf{w}\|^2 + \frac{C}{n}\sum_{i=1}^{n} \xi_i \\
&s.t.\ \forall i, \forall \mathbf{y} \in \mathcal{Y} \setminus \mathbf{y}_i : \\
&\quad \mathbf{w}^T \Psi(\mathbf{x}_i, \mathbf{y}_i) \geq \mathbf{w}^T \Psi(\mathbf{x}_i, \mathbf{y}) + \Delta(\mathbf{y}_i, \mathbf{y}) - \xi_i
\end{aligned}
$$

MAP difference

Loss defined on the quality of the whole list of ordered documents