⑤ SMO算法的思维路线

由15式 $\min_{\vec{w},b,\vec{\xi}} \frac{1}{2}\|\vec{w}\|^2 + C\sum_{i=1}^{m}\xi_i$

$$\text{s.t.} \begin{cases} (\vec{w}^T\vec{x}_i + b)y_i - 1 + \xi_i \geq 0 \\ \xi_i \geq 0 \end{cases}$$

得到其对应的KKT条件

$$\begin{cases} ① & \vec{w} - \sum_{i=1}^{m}\alpha_i y_i \vec{x}_i = 0 \\ ② & C = \alpha_i + \mu_i \\ ③ & \sum_{i=1}^{m}\alpha_i y_i = 0 \\ ④ & -\xi \leq 0 \\ ⑤ & 1 - \xi - y_i(\vec{w}^T\vec{x}_i + b) \leq 0 \\ ⑥ & \alpha_i \geq 0 \\ ⑦ & \mu_i \geq 0 \\ ⑧ & \mu_i\xi_i = 0 \\ ⑨ & \alpha_i(1 - \xi_i - y_i(\vec{w}^T\vec{x}_i + b)) = 0 \end{cases}$$

①②③ $\Big\}\ (\nabla f(\vec{x}^*) + \lambda\nabla g(\vec{x}^*) = 0)$

④–⑨ $\Big\}$ KKT对偶互补条件.

17式对应的lagrange函数 $L(\vec{w}, b, \vec{\xi}, \vec{\alpha}, \vec{\mu})$ 的原问题是

Primal $\min_{\vec{w},b,\vec{\xi}} \max_{\vec{\alpha},\vec{\mu}} L(\vec{w}, b, \vec{\xi}, \vec{\alpha}, \vec{\mu})$ 由于满足slater法则,原问题等于对偶问题

Dual: $\max_{\vec{\alpha},\vec{\mu}} \min_{\vec{w},b,\vec{\xi}} L(\vec{w}, b, \vec{\xi}, \vec{\alpha}, \vec{\mu}) = \max_{\vec{\alpha},\vec{\mu}} \left(\min_{\vec{w},b,\vec{\xi}} L(\vec{w}, b, \vec{\xi}, \vec{\alpha}, \vec{\mu}) \right)$