Course: *CMPS 320- Machine Learning* – Professor: *Dr. Osei Tweneboah*

Homework #6 Due on 12/14/2021

Instructions: While discussion with classmates are allowed and encouraged, please try to work on the homework independently and direct your questions to me.

Problem 1

In this problem, you will use support vector approaches in order to predict whether a given car gets high or low gas mileage based on `Auto` data set: https://rdrr.io/cran/ISLR/man/Auto.html.

(a) What is the fundamental idea behind Support Vector Machines?

(b) Create a binary variable that takes on a 1 for cars with gas mileage above the median, and a 0 for cars with gas mileage below the median.

(c) Fit a linear support vector classifier to the data with various values of `cost`, in order to predict whether a car gets high or low gas mileage. Comment on your results.

(d) Now repeat (c), this time using SVMs with radial and polynomial basis kernels, with different values of gamma and degree and cost. Comment on your results.

Problem 2

In this problem, we investigate a non-linear decision boundary.

(a) Sketch the curve

$$(1+x_1)^2 + (2-x_2)^2 = 4$$

(b) On your sketch, indicate the set of points for which

$$(1+x_1)^2 + (2-x_2)^2 > 4$$

as well as the set of points for which

$$(1+x_1)^2 + (2-x_2)^2 \leq 4$$

(c) Suppose that a classifier assigns an observation to the blue class if

$$(1+x_1)^2 + (2-x_2)^2 > 4$$

and to the red class otherwise. To what class is the following observations:

i. $(0,0)$
ii. $(-1,1)$
iii. $(2,2)$
iv. $(3,8)$