Indian Institute of Science

E9-253: Neural Networks and Learning Systems-I

Instructor: Shayan Srinivasa Garani
Home Work #4, Spring 2019

Late submission policy: Points scored = Correct points scored $\times e^{-d}$, d = # days late

Assigned date: March 21^{st} 2019 **Due date:** April 4^{th} 2019 in class

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PROBLEM 1: Solve

(a) 6.1 (15 points).
(b) 6.3 (15 points).
(c) 6.11 (5 points).
(d) 6.21 (5 points).
(e) 6.25 (35 points) considering the dataset as shown in Figure P6.25 on page 312 from the book Neural Networks and Learning Machines (third edition) by Simon Haykin.

(75 pts.)

PROBLEM 2: Consider the kernel $K(\overline{x}, .) = \tanh\left(\beta_0 \overline{x}^{\mathrm{T}} \overline{x} + \beta_1\right)$ for $\overline{x} \in \mathbb{R}^d$. Check if some choices of β_0 and β_1 satisfy Mercer's theorem.. (10 pts.)

PROBLEM 3: Let

$$L_\epsilon(d, y) = \begin{cases} |d - y| - \epsilon, & |d - y| \geq \epsilon \\ 0, & \text{else.} \end{cases}$$

Following the notations and their meanings as mentioned in the class,

$$\begin{aligned} \text{minimize} \qquad & R_{\text{emp}} = \frac{1}{N} \sum_{i=0}^{N-1} L_\epsilon\left(d_i, y_i\right) \\ \text{subject to} \qquad & \|\overline{w}\|^2 \leq c_0 \\ & d_i - \overline{w}^{\mathrm{T}} \phi(\overline{x}_i) \leq \epsilon + \zeta_i \\ & \overline{w}^{\mathrm{T}} \phi(\overline{x}_i) - d_i \leq \epsilon + \zeta_i' \\ & \zeta_i \geq 0 \\ & \zeta_i' \geq 0 \end{aligned}$$

for all $i = 1, \ldots N$. Set up the primal and the dual cost function with all the constraints for the given problem. (15 pts.)