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module 21  EDEX UOFT BOOTCAMP

Deep-learning-challenge

Table of Contents

[Overview of the Analysis 2](#_Toc157033162)

[Results 2](#_Toc157033163)

[Data Preprocessing 2](#_Toc157033164)

[Target and Features 2](#_Toc157033165)

[Compiling, Training, and Evaluating the Model 3](#_Toc157033166)

[Neural Network Architecture 3](#_Toc157033167)

[Model Performance 5](#_Toc157033168)

[Attempts to Increase Model Performance 5](#_Toc157033169)

[Summary 5](#_Toc157033170)

[Recommendation 5](#_Toc157033171)

# Overview of the Analysis

The purpose of this analysis was to develop a deep learning model for Alphabet Soup to predict the success of funding applicants based on various features. The goal was to create an accurate and efficient model that could assist in making informed decisions about funding allocations to various organizations.

# Results

## Data Preprocessing

### Target and Features

Target Variable(s): The target variable for the model is "IS\_SUCCESSFUL".

Feature Variable(s): The features used for the model include "CLASSIFICATION", "APPLICATION\_TYPE", "AFFILIATION", "USE\_CASE", "ORGANIZATION", "STATUS", "INCOME\_AMT", "SPECIAL\_CONSIDERATIONS", and "ASK\_AMT.”

Variables Removed: "EIN" and "NAME" variables were removed.

Initial DataFrame:

A screenshot of a computer

Description automatically generated

Final DataFrame:

A screen shot of a black screen

Description automatically generated

## Compiling, Training, and Evaluating the Model

### Neural Network Architecture

Neurons, Layers, and Activation Functions:

Number of neurons in each layer: 4+1 layers, with 150, 75, 50, 30, and 1 neuron/s respectively. The final layer is the output layer.

Number of layers: 4 layers plus output layer.

Activation functions: activation functions used inclusive of output layer include 'relu', 'relu', 'relu', 'relu', and 'sigmoid'. Other functions tried included ‘tanh’ and ‘leaky\_relu.’

Explanation: the increase and adjustment of layers was based on trial and error to achieve the best accuracy with minimal loss. Model accuracy remained unchanged, however, even against adding two additional neural network layers into the model and trying different activation methods while accounting for overfitting by including a dropout rate, and Batch Normalization. Learning rate of the optimizer was adjusted to 0.001 and to 0.01 as well.

The following is the model build:

A screenshot of a computer screen

Description automatically generated

### Model Performance

Achievement of Target Model Performance:

The model achieved an accuracy of approximately 72.05% and a loss of 0.5672 on the test dataset.

Time was 504ms/epoch with 2ms/step.



### Attempts to Increase Model Performance

Attempts to increase model performed included increasing the layers from 2 to 4, adjusting neurons per layer from an 80, 30, 1 configuration to a 150, 75, 50, 30, 1 configuration. This configuration included four hidden layer and a final output layer as opposed to two hidden layers followed by a final output layer. Batch Normalization was included in the optimization while different activations were tried including Tanh, Sigmoid, relu (current and final model), and leaky\_relu. Dropout rates were included per layer to prevent overfitting. the optimizer 'Adam’s learning rate was adjusted to 0.001, and back to 0.01 to see a change in accuracy and loss by the model. finally, epochs were adjusted between 50 to 150 (final being 150), and batch sizes were included with initial tests run on 128 batch sizes and final model kept at 64 batch sizes.

additionally, the data was preprocessed again and another category "Other" was included to remove any generalized classifications of entries and categorize them together under the "Other' classification. cutoff rates were tested at 1000 and then at 1500 for both classifications and application types to home in on improving the accuracy of the model.

# Summary

In summary, the deep learning model developed for Alphabet Soup demonstrated moderate performance with an accuracy of 72.05%. The chosen architecture, including the number of neurons, layers, and activation functions, was based on trial and error. Despite achieving a satisfactory performance, there is room for improvement based on additional data preprocessing whereby the "IS\_SUCCESSFUL" selection criteria could become more stringent based on scrutinizing other criteria/categories.

# Recommendation

A different model, such as Gradient Boosting Machines model or a Neural Network with a different Architecture model might be better suited for this classification problem. This decision is based on the classification and data types available in the dataset which causes this case to become less of a binary decision-making problem and more of a complex and robust decision tree problem. Additionally, further exploration of the dataset and feature engineering could enhance the predictive power of the existing model better than 72.05% accuracy rate.