ASSIGNMENT 3

SIMPLE LINEAR REGRESSION

AI LAB

Name: SHARAD SHAHI
Roll No: 22052332
Section: 29
Branch: CSE
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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 stops when the absolute change in the cost function value between consecutive iterations is less than 1×10^{-6}. This ensures that the model has reached optimal parameters where further updates will not significantly improve 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 used in this assignment averages the squared errors, which is different from some other formulations that may sum the squared errors without averaging.

Advantage of Averaging the Cost:

- **Dataset Independence:** Averaging normalizes the cost function with respect to the number of data points (m), making it independent of the dataset size. o This ensures that the magnitude of the cost function does not disproportionately increase with larger datasets, leading to consistent learning behaviour.
- **Stable Convergence:** Averaging reduces the risk of excessively large gradients for larger datasets, which can destabilize gradient descent. It allows for smoother and more stable convergence by ensuring that each gradient step is proportional to the dataset size.
- **Comparability Across Datasets:** With averaged costs, you can compare the performance of models trained on datasets of different sizes. This is not possible with unaveraged costs, where larger datasets would naturally have higher cost values.
- **Consistent Learning Rate:** Averaging simplifies hyperparameter tuning by ensuring the learning rate does not need to scale with dataset size.

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

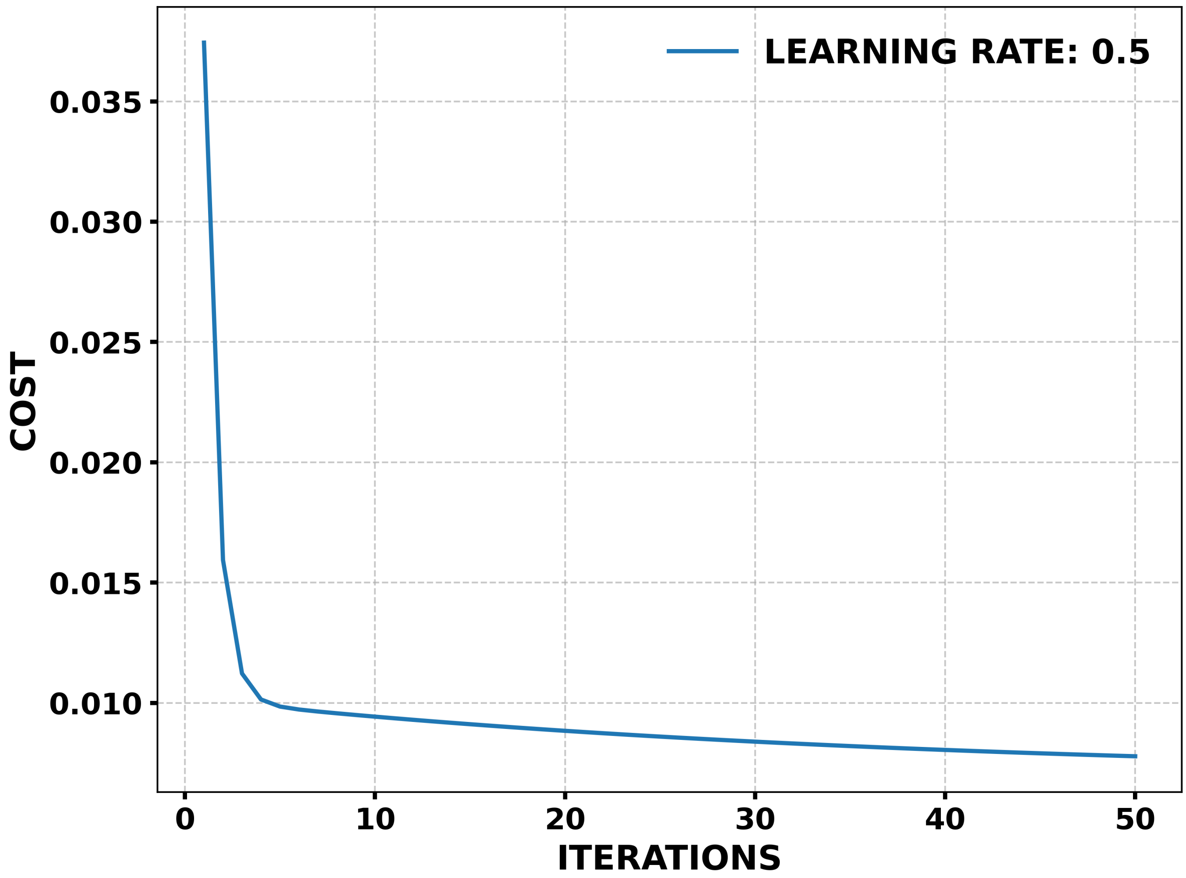

Figure 1: COST FUNCTION V/S. ITERATION FOR FIRST 50 ITERATIONS

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.

