CSE 250B Winter 2019 - Quiz 6

Mar 1, 2019 - 20 Minutes **Name:** **PID:**

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(1) This is a closed book, closed notes exam. Switch off your cell phone and do not communicate with anyone other than an exam proctor.
(2) Start writing when instructed. Stop writing when your time is up.
(3) Remember that your work is graded on the quality of your writing and explanation as well as the validity of the mathematics.

Let $v_1, \ldots, v_k$ be k vectors in $\mathbb{R}^d$. Recall that the subspace spanned by $v_1, \ldots, v_k$ is defined as the set of all vectors $\sum_{i=1}^{k} c_i v_i$ where c_i's are *any* scalars. The cone spanned by $v_1, \ldots, v_k$ is defined as the set of all vectors $\sum_{i=1}^{k} c_i v_i$ where the c_i's are *positive* scalars.

Suppose we are given training data with binary ± 1 labels, and we are using the Perceptron algorithm to train a classifier $sign(w^\top x + b)$ on training data $(x^{(1)}, y^{(1)}), \ldots, (x^{(n)}, y^{(n)})$.

State whether following statements are true or false, and justify your answer in each case.

(1) (4 points) Does w lie in the subspace spanned by $x^{(1)}, \ldots, x^{(n)}$?

True. From the perceptron algorithm, note that we begin with $w_1 = 0$, and update w_t as $w_t = w_t + y^{(t)} x^{(t)}$; this means that the w at the end can be written as:

$$w = \sum_{j \in I} y^{(j)} x^{(j)}$$

where I is the set of indices where updates are made. Thus w is a linear combination of the $x^{(i)}$'s and therefore it lies in the subspace spanned by the $x^{(i)}$'s.

(2) (3 points) Does w always lie in the cone spanned by $x^{(1)}, \ldots, x^{(n)}$?

False. This is because some of the $y^{(i)}$'s may be -1.

(3) (3 points) Does w lie in the cone spanned by $y^{(1)} x^{(1)}, \ldots, y^{(n)} x^{(n)}$?

True – for this, $c_i = 1$.