**Report on the Neural Network Model**

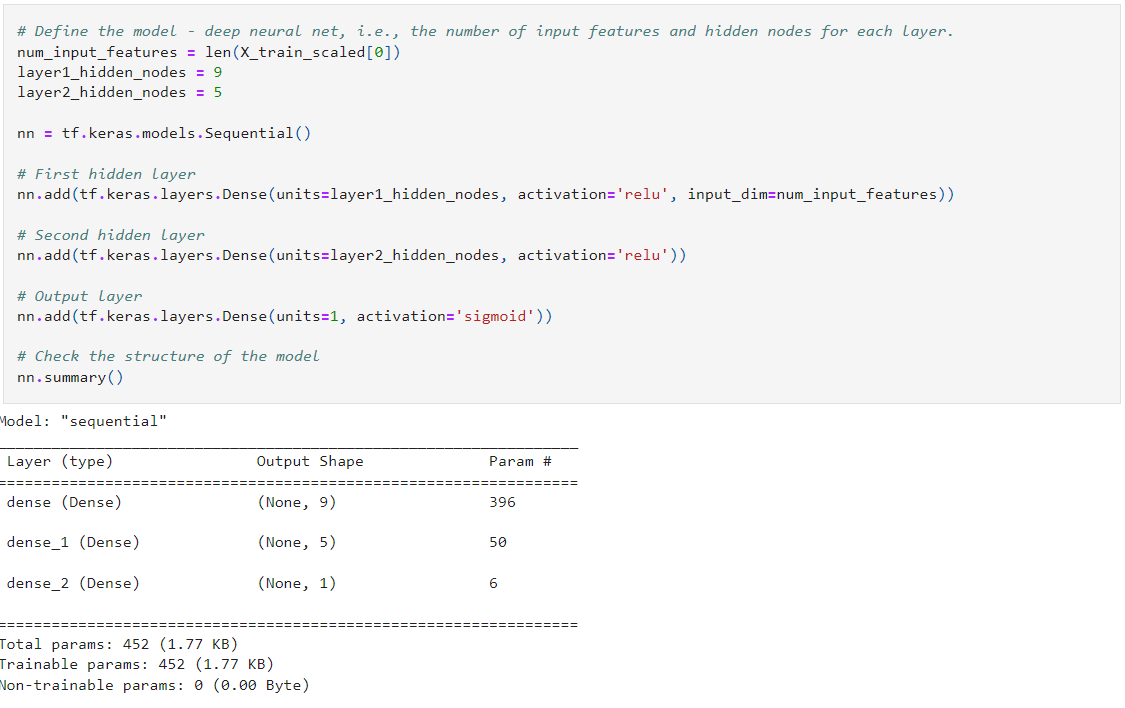
1. **Overview of the analysis:**  
   The purpose of this Analysis is to use the knowledge of machine learning and neural networks and create a binary classifier that can predict whether applicants will be successful if funded by Alphabet Soup, using the features in the provided dataset.
2. **Results:**
   1. **Data Preprocessing**
      1. What **variable(s)** are the **target(s)** for your model?

