

Multiple Linear Regression and Multivariate Linear Regression

Part A: Multiple Linear Regression

Q1: Real-World Dataset Modeling

Use the **Car Price Prediction Dataset** to build a multiple linear regression model to predict the price of the car using features like engine size, curb weight, horsepower, city mpg, and highway mpg.

Tasks:

- Build a multiple linear regression model using 70% data for training and 30% for testing.
- Report:
 - Hypothesis function
 - Training and testing MSE or MAE
 - Plot: Predicted vs Actual Price
 - R^2 Score evaluation on the test set

Q2: Manual Implementation (Without Vectorization)

Implement the gradient descent algorithm from scratch for predicting car prices, using the features above (without vectorized operations).

Tasks:

- Run gradient descent for 1000 iterations
- Plot the cost function over iterations
- Submit final learned weights

Q3: Comparison Analysis

Compare the results from **Q1** (vectorized implementation) and **Q2** (non-vectorized gradient descent).

Discuss:

- Execution time
- Convergence speed
- Code readability

- Accuracy

Part B: Multivariate Linear Regression

Q4: Predict Multiple Targets

Use the **Car Price Prediction Dataset** to build a multivariate linear regression model to predict both city mpg and highway mpg using engine size, curb weight, horsepower, and price.

Tasks:

- Construct separate theta parameters for each target
- Use vectorized implementation
- Report cost (MSE) for both outputs
- Submit visualizations for actual vs predicted for each target separately

Q5: Conceptual Question

Explain the difference between **Multiple Linear Regression** and **Multivariate Linear Regression** with at least 2 real-world examples for each.

Include the mathematical representation of the hypothesis function and cost function for both cases.