# **Neural Network Model Performance Report**

## **Overview of the Analysis**

The purpose of this analysis was to build and optimize a neural network model to predict the success of charity funding applications using the Alphabet Soup dataset. The target variable in this analysis is whether a charity's funding application was successful or not. This project involved data preprocessing, model building, and performance tuning using deep learning techniques.

## **Results**

### **Data Preprocessing**

* **Target Variable(s):** The target variable is IS\_SUCCESSFUL, indicating whether the funding application was successful (1) or not (0).
* **Feature Variable(s):** The features include variables such as:  
  + APPLICATION\_TYPE (e.g., T3, T4, T5)
  + AFFILIATION (e.g., Independent, Family)
  + CLASSIFICATION (e.g., C1000, C2000)
  + INCOME\_AMT (Income amount range)
  + ASK\_AMT (Amount of funding requested)
  + USE\_CASE (Type of request: program, general support)
  + ORGANIZATION
  + STATUS (Current status of the application)
  + SPECIAL\_CONSIDERATIONS (If there were special considerations for the application)
* **Variables Removed:** The EIN and NAME columns were removed from the dataset, as they do not provide useful information for the prediction and are not target or feature variables.

### **Compiling, Training, and Evaluating the Model**

* **Neurons, Layers, and Activation Functions:**
  + The model consisted of **3 dense layers**.
  + The first layer had **80 neurons** with the **ReLU** activation function.
  + The second layer had **30 neurons** with the **ReLU** activation function.
  + The output layer had **1 neuron** with the **sigmoid** activation function to handle binary classification (0/1).
  + These selections were made to optimize the model's ability to capture complex patterns in the data while preventing overfitting.
* **Model Performance:**
  + The model performance was evaluated using accuracy as the primary metric.
  + Initial training showed an accuracy of approximately **73-75%**, which was below the desired performance threshold of **75%**.
* **Steps to Improve Performance:** Several strategies were employed to increase the model performance:
  + **Changing the number of neurons**: Adding and reducing the number of neurons in hidden layers to optimize learning.
  + **Activation function tuning**: Trying different activation functions, such as ReLU and Tanh, to identify the best performing option.
  + **Additional preprocessing**: Scaling numerical variables and applying one-hot encoding to categorical variables to ensure better data representation.
  + **Dropout layers**: Adding dropout layers to prevent overfitting and improve generalization.

Despite these efforts, the target performance of 75% accuracy was only marginally achieved in some model configurations, and further optimization could be considered.

### **Summary**

The deep learning model achieved modest accuracy in predicting the success of charity funding applications. While the model performed reasonably well, reaching about 75% accuracy, there is room for further optimization. Based on the results:

* **Recommendation:** For further improvement, an ensemble model could be used, such as a combination of neural networks with traditional machine learning models like Random Forest or Gradient Boosting. These models could provide better performance by leveraging the strengths of both deep learning and tree-based algorithms for classification problems like this.