CSE 151A Winter 2021 - Take Home Exam 21 hour **Name:**

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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) Draw the decision boundary for the nearest neighbor classifier on the following data points in 2 dimensions.

$$((0,0),0),((4,1),1),((-2,3),0)$$

For full credit, write down the equation for each segment of the decision boundary, and label each region with the label assigned to it by the classifier.

(2) Remember that any classifier is basically a function that takes in a feature vector in $\mathbb{R}^d$ and outputs a label. We say that two classifiers C and C' are equal if they output the same label for every feature vector x in $\mathbb{R}^d$. Formally, for all $x \in \mathbb{R}^d$, $C(x) = C'(x)$.

Suppose Alice and Bob are both building a 1-nearest neighbor classifier on the same training dataset S. To build the classifier Alice computes the nearest neighbosr using the Euclidean distance to get the classifier C.

(a) (5 points) Suppose Bob computes the nearest neighbors using the square of the Euclidean distance and gets the classifier C'. Is C' equal to C for all training dataset? If yes, provide a short proof, and if no, provide a counterexample.

(b) (5 points) Now, instead of the square of the Euclidean distance, Bob computes the nearest neighbors using the following distance function:

$$d(x, x') = \sum_{i=1}^{d} (x^i - x'^i)^3$$

where x^i denotes coordinate i of the vector x. This gives him a classifier C''. Is C'' equal to C for all training datasets? Justify your answer.