Machine learning Homework- Soft-Margin SVM and Kernels

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Problem 1:

No it will not be the correct label. The training sample depends on the distance from the hyperplane decision boundary ξ. If $\xi < 1$ for the training sample it gets classified correctly else it gets mis-classified.

Problem 2:

The cost function for soft-margin SVM is

$$min f_0(\mathbf{w}, b, \xi) = \frac{1}{2}\mathbf{w}^T\mathbf{w} + C\sum_{i=1}^{N}\xi_i \tag{1}$$

C is a penalizing factor on ξ.
case 1: when C = 0 there is no restriction on ξ values.
case 2: when C ¡ 0 it encourages higher values of ξ and hence encouraging mis-classification.

Problem 3:

Problem 4:

Problem 5:

1. from $g(\alpha)$ we know that $\alpha Q \alpha^T$ is equivalent to $-\sum_{i=1}^{N}\sum_{j=1}^{N} y_i y_j \alpha_i \alpha_j \mathbf{x}_i \mathbf{x}_j$. By rearranging the scalars we get,$-\sum_{i=1}^{N}\sum_{j=1}^{N} \alpha_i y_i y_j \mathbf{x_i x_j} \alpha_j$.
   Therefore $Q = (-yy^T(hadamard)XX^T)$
2. We know that $Q = -p^T p$ and also we know that $p^T p$ is positive semi definite due to its symmetric nature. So $a^t(p^T p)a \geq 0$ but we negative sign also. Therefore, Q is negative semi definite.
3. The negative semi definiteness allows the concave optimisation to be a maximisation problem.