ASSIGNMENT - 3

SIMPLE LINEAR REGRESSION

AI LAB

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GitHub Link: 22052321-ASSIGNMENT

Q1. Use linear regression to fit a straight line to the given database. Set your learning rate to 0.5. What are the cost function value and learning parameters values after convergence? Also, mention the convergence criteria you used.

Convergence Criteria: The algorithm terminates when the absolute difference in the cost function value between successive iterations falls below 1×10^{-6}. This ensures that the model has reached a state where further parameter updates yield negligible improvement in the cost.

Final Parameters (Theta):

$\Theta_0 = 0.40672447$

$\Theta_1 = 0.35975493$

Final Cost: 0.007784690728654539

Q2. The cost function that we are using in this assignment is different than the one we used in class. Can you think of the advantage of averaging the cost?

The cost function in this assignment calculates the average of squared errors, differing from other formulations that sum squared errors without averaging.

Advantages of Averaging the Cost:

- **Dataset Independence:** Averaging normalizes the cost function by dividing by the number of data points (m), ensuring that its value remains independent of dataset size. This prevents the cost function's magnitude from scaling disproportionately with larger datasets, enabling consistent learning behavior.
- **Stable Convergence:** By averaging, the risk of large gradients in gradient descent for larger datasets is minimized. This ensures smoother and more stable convergence since each gradient step is appropriately scaled to the dataset size.
- **Comparability Across Datasets:** Averaged costs enable comparison of model performance across datasets of varying sizes. Without averaging,

larger datasets would naturally yield higher cost values, making comparisons less meaningful.

- **Consistent Learning Rate:** Averaging simplifies hyperparameter tuning by eliminating the need to adjust the learning rate based on dataset size, ensuring consistent behavior.

Q3. Plot cost function v/s iteration graph for the model in question 1 for first 50 iterations.

