Then it is easy to see that we can compute b and η using the following averaging formulae:

$$b = w^\top \left(\Big(\sum_{i \in I_\lambda} u_i \Big) / |I_\lambda| + \Big(\sum_{j \in I_\mu} v_j \Big) / |I_\mu| \right) / 2$$

$$\eta = w^\top \left(\Big(\sum_{i \in I_\lambda} u_i \Big) / |I_\lambda| - \Big(\sum_{j \in I_\mu} v_j \Big) / |I_\mu| \right) / 2.$$

The "kernelized" version of Problem (SVM$_{s2'}$) is the following:

Soft margin kernel SVM (SVM$_{s2'}$):

$$\begin{aligned}
&\text{minimize} \quad \frac{1}{2}\langle w, w\rangle - K_m \eta + K_s \begin{pmatrix} \epsilon^\top & \xi^\top \end{pmatrix} \mathbf{1}_{p+q} \\
&\text{subject to} \\
&\qquad \langle w, \varphi(u_i)\rangle - b \geq \eta - \epsilon_i, \quad \epsilon_i \geq 0 \qquad i = 1, \ldots, p \\
&\qquad - \langle w, \varphi(v_j)\rangle + b \geq \eta - \xi_j, \quad \xi_j \geq 0 \qquad j = 1, \ldots, q \\
&\qquad \eta \geq 0.
\end{aligned}$$

Tracing through the derivation of the dual program we obtain

Dual of the Soft margin kernel SVM (SVM$_{s2'}$):

$$\begin{aligned}
&\text{minimize} \quad \frac{1}{2} \begin{pmatrix} \lambda^\top & \mu^\top \end{pmatrix} \mathbf{K} \begin{pmatrix} \lambda \\ \mu \end{pmatrix} \\
&\text{subject to} \\
&\qquad \sum_{i=1}^p \lambda_i - \sum_{j=1}^q \mu_j = 0 \\
&\qquad \sum_{i=1}^p \lambda_i + \sum_{j=1}^q \mu_j \geq K_m \\
&\qquad 0 \leq \lambda_i \leq K_s, \quad i = 1, \ldots, p \\
&\qquad 0 \leq \mu_j \leq K_s, \quad j = 1, \ldots, q,
\end{aligned}$$

where $\mathbf{K}$ is the kernel matrix of Section 54.1.

As in Section 54.3, we obtain

$$w = \sum_{i=1}^p \lambda_i \varphi(u_i) - \sum_{j=1}^q \mu_j \varphi(v_j),$$