CSE 251A Winter 2021 - Take Home Exam 4

1 hour **Name:** **PID:**

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(1) This is an open book, open notes exam. You are free to consult any text book or notes. **You are not allowed to consult with any other person.**
(2) If you need any clarification, please post a private message to the instructors on Piazza.
(3) Remember that your work is graded on the *clarity* of your writing and explanation as well as the validity of what you write.
(4) This is a one-hour exam.

(1) A decision region of a classifier f corresponding to a label y is the set of inputs where f predicts y. Formally, the decision region for a classifier $f : \mathbb{R}^d \to \mathcal{Y}$ for a label y is the set $\{x \in \mathbb{R}^d, f(x) = y\}$.

We say that a classifier has convex decision regions if all its decision regions corresponding to every label are convex.

(a) (5 points) Suppose we are given a multiclass linear classifier f_L with $k > 2$ classes. Does f_L have convex decision regions? Please state which of these choices is true: 1) true for all f_L; 2) true for some f_L but not others; 3) not true for any f_L. Justify your answer.

(b) (5 points) Now suppose f_T is a decision tree with two output labels. Does f_T have convex decision regions? Please state which of these choices is true: 1) true for all f_T; 2) true for some f_T but not others; 3) not true for any f_T. Justify your answer.

(2) State whether the following statements are true or false. Justify your answer.

(a) (5 points) If $K(x, z)$ is a kernel, then $L(x, z) = K(x, x) + K(z, z) - 2K(x, z)$ is also a kernel.

(b) (5 points) Suppose $K(x, z)$ is a kernel. Then $K(x, x)$ is always a convex function of x.