Assignment 1, Deep Learning Fundamentals - a1895237

ABSTRACT

Diabetes is a chronic disease affecting millions of people worldwide, which is rapidly increasing. Early detection of diabetes risk is important for prevention and management. This paper explores how the application of perceptron-based machine learning models to predict diabetes is used. Perceptron, a fundamental supervised learning algorithm of neural networks,is resulted to create a binary classifier for diabetes prediction. We use the given dataset containing the information features to analyze and evaluate the per- ceptron model. Engineering and preprocessing modelsare applied to enhance model performance. This paper demonstrates the applications of perceptron-basedmodels in accurately detecting the diabetes risk, high- lighting their simplicity and effectiveness. The results can be compared with other machine learning tools, showing the percep- tron's fullest utility in medical applications. This paper contributes to the development of early dia- betes prediction systems.

INTRODUCTION

According to the International Diabetes Federation, over 465 million people were living with diabetes in 2022, and this number is expected to rise to 800 million by 2045 if no effective preventive measures are taken. Early findings and prediction of diabetes is important to eradicate the cases. By using the perceptron algorithm, we can detect whether the patient can be at any risk of diabetes, there are many alternative algorithms to prove our case like gradient descent optimization (e.g., Adam, RMSprop), weight initialization strategies, regulation methods (L1, L2 dropouts) and batch normalization. As coming to the following paper, we use the multilayer perceptron to detect the diabetes, Although MLP is used in many applications but there has not been any significant development on this MLP algorithm, as the primary goal of this paper is to detect and advance of the perceptron model as the current available tests are not accurate and is considered to be a problem statement. So, the usage of MLP algorithms is accurate and the results will be used for eradicating the risk of diabetes.

In this following paper we can see how we used the given datasets to prove the multi-layer perceptron by using read, head, tail, info, describe and shape and deriving the algorithms to detect the diabetes using multi-layer perceptron. However, the effect of these algorithms is sometimes limited to the needs of human engineering and enable us to recognize the patterns in the given data, now a days MLP are gaining popularity in the medical field as it's easy to analyze complex data sets with such an accuracy and ease.

The suggested adaptation of the MLP algorithm for predicting diabetes, when utilized alongside the PCA-transformed PIMA diabetes dataset, is anticipated to enhance prediction accuracy compared to both traditional machine learning techniques and the standard MLP algorithm.

While MLP has found various applications, including diabetes prediction, there has been limited research dedicated to the enhancement and adaptation of the MLP algorithm to improve its diabetes prediction capabilities and address its inherent limitations.

REPRESENTATION

As we know, the perceptron is a binary classification as it converts data into two classes as it is very similar to the neural network. For example, we take input features as x1, x2, x3, ..., xn as these are input layer and now, we try to make channels which has certain weights say w1, w2, w3, ,wn and in the perceptron the inputs and weights and summed and this circuit is also known as Adder circuit in which bias will be applied. So, the notation will be denoted as R. To enhance the modified MLP model's ability to generalize, we incorporated two key techniques.

The versatile computational models, referred to as Multiple-Layer Perceptrons (MLP), find applicationsin a diverse range of problems such as clustering, logical regression, and classification. MLP operates by adapting a "generalized" form of the feedforward

neural network architecture utilized in SNNs. The configuration of hidden nodes in MLP necessitates the use of a random number generator, a crucial step in the process. By applying classical optimization theory principles to the MLP challenge, we can categorize it as an optimization problem with a formulation similar to that of the support vector machine optimization problem. This similarity becomes evident when comparing the solutions to both problems using SVM.

Dropout regularization, which helps combat overfitting by deactivating specific neurons during training, was employed. Additionally, adaptive learning rates were introduced to expedite convergence and optimize model weights with greater precision. These improvements result in a more resilient and adaptable model, enabling it to effectively handle intricate data patterns and perform effectively with previously unseen data.

$R = x1w1 + x2w2 + x3w3 + \ldots\ldots\ldots + xnwn + b$ (bias)

$R = x.w + b$

As the result is passed to the next step known as threshold activation function and it is binary with 0,1

If the $x.w + b < 0$ then 0

$x.w + b > 0$ then 1

Processing the dataset, doing Principal Component Analysis (PCA), and doing the modified MLP algorithm are the initial steps for the modification of MLP algorithms. The following steps are implemented during the run of the program:

Step 1: Load the dataset

Step 2: Run the Principal Component Analysis on the dataset

Step 3: Run the required ML algorithms

Step 4: Evaluate the following required outputs

These are the steps for the data preprocessing as the MLP is developed to improve neural networks. The configuration of each hidden node is studied independently through trial and error.

The existing diabetes prediction models face challenges in terms of accuracy and their ability to generalize, which can be seen as a problem statement. To address these issues, the proposed strategy involves implementing the Multi-Layer Perceptron (MLP) method to enhance the performance of current models. This paper primarily focuses on identifying individuals at a high risk of developing diabetes, aligning with the objective of improving prediction accuracy and refining the MLP algorithm.

