



Machine Learning Bootcamp

Project Report

Winter of Code 3.0

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Personal Information

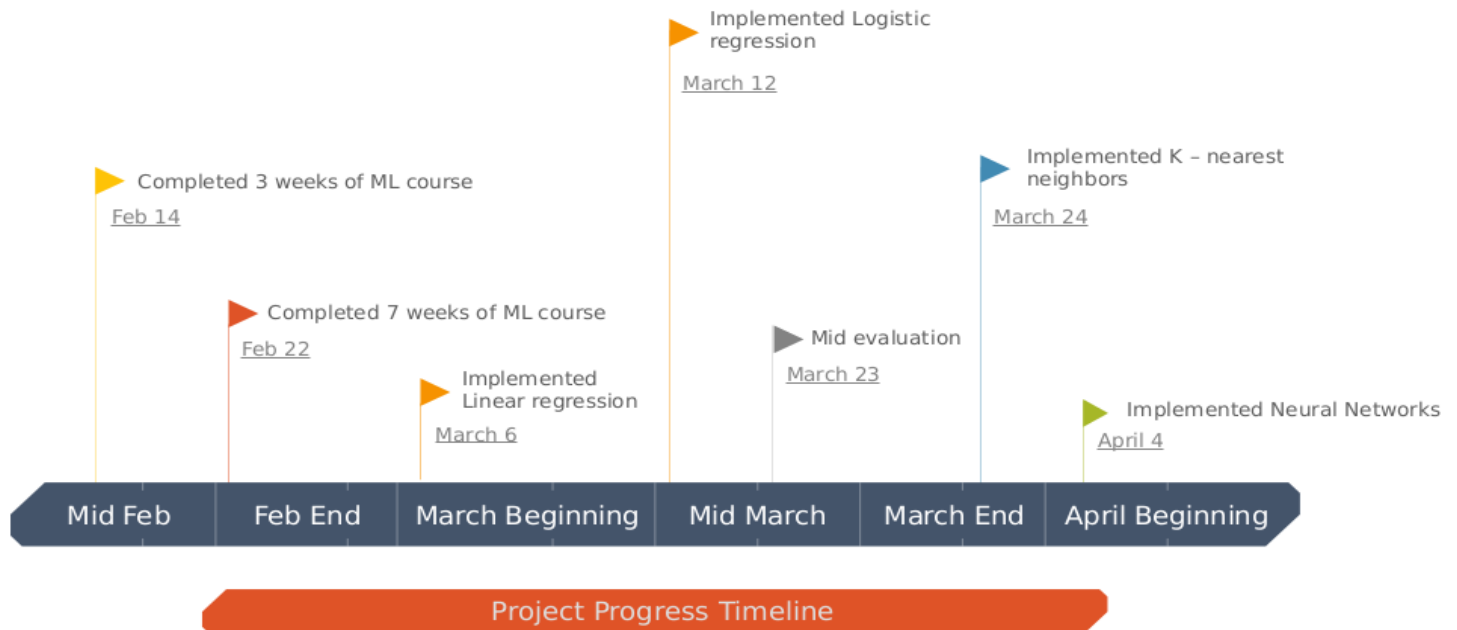
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Year: I (First)

Abstract

The objective of this project was to get familiar with four of the most fundamental machine learning algorithms like Linear Regression, Logistic Regression, K-Nearest Neighbors and Neural Networks.

The main goal of this project was to implement the models of the above mentioned algorithms on the given MNIST dataset, define a cost function that decreases after every iteration as defined in gradient descent, and set the parameters / hyper-parameters in such a way that the model achieves maximum possible accuracy on the test dataset.

Project Progress Timeline

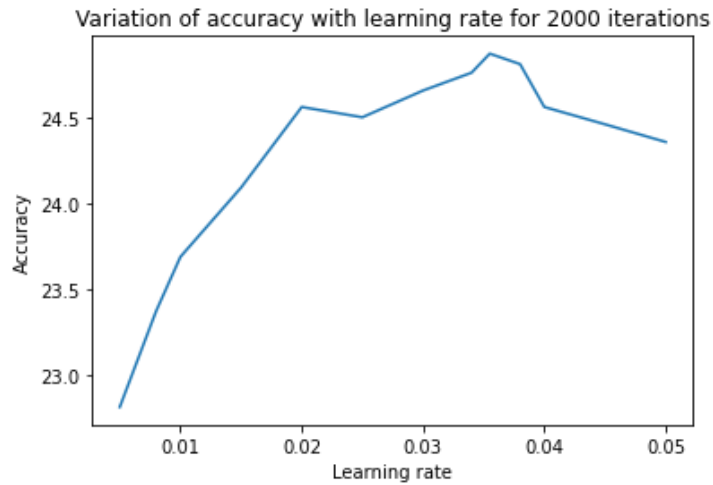


Implementation Details:

Linear regression

Implementation of Linear regression isn't as difficult as I thought it to be, but because it was the first ML algorithm ever implemented, I came across many obstacles like I forgot to normalise the features, due to which the predicted labels came out to be pretty greater than actual labels. Thereafter, I normalised the features in all the upcoming algorithms.