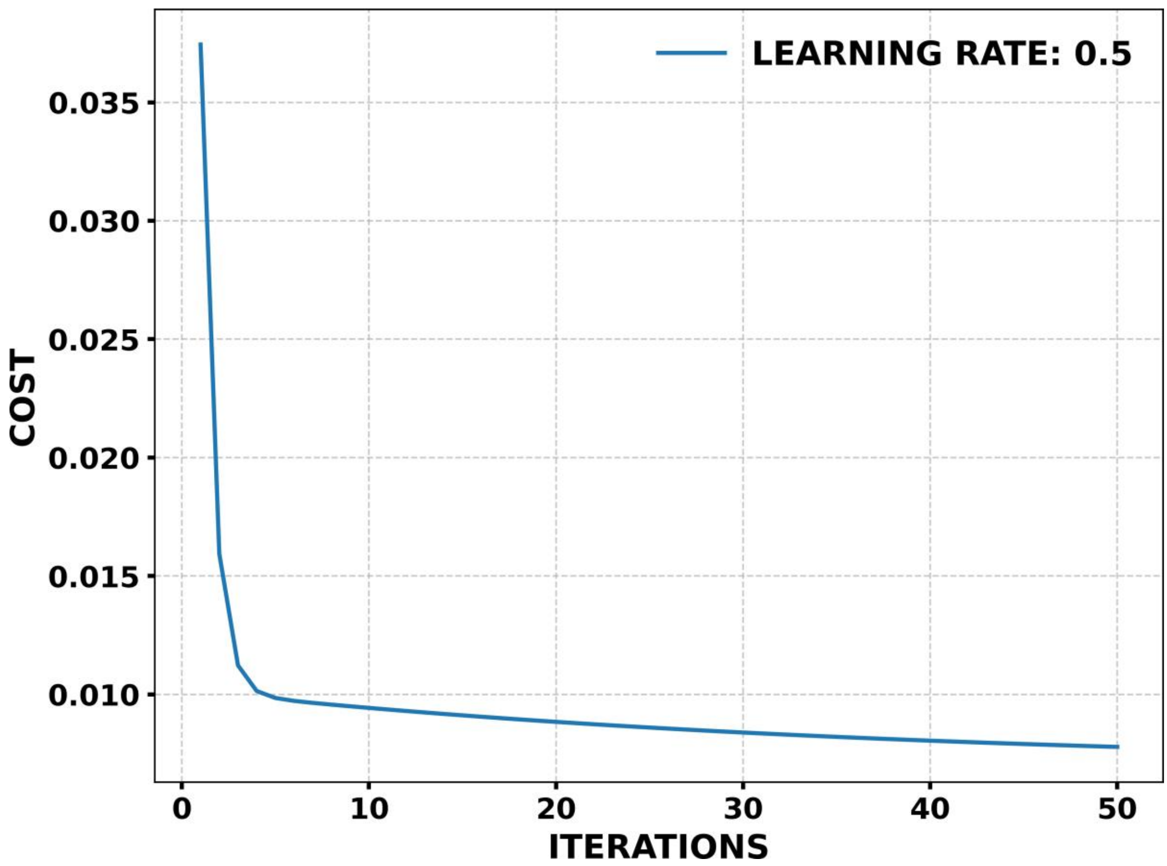

Figure 1: COST FUNCTION V/S. ITERATION FOR FIRST 50 ITERATIONS

Q4. Plot the given dataset on a graph and also print the straight line you obtained in question 1 to show how it fits the data.