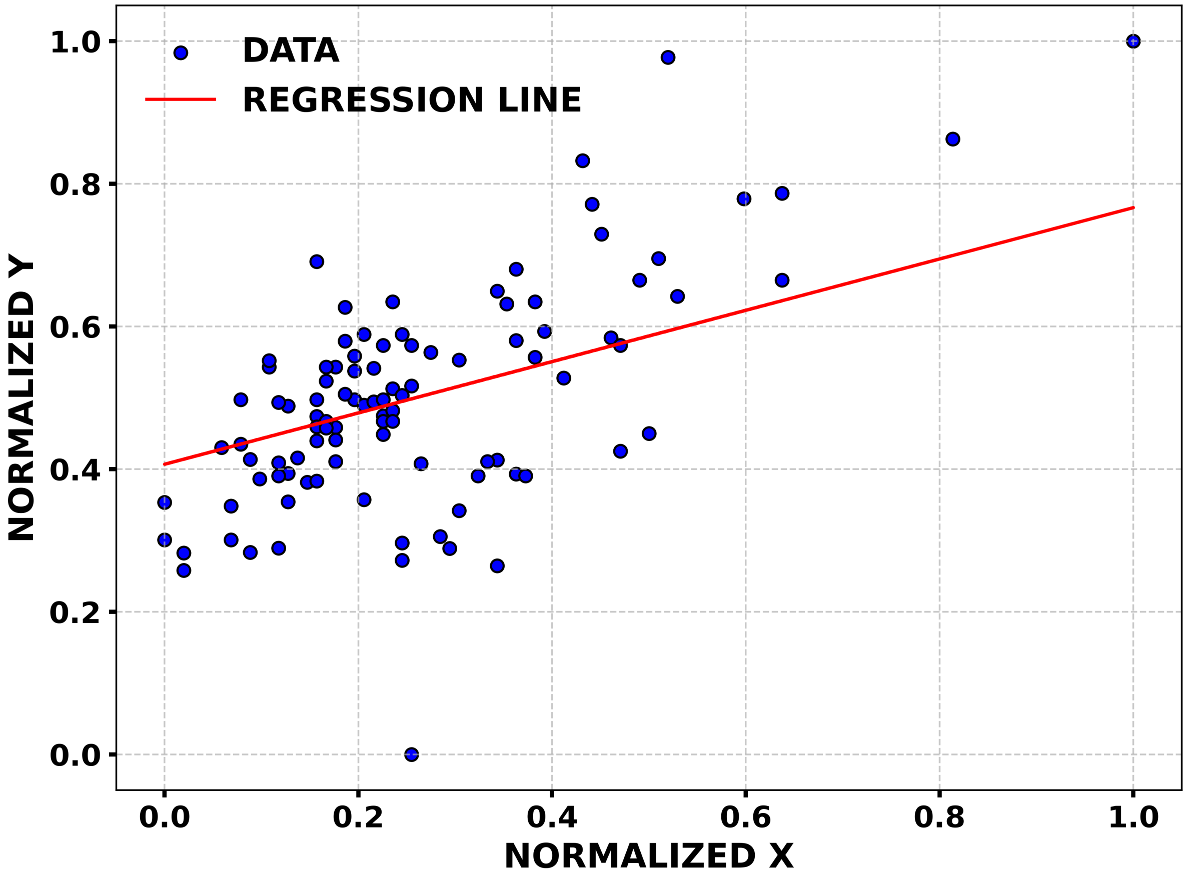

Figure 2: DATA SET AND REGRESSION LINE

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.