RELATED WORK (CODE)

Using the given health datasets, several machine learning and deep learning techniques have been applied to predict diabetes and the most popular algorithm is to be the MLP, as the given data set has been used for this paper. They found an improvement in prediction accuracy when compared to traditional machine learning methods. Various techniques can be used for making health-related predictions, such as decision trees and their ensemble counterpart, random forests. However, it became evident that not all these predictions were entirely accurate.

As in the code started with the import of pandas, numpy, seaborn, torch and matplot and after that we use tenserflow for importing sequentail, dense. Mainly this paper focuses on the prediction of diabetes and how to classify using machine learning algorithms. As the following code we must the read the given data set csv file diabetes.csv and after reading the dataset we use head function to read the first 10 readings can be displayed in a table containing various classifications of glucose, BP, insulin, skin thickness, BMI etc. By using the tail function used to tell the last 10 readings of the given data. As we used the describe function in the code as the correlation matrix gives the heat map of the given Pima Indian data set using plt.showand the outcomes of the diabetes and non-diabetes are also shown in the following code.

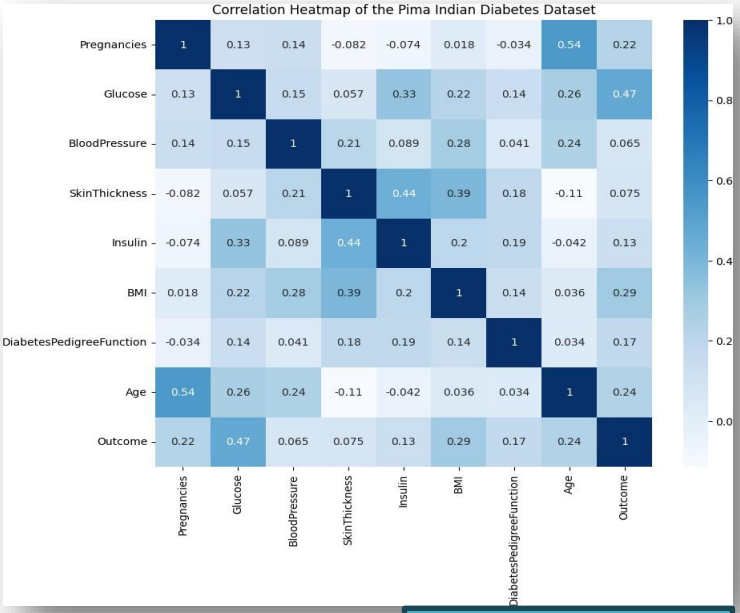

Fig.1

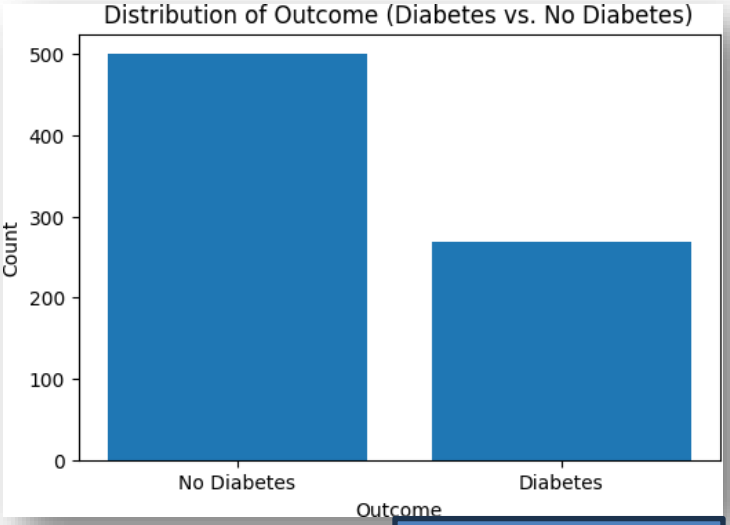

Fig.2

With this obtained output data, we can show the training and length of the data, which is450 and 318, As we defined all the data typesof the following within the code using type as we import the pytorch we can build the multi-layer perceptron with hidden layers by using class SimpleMLP and listing the output.

CONCLUSION

This paper has demonstrated the potential of perceptron in the prediction of diabetes risk. The MLP is a powerful neural network model as we have also explored binary classification. By contributing this kind of algorithm paves the way for more healthcare interventions, as it helps in identifying the risk earlier and the risk can be nullified by changingthe lifestyle modifications. By employing cutting-edge optimization methods, we can swiftly and precisely fine-tune the model's weights, leading to heightened prediction precision. Dropout regularization, a machine learning strategy aimed at curbing overfitting, fosters the creation of more robust and broadly applicable input representations by randomly deactivating a small fraction of neurons during training. Models equipped with adaptable learning rates are better positioned to attain peak performance since they can more effectively adapt to the nuances of the training data. In further future more complex datasets can be solved by implementing the MLP as the algorithm is changing with respect to technology and its advancement can change the views in the field of medical and burden of uncurable diseases can be nullified in the future.

REFERENCES

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