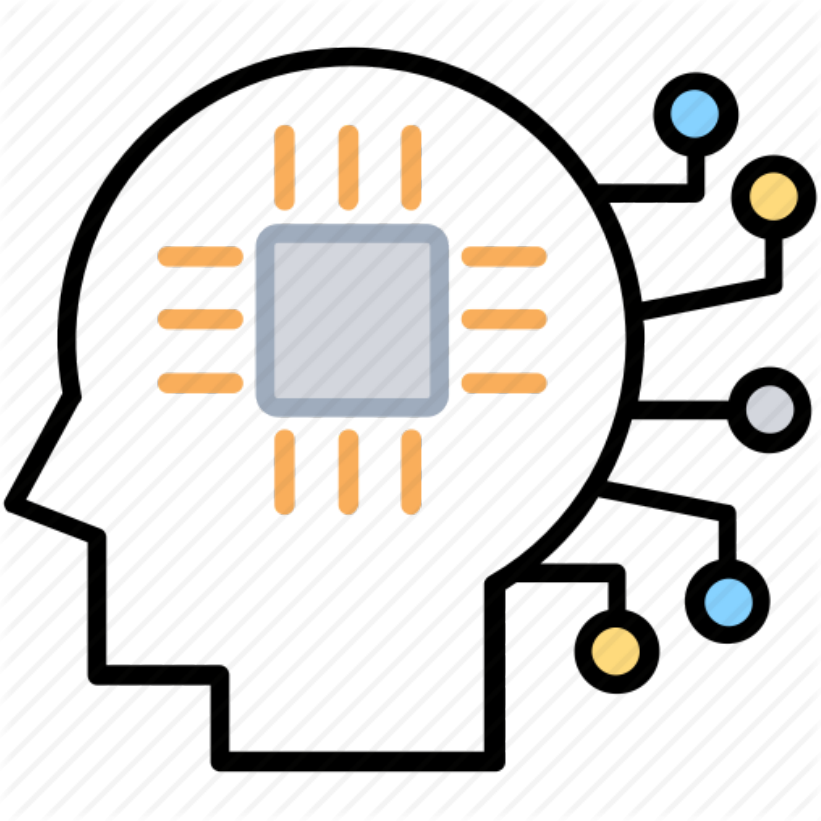
Homework 03 Artificial Neural Networks



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I. Introduction

1.1) Task and Objectives

The objective of this homework is to implement the training and prediction processes of an Artificial Neural Network. The implementation should offer the flexibility to create a variable number of hidden layers, any number of output neurons, and support for any number of n (features in the input).

In order to reach this goal we decided to use Python because it has a wide range of useful tools that could help us implement these algorithms. Furthermore, it has some custom built libraries specifically for the field of data science and machine learning. So, our team decided to use numpy and pandas to build these models. We also decided to implement our Linear Regression model used in our second homework. Regarding the data used, we resorted to the datasets provided by profesor Rafael Salazar.

In this report we documented our process and our results in order to clearly show the impact and the use of every model implemented in this investigation.

II. Artificial Neural Networks

An artificial neural network (ANN) is the piece of a computing system designed to simulate the way the human brain analyzes and processes information. It is the foundation of artificial intelligence (AI) and solves problems that would prove impossible or difficult by human or statistical standards. ANNs have self-learning capabilities that enable them to produce better results as more data becomes available.

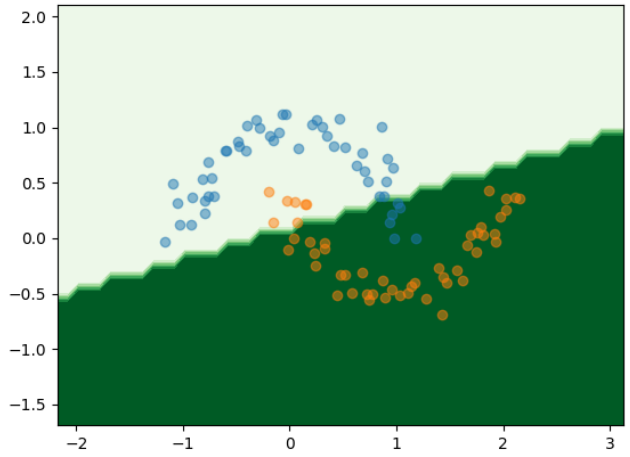
For the development of this ANN we first imported the necessary libraries (numpy and pandas) and we read the dataset “blobs.csv” given by our professor. We also used the LogisticRegressor class that our professor kindly shared with us.