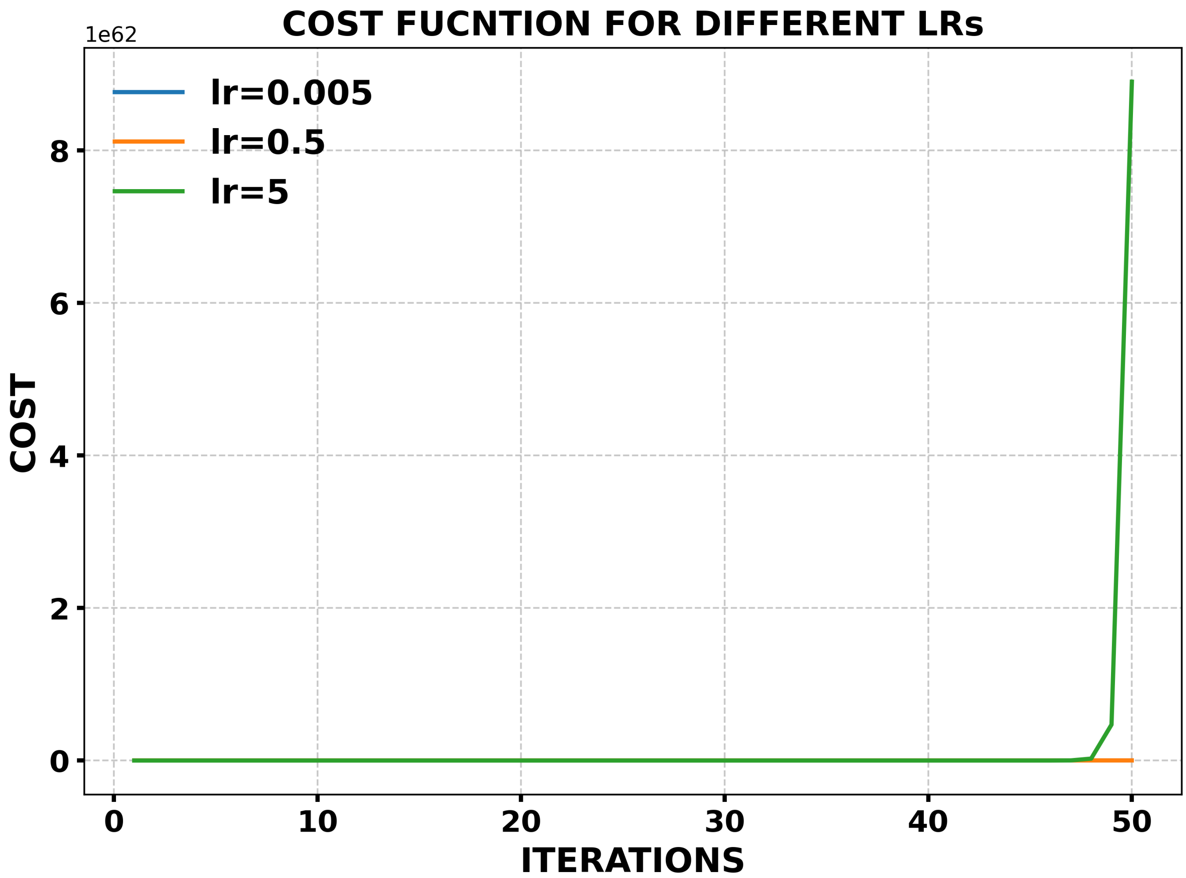

Figure 3: COST FUNCTION FOR DIFFERENT LEARNING RATE

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.

