Assignment 10

Deadline 26th May at 11.59PM. DSA 8302 Computational Techniques in Data Science

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1. **Gradient Descent for Linear Regression (Dataset: Boston housing data)**

Use **gradient descent** to fit a linear regression model predicting medv (median house value) from lstat (% lower status of the population).

1. Normalize the input features.
2. Implement gradient descent manually in R.
3. Plot cost vs iterations.
4. Compare your coefficients to those from linear model
5. Interpret the coefficients and the convergence behavior.

2. **Gradient Descent for Logistic Regression (Dataset: Default from ISLR package)**

Use **gradient descent** to fit a logistic regression model predicting default (yes/no) based on balance and student status.

1. Encode default as binary.
2. Manually implement logistic loss and gradient descent.
3. Plot the log-loss vs iterations.
4. Compare with glm() and interpret coefficients.

3. **Nelder-Mead for Linear Regression (Dataset: airquality)**

Use the **Nelder-Mead** method to minimize **Mean Squared Error (MSE)** of a linear regression model predicting Ozone using Temp and Wind.

1. Create a function that returns MSE given a parameter vector.
2. Use optim(method = "Nelder-Mead") to find coefficients.
3. Compare with lm() results.

4. **Nelder-Mead for Hyperparameter Tuning in kNN (Dataset: Sonar from mlbench)**

Tune the **number of neighbors (k)** for k-Nearest Neighbors (kNN) classification using **cross-validation error** as the objective, optimized via **Nelder-Mead**.

1. Define a function that returns CV error for a given k.
2. Use optim(method = "Nelder-Mead") to find best k.
3. Validate using caret::train() or similar.

4. Compare your best model to default settings and interpret results.