We started off by reading the dataset and creating 2 sets of variables. ‘X’ where we stored all of the information for all but the last column of labels and ‘y’ where we stored the last column of the dataset. Afterwards we implemented the necessary functions needed to develop the artificial neural network. At first we were kind of lost and really didn’t know where to start. So in order to achieve the goal of this homework we consulted various resources plus we worked with our professor. He guided us through the development of most of the assignment. Finally, we used

the Linear Regression class in order to calculate the fit. We initialized the Logistic Regression class with an alpha value of 0.001 and 100000 epochs. As a result we got that the final theta was [[33.0012504 -300.41668227 146.33473346]].

For the ANN we initialized the hidden neurons with [2,5]. After finishing the implementation of the Artificial Neural Network we got the following solutions:

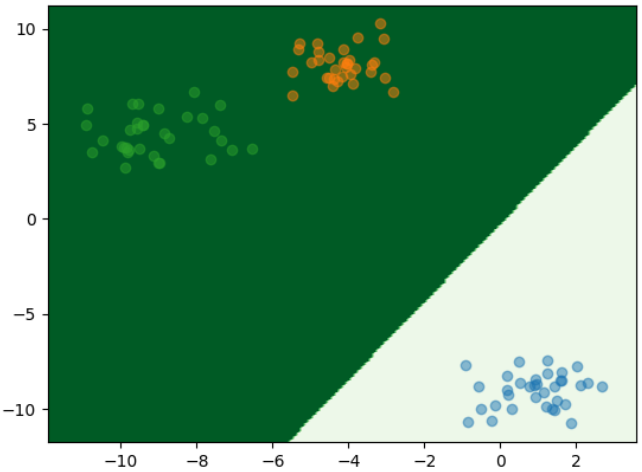
For the **Moons** dataset we got this plot:



and this data:

```
Final theta is [[ 0.370717    1.16857673 -4.1465483 ]]
[[ 1.         0.95437187 -0.46553674]] pred as [[0.49257551 0.49215384]], should be [[0. 1.]]
```

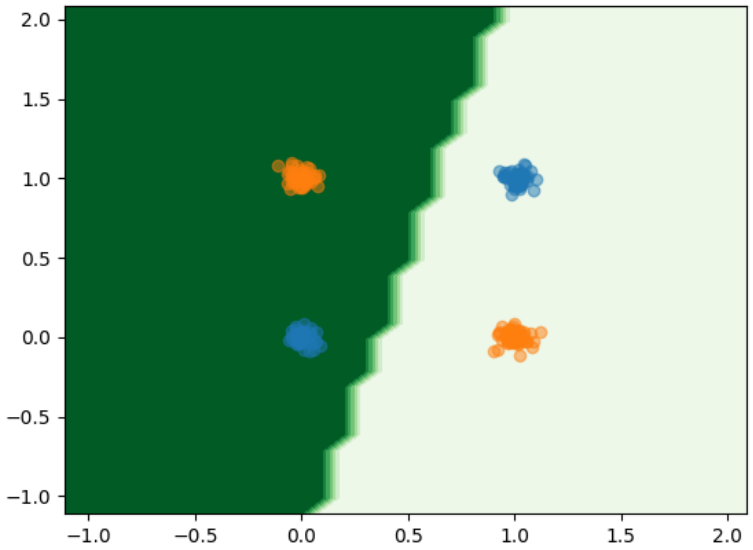
For the **blobs** dataset we got this plot:



and this data:

```
Final theta is [[  33.0012504  -300.41668227  146.33473346]]
[[ 1.         -4.56195315  7.41701063]] pred as [[0.34322198 0.32967034 0.33230182]], should be [[0. 1. 0.]]
```

