Exercise

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Informatics 3 - Professorship of Data Mining and Analytics

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SVM and Kernels

Problem 1:

Similarities:

Both try to find a fitting hyperplane which seperates the data classes.

Difference:

SVM tries to maximize the margin from the hyperplane to the data points, perceptron algorithms only care about a valid seperation of the data classes.

Problem 2:

a)

$g(\alpha)$ vectorized definition:

$$g(\alpha) = \frac{1}{2}\alpha^T Q\alpha + \alpha^T 1_N$$

$g(\alpha)$ standard definition:

$$g(\alpha) = \sum_{i=1}^{N} \alpha_i - \frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N} y_i y_j \alpha_i \alpha_j x_i^T x_j$$

y is a vector of dimension $N \times 1$

x is a matrix of dimension $N \times M$

$\sum_{i=1}^{N}\sum_{j=1}^{N} y_i y_j$ is equivalent to yy^T (dimension is $N \times N$)

$\sum_{i=1}^{N}\sum_{j=1}^{N} x_i^T x_j$ is equivalent to xx^T (dimension is $N \times N$)

$\sum_{i=1}^{N}\sum_{j=1}^{N} y_i y_j x_i^T x_j$ is the Hadamard product so: $[yy^T \odot xx^T]$

Take the -1 scalar from the standard definition into the matrix: $[-yy^T \odot xx^T] = Q$

$\implies \frac{1}{2}\alpha^T Q\alpha \equiv \frac{1}{2}\alpha^T[-yy^T \odot xx^T]\alpha \equiv -\frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N} y_i y_j \alpha_i \alpha_j x_i^T x_j$

$\alpha^T 1_N \equiv \sum_{i=1}^{N} \alpha_i$ is trivial.

$\implies g(\alpha)$ vectorized definition $\equiv g(\alpha)$ standard definition

b)

Problem 3:

Problem 4:

Problem 5:

Problem 6:

Appendix

We confirm that the submitted solution is original work and was written by us without further assistance. Appropriate credit has been given where reference has been made to the work of others.

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