Neural Network Model Analysis for Alphabet Soup Charity

Overview of the Analysis

The purpose of this analysis is to develop, optimize, and evaluate a deep learning model to predict the success of applications for Alphabet Soup Charity. By accurately predicting successful applications, the charity can better allocate resources and improve operational efficiency.

Results

Data Preprocessing

Target Variable(s):

The target variable for the model is IS\_SUCCESSFUL, indicating whether an application was successful. A computer screen shot of white text

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Feature Variable(s):

Features used in the model include variables such as APPLICATION\_TYPE, AFFILIATION, CLASSIFICATION, USE\_CASE, ORGANIZATION, STATUS, INCOME\_AMT, SPECIAL\_CONSIDERATIONS, and ASK\_AMT.

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Removed Variable(s):

Variables such as EIN and NAME, which do not contribute to the prediction, were removed from the input data. A black background with white text

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Compiling, Training, and Evaluating the Model

Neurons, Layers, and Activation Functions:

Initial Model:

First Hidden Layer: 80 neurons, relu activation function.

Second Hidden Layer: 30 neurons, relu activation function.

Output Layer: 1 neuron, sigmoid activation function.

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Optimized Model:

First Hidden Layer: 256 neurons, tanh activation function, with L2 regularization.

Second Hidden Layer: 128 neurons, leaky\_relu activation function, with L2 regularization.

Third Hidden Layer: 64 neurons, leaky\_relu activation function, with L2 regularization.

Fourth Hidden Layer: 32 neurons, leaky\_relu activation function, with L2 regularization.

Fifth Hidden Layer: 16 neurons, leaky\_relu activation function, with L2 regularization.

Output Layer: 1 neuron, sigmoid activation function.

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Rationale:

The initial model was designed with a simple architecture to establish a baseline performance.

The optimized model included additional layers and neurons to capture more complex patterns in the data. Activation functions such as tanh and leaky\_relu were chosen for their effectiveness in handling non-linearities and avoiding issues like vanishing gradients.

L2 regularization, batch normalization, and dropout were employed to improve generalization and prevent overfitting.

Hypermodel Definition:

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Description automatically generatedThe hypermodel was defined using the Keras Tuner library to perform hyperparameter tuning.

Target Model Performance:

The initial model achieved an accuracy of approximately 72%.

The optimized model achieved a best validation accuracy of approximately 73.04%.

Steps Taken to Increase Performance:

Adjusted the learning rate and batch size.

Experimented with adding and reducing the number of layers and neurons.

Tried different activation functions (tanh, leaky\_relu).

Implemented callbacks such as early stopping and learning rate reduction.

Further tuned hyperparameters like dropout rate and L2 regularization.

Used Keras Tuner for hyperparameter optimization.

Summary of the Overall Results

The deep learning model developed for Alphabet Soup Charity achieved a best validation accuracy of approximately 73.04%. Despite various optimization attempts, the target accuracy of 75% was not reached. However, the optimized model showed improvement over the initial model. The model's performance can be further improved through additional hyperparameter tuning, data augmentation, and advanced techniques.

Alternative Model Recommendation

To further enhance the model's accuracy, I recommend exploring ensemble methods such as Random Forests or Gradient Boosting, which can combine multiple models to improve performance. Additionally, incorporating feature engineering techniques and leveraging pre-trained models for transfer learning may yield better results. Implementing these strategies can help in achieving or surpassing the target performance.