Machine Learning

Assignment 3 - Binary Classification
Spring 2023

1 Theory

1. For the function $J = (x_1w_1 - 5x_2w_2 - 2)^2$, where $w = [w_1, w_2]$ are our weights to learn:

   (a) What are the partial gradients, $\frac{\partial J}{\partial w_1}$ and $\frac{\partial J}{\partial w_2}$? Show work to support your answer (6pts).

   I used the chain rule to find both partial gradients.

   $\frac{\partial J}{\partial w_1} = 2(x_1w_1 - 5x_2w_2 - 2)x_1$

   $\frac{\partial J}{\partial w_2} = -10(x_1w_1, -5x_2w_2 - 2)x_2$

   (b) That are the value of the partial gradients given current values of $w = [0, 0], x = [1, 1]$ (4pts)?

   For $\frac{\partial J}{\partial w_1}$:
   $= 2 * (1 * 0 - 5 * 1 * 0 - 2) * 1$
   $= 2(-2) * 1$
   $=$ -4

   For $\frac{\partial J}{\partial w_2}$:
   $= -10 * (1 * 0 - 5 * 1 * 0 - 2) * 1$
   $= -10(-2) * 1$
   $= 20$

2 Linear Descriment Analysis (LDA) Classifier

Training Accuracy: 0.9103650586701434 = 91%
Validation Accuracy: 0.9080234833659491 = 90%
Precision: 0.8769497400346621 = 88%
Recall: 0.8784722222222222 = 87%
F-Measure: 0.8777103209019947 = 88%

3 Logistic Regression

With a learning rate = 0.01, and an epoch = 10,000
Precision: 0.9110320284697508 = 91%
Recall: 0.8888888888888888 = 89%
F-Measure: 0.8998242530755711 = 90%
Accuracy: 0.9256360078277887 = 93%