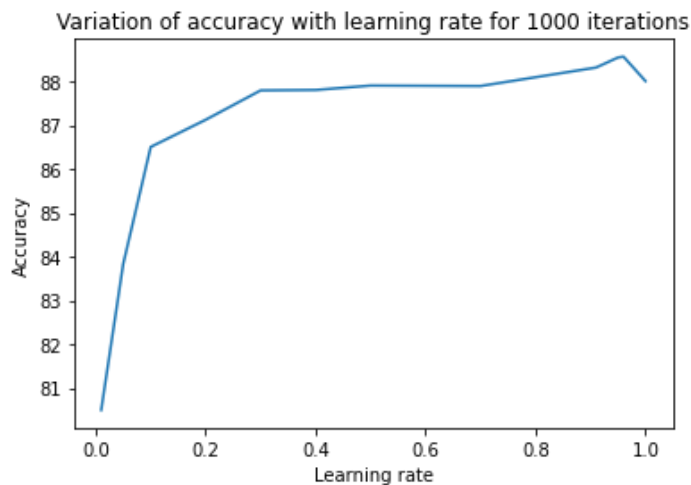
The next challenge was to increase the accuracy of the model on the test set because it was really hard to find the correct learning rate. I kept changing the learning rate and number of iterations as visualised in the graph below. I also tried mini-batch gradient descent instead of normal gradient descent but the accuracy didn't increase, so I removed it later. Finally, I got an accuracy of 24.87% with the learning rate as 0.0355.



Logistic regression

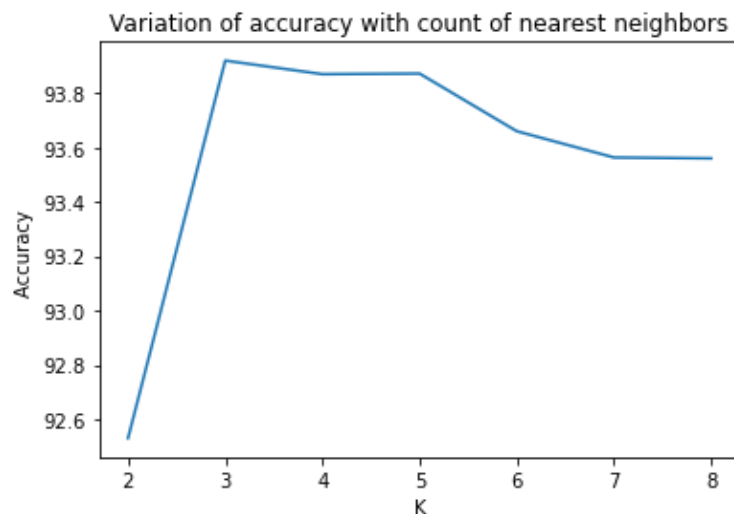
In the beginning, I thought the implementation of Logistic regression would be easy as I have already implemented linear regression, but as Logistic regression is a classifier, it took me around 2 days to read many different blogs and understand how to convert a binary classifier to a regressor, i.e, The concept of One-hot encoding , and as soon as I applied it, Logistic regression became easy and implementing it was really interesting!

Increasing the accuracy of the model was another dilemma as the usual range of learning rate, i.e, between 0.0001 and 0.1 didn't give me a good accuracy, so I had to increase it and finally, keeping the learning rate as 0.96 (10k iterations) gave me the maximum possible accuracy of 89.29%



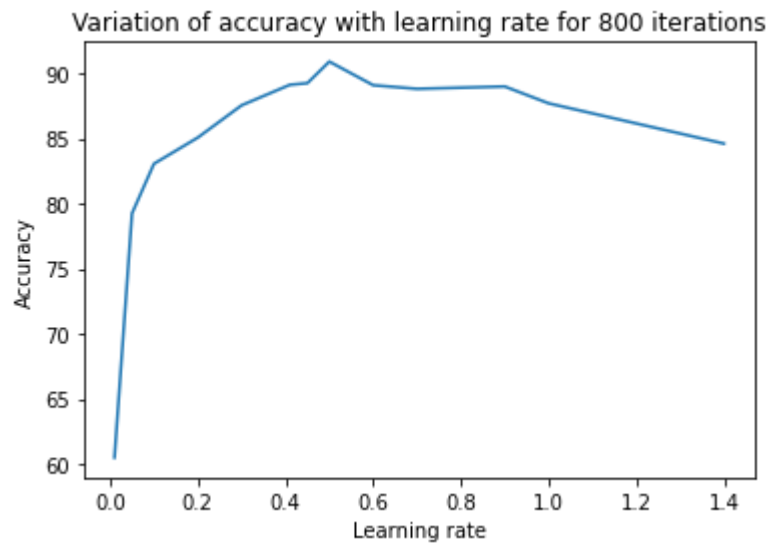
K-Nearest Neighbors

The approach for implementing this algorithm was totally different from all the other implemented algorithms because the Andrew Ng course didn't include any info about KNN. I had completed 7 weeks of the course by then and started the 8th week as it contained K-means for unsupervised learning, got an idea what KNN can be about, but the concept was still not clear, so I searched about it on Youtube, read different blogs and started implementing. Once implemented, increasing the accuracy wasn't a difficult task here as there has to be an integral value of K and just a limited range gave acceptable accuracy, the maximum accuracy being 93.92% for K=3, as shown in the graph.



Neural Networks

Neural Network required some really deep knowledge and as soon as I cleared my concepts related to forward and backward propagations, I was able to construct the model with an hidden layer(Using Rectified Linear unit, i.e. ReLU) and one softmax layer (that predicted the probabilities of all the unique labels). Thereafter, I created a second hidden layer(Using sigmoid activation function). I interchanged the functions to check which order is giving a good accuracy and tried different learning rates for a better accuracy, as shown in the graph. Finally my model contains two hidden layers and it has an accuracy of **90.88%** with 0.5 as the learning rate.



What I learnt

Working on this project was really beneficial for me as before WoC I had no idea what those algorithms meant, and as this is my first project, I learnt many things from creating a project proposal to making a project report.

Moreover, I explored a lot about Machine Learning and developed even more interest in the same. Looking forward to more such projects.