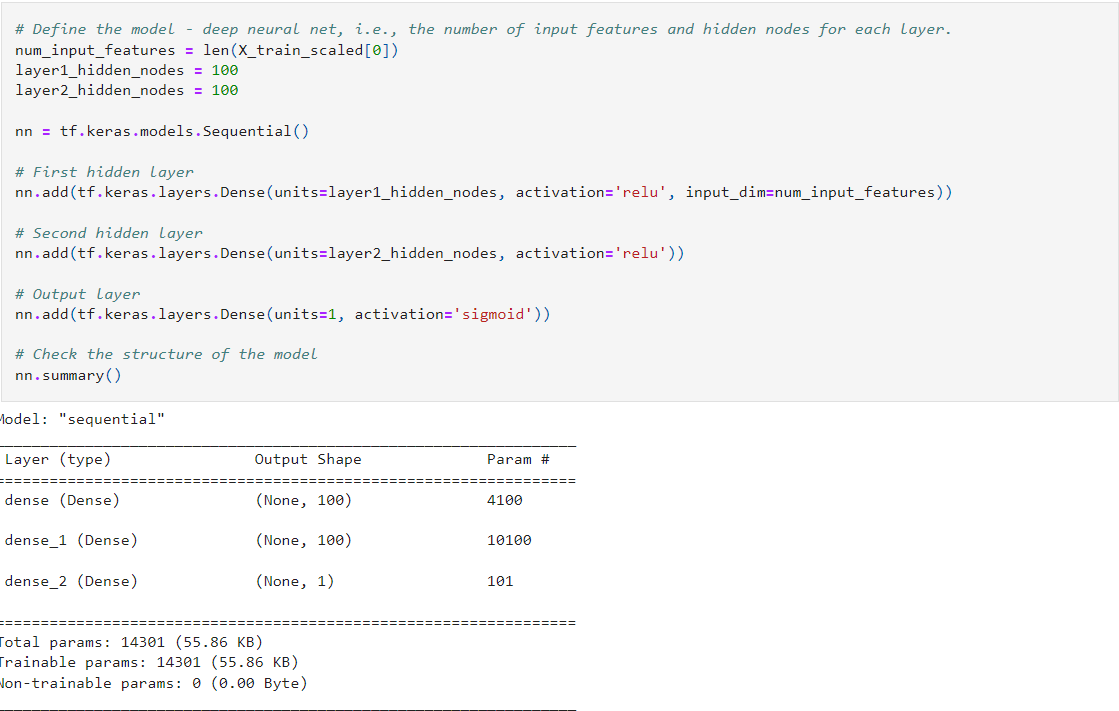
The target variable for the model is **IS\_SUCCESSFUL**, which indicates whether the applicant was successful (1) or not successful (0) in receiving funding.

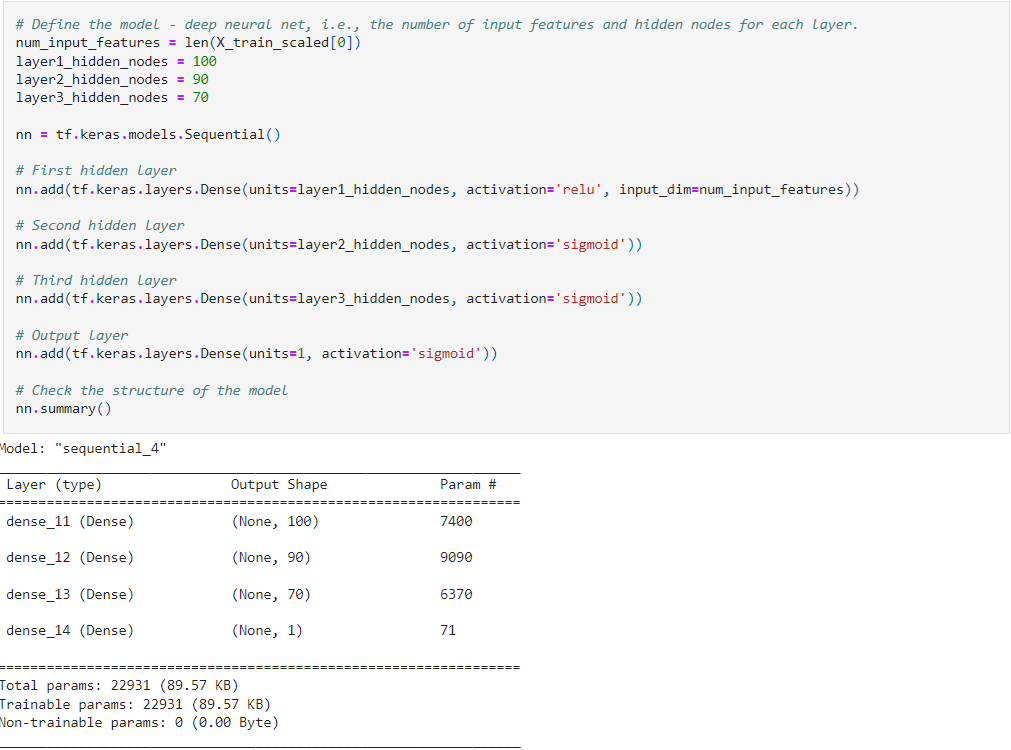
* + 1. What **variable(s)** are the **features** for your model?

