University of TEHRAN

Machine Learning

Problem Set 8

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Azar 2, 1398
(November 23, 2019)

Problem 1: Review Questions
Write a summary of the lectures of this week. Write down all formulas we discussed in the lectures and explain in detail each step of derivations. As a guideline, you may consider the following topics:

(a) Convex sets & functions; convex optimization; linear and quadratic programming; Lagrangian duality; dual problem of linear programming

(b) Subgradient; coordinate descent algorithm for linear regression and Lasso; sequential minimal optimization (SMO)

(c) **(Important)** Write a summary of ISL, Sec. 9.4-5.

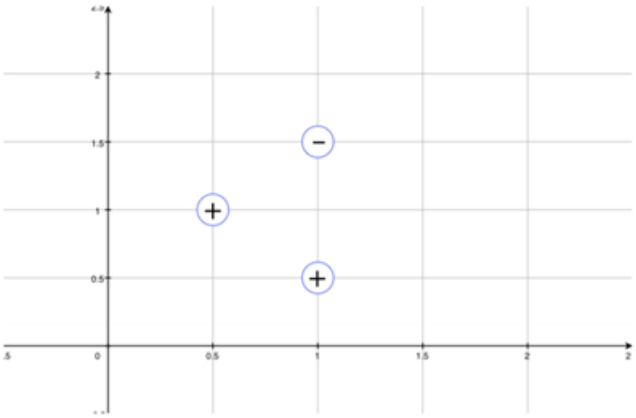
Problem 2: Dual problem of quadratic programming
Derive the dual optimization problem of quadratic programming.

Problem 3: Bias-variance tradeoff in SVM
Discuss how the bias and variance vary with the parameter C in SVM.

Problem 4: Complementary slackness (Optional)
Prove if strong duality holds, the optimal primal and dual solutions satisfy complementary slackness conditions.

Problem 5: Conceptual questions (Optional)
ISL chapter 9, questions 1-3

Problem 6: Programming: Primal and dual problems in SVM
Fit a linear SMV model by solving the primal and dual optimization problems for the following data points using a quadratic programming solver in R (or programming language of your choice).



Problem 7: Programming: Coordinate descent algorithm
Implement coordinate descent algorithms for fitting linear regression and LASSO for a simple simulated problem of your choice and compare to the built-in functions in R.

Submit your solutions (using Easyclass) by Azar 10, 1398.