Name: _____

Problem	Points	Score
1(a)	15	
1(b)	10	
1(c)	15	
1(d)	10	
2(a)	10	
2(b)	15	
2(c)	15	
2(d)	10	
Total	100	

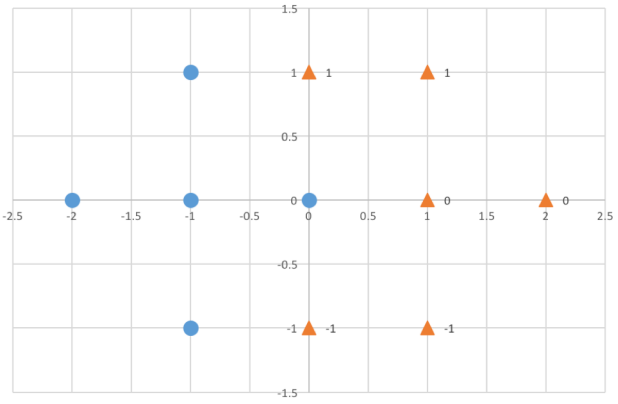
Notes:

(1) The exam is closed books and notes except for one double-sided sheet of notes.

(2) Please indicate clearly your answer to the problem.

(3) If I can't read or follow your solution, it is wrong and no partial credit will be awarded.

Problem No. 1: Consider the data shown to the right. We are going to answer a few qualitative questions about classifiers trained on this data. Assume a Euclidean distance is used to compute probabilities and that priors and variances are ignored. Use maximum likelihood classification.



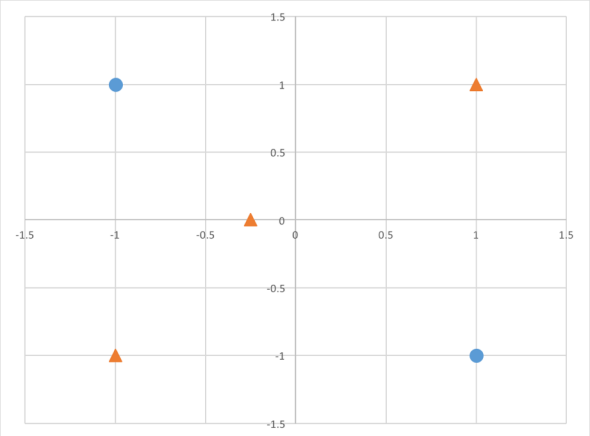
(a) Draw the decision surface that would be computed using a kNN classifier where $k \rightarrow \infty$ (in other words, all the data is used to form the decision surface). Explain.

(b) What value of k is optimal (achieves a minimum error rate)? Explain.

(c) Draw the decision surface that would be achieved by a Support Vector Machine (SVM) (with no slack variables). Explain.

(d) Explain any differences between the SVM and kNN decision surfaces and what aspects of the data influence these differences.

Problem No. 2: Let's assume that we train and classify the data to the right using a linear classifier. Again, ignore priors and variances. Use a Euclidean distance.



(a) What is the minimum theoretical error rate that can be achieved?

(b) There are four points in this data set. Using a kNN approach and leave-one-out cross validation, what is the minimum error rate that can be achieved?

(c) Suppose a linear classifier was trained using maximum likelihood parameter estimation, and a decision surface was found that corresponds to a vertical line at the origin (y = 0). Next, suppose several iterations of discriminative training were run. How would you expect the decision surface to change? Note that since a linear classifier was used, the surface must always remain a line.

(d) If you trained a decision tree on this data, what might the tree look like? Clearly explain your assumptions.