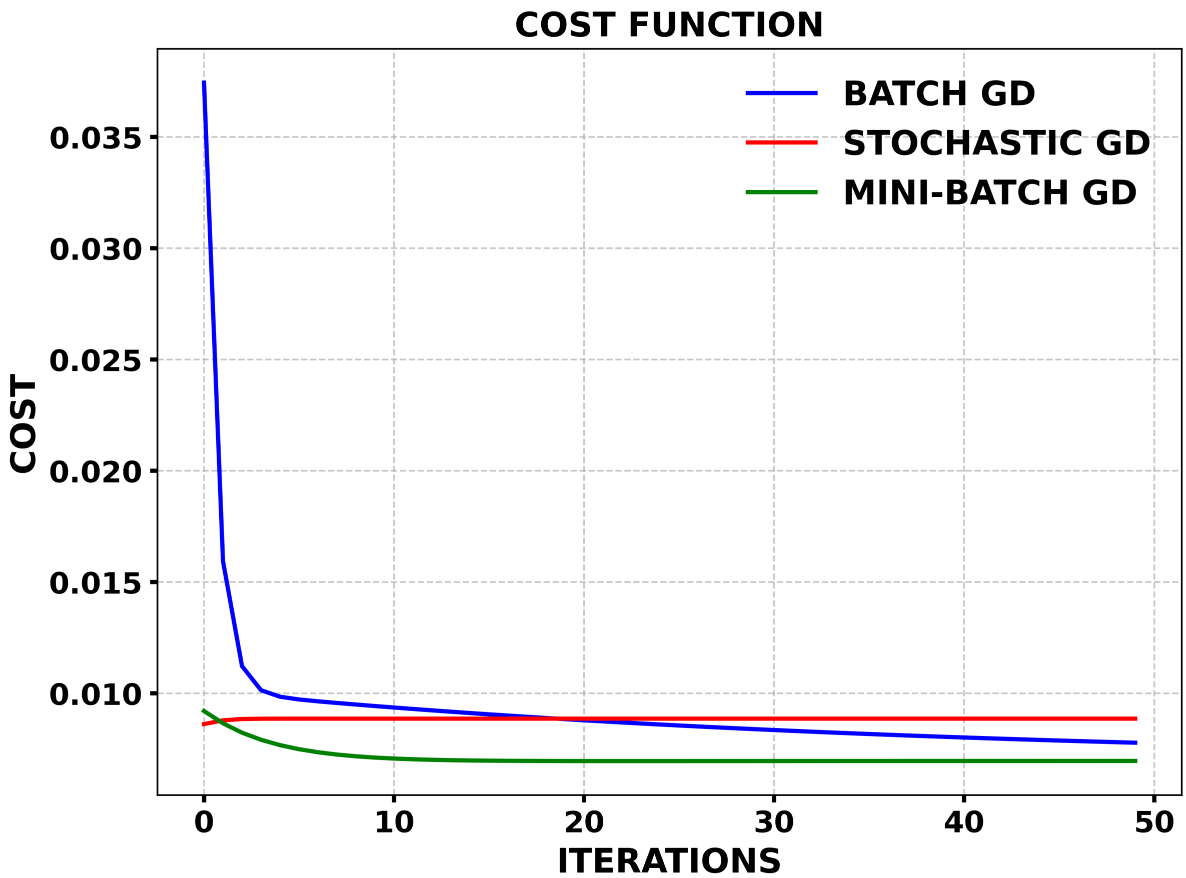

Figure 4: COMPARISON OF GRADIENT DESCENT TECHNIQUE