Developing a new artificial neural network on sparse autoencoder for predicting heart disease.

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Abstract

Most medical datasets appear to be unbalanced, and when trained with such data, traditional machine learning algorithms underperform, particularly in the prediction of the minority class. This research proposes a strategy that consists of feature learning and classification stages that merge an enhanced sparse autoencoder (SAE) and Softmax regression, respectively, to overcome this difficulty and provide a robust model for disease prediction. Sparsity is achieved in the SAE network by penalising the network's weights, as opposed to traditional SAEs, which penalise the activations within the hidden layers. The Softmax classifier is further tuned for the classification task to attain great performance. As a result, the suggested method has the benefits of effective feature learning and reliable classification performance. When used to forecast three diseases, the suggested method achieved test accuracies of 98 percent, 97 percent, and 91 percent for chronic kidney disease, cervical cancer, and heart disease, respectively, outperforming other machine learning algorithms.

Keywords: New artificial neural network, Autoencoder.

Introduction

Heart disease (HD) is one of the most lethal human diseases, and its diagnosis and treatment are extremely difficult. Predicting cardiac disease is difficult, but it is necessary because if the condition is recognised early and preventive actions are implemented, the mortality rate can be considerably decreased. As a result, precise prediction of a patient's heart disease risk is critical in lowering the risk of serious cardiac diseases.

An autoencoder consists of two functions: an encoder that converts the original d-dimensional input data to an intermediate or hidden representation, and a decoder that converts the intermediate or hidden representation back to a d-dimensional vector that is as close as possible to the encoder's original input. The procedure is known as reconstruction, and the discrepancy between decoder output and encoder input is known as the reconstruction error. According to research, when representations are learned in a fashion that fosters sparsity, classification performance improves. The training criterion for sparse autoencoders involves a sparsity penalty on the coding layer [1].

Unsupervised feature leaning and prediction of heart disease using a sparse autoencoder (SAE) technique that is efficient and trustworthy. We concentrate on building an SAE model that can learn effective features from the HD dataset and then classify the data using the learnt features. To enable dynamic modification of different parameters, the model is optimised using the adaptive moment estimation approach, and a batch normalisation technique is used to avoid overfitting and increase the model's performance, speed, and stability. In addition, the optimum setting ensures that reconstruction error is greatly reduced [2].

By comparing the proposed method to a standalone ANN, well-performing algorithms such as k-nearest neighbour (KNN), classification and regression tree (CART), Logistic regression (LR), linear discriminant analysis (LDA), and other scholarly works, the effectiveness of the proposed method is demonstrated. Our proposed technique achieves improved classification performance, as evidenced by the results.

Our sparse autoencoder's low-dimensional features increase the classification performance of the ANN, as the suggested technique outperforms the ANN, demonstrating that the sparse autoencoder is capable of keeping the information in the input data while obtaining optimal low-dimensional features. It performs well on the test data, which a strong indicator of its efficacy is given that the model has never seen the data before. We also ran comparison tests with five different basic classifiers: KNN, CART, Logistic regression, Naive Bayes, and LDA [3].

To aid in the prediction of heart disease, an improved sparse autoencoder based ANN is presented. The sparse autoencoder is used to learn the optimum data representation, and the

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ANN is used to make predictions based on the learnt records. The SAE was improved with the Adam method and batch normalisation. On test data, the model has a 90% accuracy rate.In comparison to ANN and several traditional machine learning techniques [4].

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