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## Training a Linear Regression Model with Stochastic Gradient Descent (SGD)

### Introduction

Linear regression is trained by Stochastic Gradient Descent (SGD) in this report. This methodology allows for the learning of the model in incremental steps whereby the model makes small adjustments after seeing each data point. Random data were created using a tool called make\_regression for this experiment.

### How We Did It

Data creation: Using a dataset generated by make\_regression, we created 1000 data points with 10 features. The data are perfectly correlated but slightly disrupted to incorporate some randomness for a more realistic input.

Model initialization: The model initialized with random values.

Training via SGD: Model tweaked its values slowly by observing one data point at a time.

Observed Learning Speed: We varied the values of the "learning rate," which is a measure of how quickly the model updates itself.

Effects of the Learning Rate

Three learning rates were tried:

Fast Learning (High Rate: 0.1) → Learns quickly, jumping too much.

Balanced Learning (Medium Rate: 0.01) → Learns well, having good stabilization.

Slow Learning (Low Rate: 0.001) → Really slow learning, very stable.

Results

We kept track of the error the model was making in learning. When the learning rate was too high, the error never settled down properly. Low learning rates took way too long for learning. The medium learning rate worked very well because it was able to balance speed versus accuracy well.

### Conclusion

One crucial aspect of training neural networks relates to the learning rate. When the learning rate is too high, convergence of the model does not occur. In contrast, with low learning rates, the model suffers by taking excessively long to converge. Most of the time, the moderate learning rate is the best option.