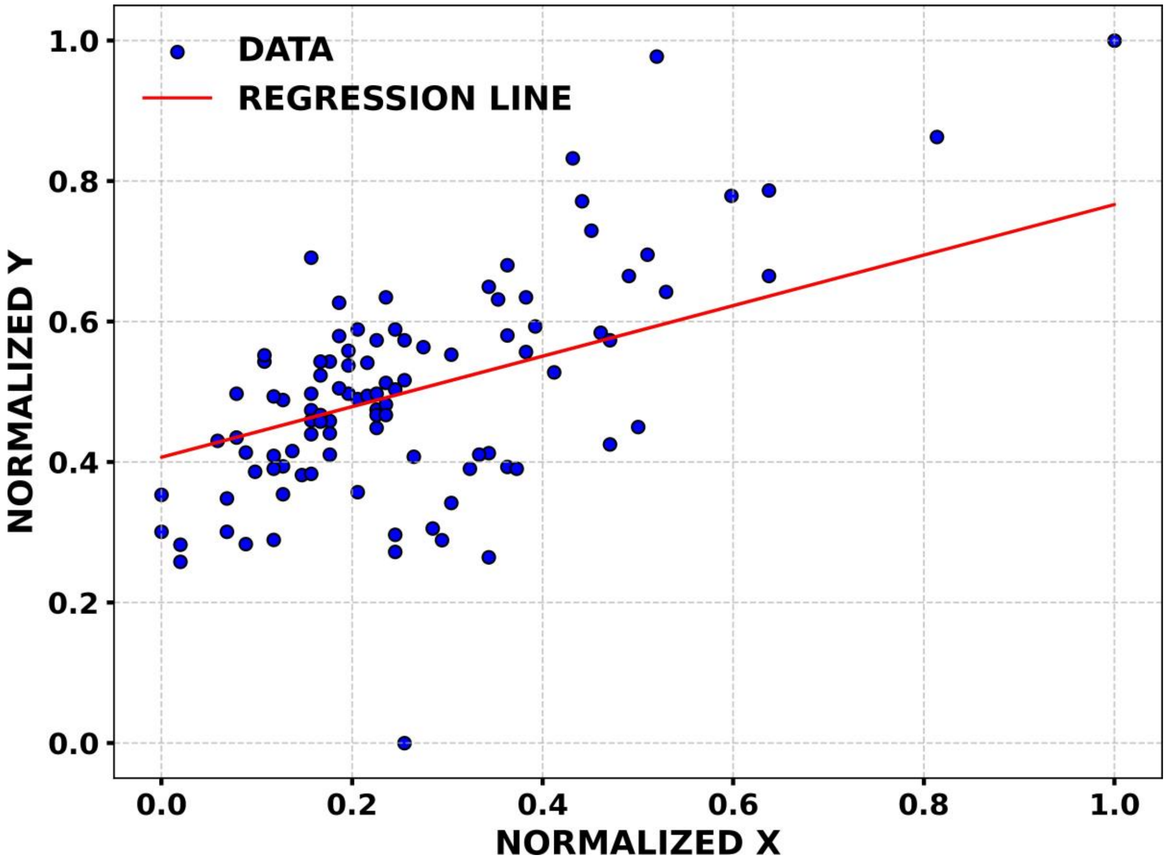

Figure 2: DATA SET AND REGRESSION LINE

Q5. Test your regression model with the learning rates lr = 0.005, lr = 0.5, lr = 5. For each learning rate, plot a graph showing how the cost function changes for the first 50 iterations and write your observation.

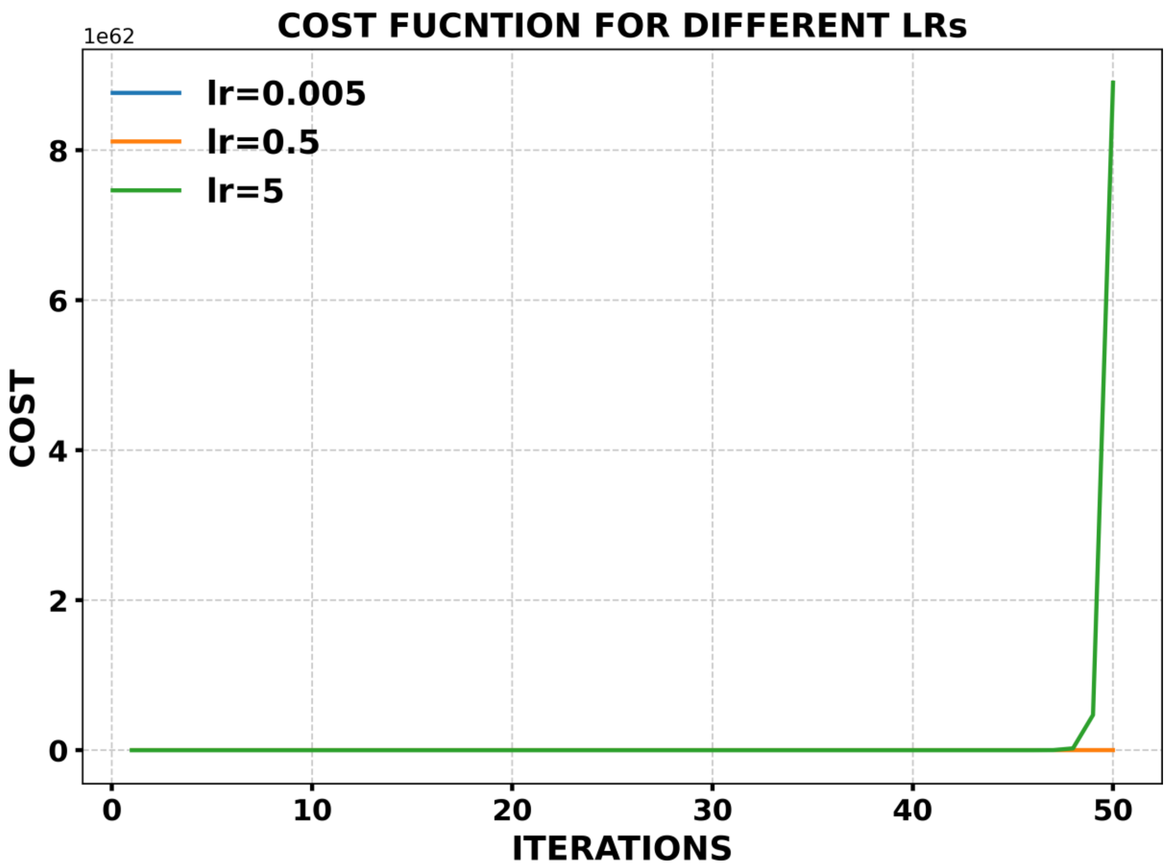

Figure 3: COST FUNCTION FOR DIFFERENT LEARNING RATE

Q6. Choose a suitable learning rate, then implement stochastic and min-batch gradient descent, plot the cost function against iteration, and observe how your cost function changes compared to batch gradient descent.