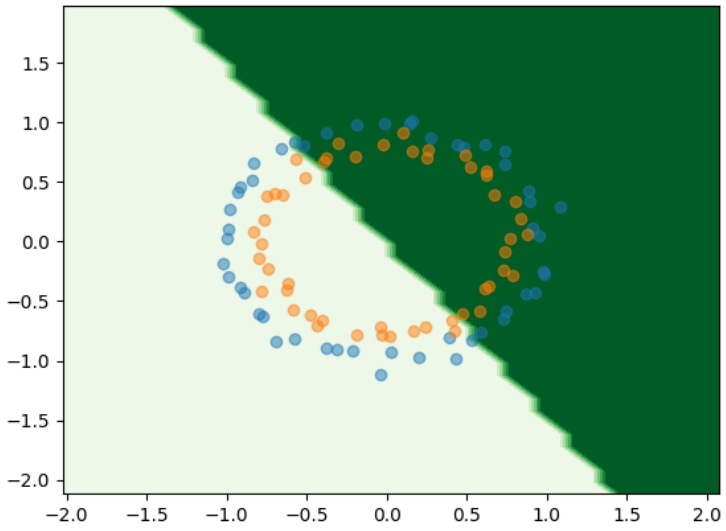
For the **xor** dataset we got this plot:



and this data:

```
Final theta is [[ 0.01737974 -0.04729599  0.01267652]]
[[1.         0.03355934 0.03724408]] pred as [[0.50296645 0.49990493]], should be [[1. 0.]]
```

For the **circles** dataset we got this plot:



and this data:

```
Final theta is [[0.00015666 0.04332315 0.02957178]]
[[1.         1.08471921 0.29753102]] pred as [[0.49380833 0.491755  ]], should be [[1. 0.]]
```

III. Conclusión

Before starting with the project, our team started to browse the web in order to broaden our consciousness regarding ANNs. Once gaining more context, we had a seminar in order to share our findings and expand our knowledge on the topic, however, we also discussed how we could work as a team by applying our diverse and unique skill sets in order to complete the project.

The project task was interesting and it was beneficial and quite of a challenge to grasp our theoretical wisdom on ANNs and place it into practice.

After obtaining the information from the datasets and using ANNs, we pursued the fascinating process of data attainment. Needless to say, our discoveries were astonishing.

The implementation of these models were greatly assisted by using the tools provided by the Professor such as Pandas, NumPy and Jupyter. We found these algorithms to be quite hard at first, however, once we understood the mathematics behind these models, everything became much clearer. Plus, doing our own research and reading different articles really helped us obtain a better understanding of what should be done and how we should approach the problems.

It was quite beneficial that we were provided with multiple data sets because it allowed us to clarify every variables' purpose and it allowed us to play with our algorithm in order to optimize it.

Although this activity focused on multiple models, this activity allowed us to put our theoretical knowledge into practice and this served as a great introduction to the application side of the theory learned in class. We believe that with more practice we can slowly begin to master these machine learning algorithms and apply them in real world scenarios with real datasets.

Despite the fact that at last we could finally achieve our goal of completing this assignment we do think that it would be of great help if the professor would give us an idea of how the final results would look like. Since on many occasions we would do an algorithm but we weren't sure if the results were the expected result.

Finally, we realized we were experiencing the hardcore analytical inventions of the real world. We bear the responsibility of taking the next evolutionary steps towards a preeminent AI driven world, and learning these small but powerful models is the first step towards greatness.

IV. References

Aflak, O. (2021, January 13). Neural network from scratch in Python. Retrieved April 30, 2021, from https://towardsdatascience.com/math-neural-network-from-scratch-in-python-d6da9f29ce65

Mesquita, D. (2021, February 27). Python ai: How to build a neural network & make predictions. Retrieved April 30, 2021, from https://realpython.com/python-ai-neural-network/