**James Folk**

**DATA 527 – Predictive Modeling**

**Assignment 3**

**DEADLINE: March 28, 2024**

**Spring 2024**

**Overview**

The purpose of this study is to implement a feed forward network solves the problem of the XOR logic function.

**Methodology**

* **Creation of the data structure of the Neural Network:** I chose to create the neural network using a class data structure.
* **Viewing the data:** I wanted to be able to view the neural network, so I added functions to draw the neural network using `matplotlib`.
* **Writing the feed forward:** Following the algorithm of the lecture, I wrote the feed forward process
* **Writing the back propagation:** Following the algorithm of the lecure, I wrote the back propagation process.
* **Testing the algorithm:** I utilized python’s `unittest` package to test the different functionality. The two functions `test\_batch\_learning` and `test\_stochastic` run the batch learning process and the stochastic process.
* **Calculation the error:** Implemented the estimate function, utilizing the obtained slope and intercept to predict dependent values based on the dependent values.

**Implementation**

A black background with a black square

Description automatically generated with medium confidence

**Results**

****

**Simple Linear Regression**

The dots are the actual. The line is the estimation.

****

**Mean Square Errors**

The x-axis is the error per iteration. Th y axis is the actual erorr value.

{

"learningRate": 0.0001,

"iterations": 3369787,

"final mse": 110.25738344912885,

"slope": 1.3224310226892124,

"yIntercept": 7.991020985666067,

"r value": 0.5986557915661921

}

**Discussion**

Challenges Faced and Solutions

* **Error in Lecture Material:** One of the initial challenges encountered during the implementation process was identified in the lecture material. Specifically, there were errors in some of the functions, particularly in the cost function and the calculation of derivatives with respect to slope and intercept. The issue was found to be a misalignment in the assignment of predicted and actual values.
* **Verification Using Assignment One Data:** To validate the correctness of the implemented functions, the model was initially tested using data from assignment one. This step was crucial in establishing a benchmark and ensuring that the functions produced reliable results.
* **Learning Rate Selection:** Another significant challenge was encountered in determining the appropriate learning rate. Initiating the model with a learning rate of 0.001 resulted in a regression line that did not align well with the scatter plot. Adjusting the learning rate to 0.0001 yielded a more accurate regression line.

In summary, the challenges faced during the model implementation, such as errors in the lecture material and the critical decision of learning rate selection, were overcome through careful validation, benchmarking, and iterative adjustments. These experiences highlighted the importance of robust testing and parameter tuning in ensuring the reliability and effectiveness of the implemented model.

**Conclusion**

In this work, we investigated the prediction of dependent values using a basic linear regression model, with a focus on independent values.

**References**

The assignment specification.