Alphabet Soup Charity: Deep Learning Model Report

Overview

The purpose of this analysis is to build a deep learning model that can predict whether or not applicants for funding will be successful. This is a binary classification problem, where the model needs to predict one of two possible outcomes: "successful" or "unsuccessful". By accurately predicting funding outcomes, Alphabet Soup can optimize its grant allocation process and maximize its impact.

Results

Data Preprocessing

**Target Variable:** IS\_SUCCESSFUL is the target variable for this model, indicating whether an application was successful (1) or unsuccessful (0).

**Features:** The features for the model are all columns in the dataset except IS\_SUCCESSFUL, EIN, and NAME. This includes variables such as APPLICATION\_TYPE, AFFILIATION, CLASSIFICATION, USE\_CASE, ORGANIZATION, STATUS, INCOME\_AMT, SPECIAL\_CONSIDERATIONS, and ASK\_AMT. These variables provide information about the applicant organization and the grant request.

**Removed Variables:** The variables EIN and NAME are removed from the input data because they are neither targets nor features. These are identification columns that do not contribute to predicting funding success.

Compiling, Training, and Evaluating the Model

**Neural Network Architecture:** The model uses a sequential neural network architecture with the following specifications:

**Input Layer:** The number of input features is determined by the encoded features, in this case 43.

**Hidden Layer 1:** 80 neurons, ReLU activation function. This layer captures initial patterns and relationships in the data. A higher number of neurons helps capture more complex patterns. ReLU is chosen for its efficiency and effectiveness in deep learning models.

**Hidden Layer 2:** 30 neurons, ReLU activation function. This layer further refines the patterns identified in the first hidden layer. Fewer neurons help focus on the most important patterns.

**Output Layer:** 1 neuron, Sigmoid activation function. This layer outputs the probability of an application being successful. The sigmoid function ensures the output is a probability between 0 and 1.

**Model Performance:** The target model performance was to achieve an accuracy of at least 75%. Based on the results of this model, the accuracy was 72.5% indicating the target model performance was not achieved.

**Attempts to Increase Model Performance:** The following steps were taken to increase model performance:

**Adjusting the number of neurons and layers:** Experimenting with different configurations for the number of neurons and layers can potentially identify a more optimal architecture. In this case, it was found the higher the number of neurons and adding a 3rd hidden layer led to overfitting, so this was corrected with fewer neurons and layers.

**Changing the activation functions:** Using different activation functions in hidden layers might lead to better results. Using tanh instead of relu reduced the accuracy, while relu worked better for this model.

**Feature engineering:** Creating new features based on existing ones can provide additional information to the model, thereby improving performance. Adding features such as ratios or interactions between existing features could potentially lead to performance gains. A variety of different features were added and tested throughout, such as creating interaction variables by multiplying ASK\_AMT with other features. These additional features did not lead to notable increases in accuracy and thus were removed in favor of a more simple model with a faster runtime.

**Optimizing the cutoff threshold for classification:** This may change the precision and recall trade-off, potentially leading to an improved accuracy score if a balanced threshold is chosen.

**Trying different classification models:** Trying different classification models, such as Random Forest or Gradient Boosting, may reveal an alternative approach that performs better on this dataset.

Summary

The deep learning model achieved an accuracy of 72.5%, which did not meet the target performance of 75%. However, the model still provides valuable insights into predicting funding outcomes for Alphabet Soup.