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Learning Concentric Circular Boundaries: A Simulation Study Comparing Neural Networks and Random Forests

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Abstract

As the amount of data generated by individuals continues to grow, the ability to extract information and make viable predictions from that data is increasingly important. This thesis aims to investigate the performance of two machine learning methods, namely random forest and neural network. For the neural network, we try two different activation functions, sigmoid and rectified linear unit (ReLU). The methods are used to solve a binary classification problem with simulated data, where each data point is labelled according to whether it falls within an even or odd numbered concentric circle. We evaluate the performances of the two methods for three different simulation scenarios: varying the number of input variables, varying the size of the training dataset and varying the label flipping probability. We measure the performance in classification error and mean squared prediction error (MSPE). The results show that the neural network with the ReLU activation achieves lower classification errors and MSPEs, overall, and that the neural network with a sigmoid activation function struggles to learn the signal in the data. This suggests that neural networks are better suited for circular boundaries than random forests but that the activation function has to be appropriately chosen for achieving good model performance.

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