

Problem Set 8

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Primal versus Dual Problem

1. [d] a quadratic programming problem with $d + 1$ variables

In the original formulation of the hard-margin SVM problem, we aim to minimize $\frac{1}{2}\mathbf{w}^T\mathbf{w}$ with the constraint $y_n(\mathbf{w}^T x_n + b) \geq 1$ for $n = 1, 2, \dots, N$. Because y_n and x_n are given as input data, our only variables are \mathbf{w} and b . Note that in this scenario, $\mathbf{w} = (w_1, w_2, \dots, w_d)$, and $b = w_0$. Thus, we have $d + 1$ variables, \mathbf{w} contributing d variables and b contributing one variable.

Polynomial Kernels

2. [a] 0 versus all
See attached code.
3. [a] 1 versus all
See attached code.
4. [c] 1800
See attached code.
5. [d] Maximum C achieves the lowest E_{in}
See attached code.
6. [b] When $C = 0.001$, the number of support vectors is lower at $Q = 5$.
See attached code.

Cross Validation

7. [b] $C = 0.001$ is selected most often.
See attached code.
8. [c] 0.005
See attached code.

RBF Kernel

9. [e] $C = 10^6$

See attached code.

10. [c] $C = 100$

See attached code.