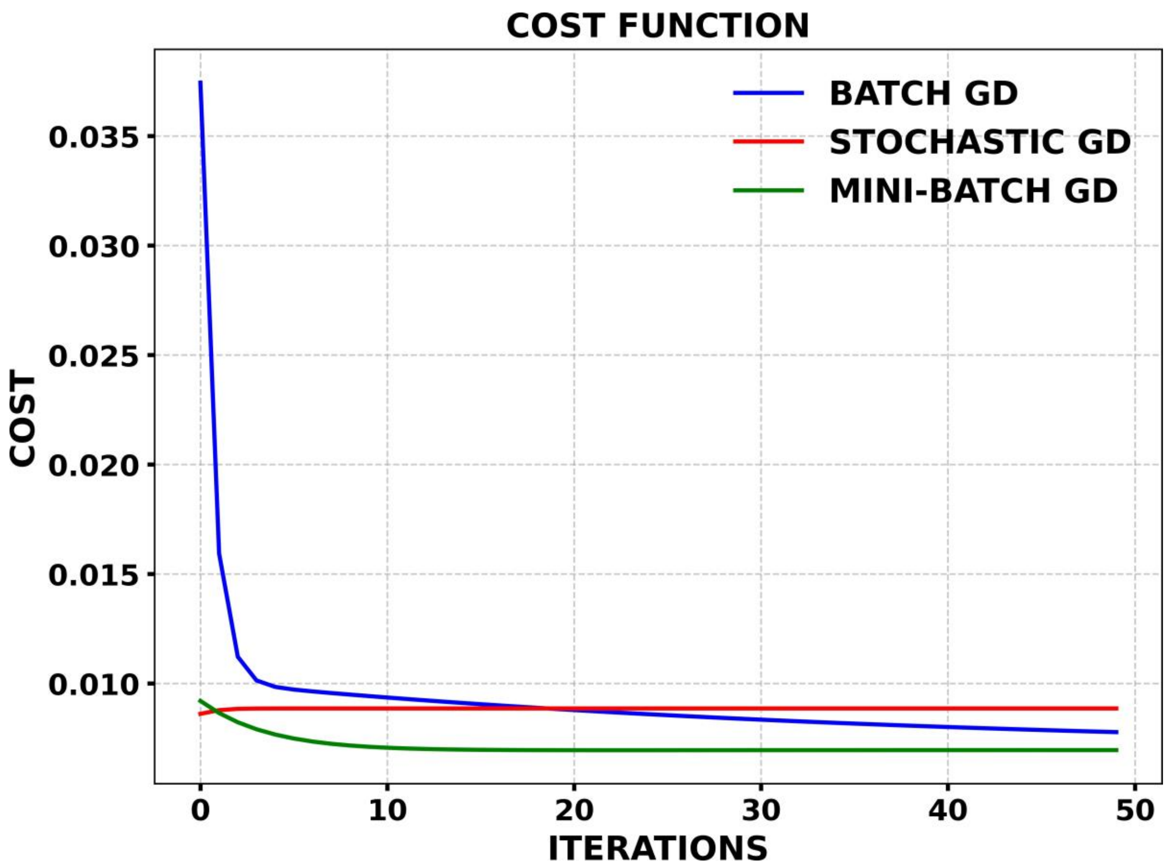

Figure 4: COMPARISON OF GRADIENT DESCENT TECHNIQUE