

# 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  $\xi$ . If  $\xi < 1$  for the training sample it gets classified correctly else it gets mis-classified.

## Problem 2:

## Problem 3:

- Both use hyperplane for classification
- SVM have margins and perceptrons do not have them

## Problem 4:

As we use KKT conditions for finding the minima of the constraint optimisation problem. Therefore, We satisfy the Slater theorem, which states if the constraint functions are affine, the duality gap is zero.

## 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,  $-\sum_{i=1}^N \sum_{j=1}^N \alpha_i y_i y_j \mathbf{x}_i \mathbf{x}_j \alpha_j$ .  
Therefore  $Q = (-yy^T(\text{hadamard})XX^T)$
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.