The feature variables for the model are as follows:

**APPLICATION\_TYPE, AFFILIATION, CLASSIFICATION, USE\_CASE, ORGANIZATION, STATUS, INCOME\_AMT, SPECIAL\_CONSIDERATIONS, ASK\_AMT**

* + 1. What **variable(s)** should be **removed** from the input data because they are neither targets nor features? The variable removed from the input data are: **EIN** and **NAME** in the initial model. I have removed **two other variables** in the **optimization models**, which are: **STATUS** and **SPECIAL\_CONSIDERATIONS**.
  1. **Compiling, Training, and Evaluating the Model**  
     i. How many neurons, layers, and activation functions did you select for your neural network model, and why?
* I used **two** hidden layers in the initial and first optimization models, and 3 hidden layers in the third optimization model.
* In the initial model, I used 9 neurons with relu activation function in the first hidden layer and 5 neurons with relu activation function in the second hidden layer, and sigmoid activation function in the output layer.
* In the first optimization model, I used 100 neurons with relu activation function in the first hidden layer and 100 neurons with relu activation function in the second hidden layer, and sigmoid activation function in the output layer.
* In the second optimization model, I used 100 neurons with relu activation function in the first hidden layer, 90 neurons with sigmoid activation function in the second layer, 70 neurons with sigmoid activation function in the third hidden layer, and sigmoid activation function in the output layer.  
    
  **InitialModel**[](https://private-user-images.githubusercontent.com/144713762/321437847-9ff167c8-18cd-4693-91d0-a4bc666f389d.png?jwt=eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJpc3MiOiJnaXRodWIuY29tIiwiYXVkIjoicmF3LmdpdGh1YnVzZXJjb250ZW50LmNvbSIsImtleSI6ImtleTUiLCJleHAiOjE3MTM5OTI5MDYsIm5iZiI6MTcxMzk5MjYwNiwicGF0aCI6Ii8xNDQ3MTM3NjIvMzIxNDM3ODQ3LTlmZjE2N2M4LTE4Y2QtNDY5My05MWQwLWE0YmM2NjZmMzg5ZC5wbmc_WC1BbXotQWxnb3JpdGhtPUFXUzQtSE1BQy1TSEEyNTYmWC1BbXotQ3JlZGVudGlhbD1BS0lBVkNPRFlMU0E1M1BRSzRaQSUyRjIwMjQwNDI0JTJGdXMtZWFzdC0xJTJGczMlMkZhd3M0X3JlcXVlc3QmWC1BbXotRGF0ZT0yMDI0MDQyNFQyMTAzMjZaJlgtQW16LUV4cGlyZXM9MzAwJlgtQW16LVNpZ25hdHVyZT01ZGFjMWI5ODFlZjQxMzlkNGIyMzUxZjcyNWU3OTQzMTQzZWY0OWUwNjkyNWJiMDU4ZjgxNTk2MzBiOTYzYjNhJlgtQW16LVNpZ25lZEhlYWRlcnM9aG9zdCZhY3Rvcl9pZD0wJmtleV9pZD0wJnJlcG9faWQ9MCJ9.aHKQguuJegBhxdzhUYQP7hveil5NEDkAnr-xazlCjfU)

**OptimizationModel1**[](https://private-user-images.githubusercontent.com/144713762/321437871-aa37f398-0978-47b4-afd4-530279fe9123.png?jwt=eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJpc3MiOiJnaXRodWIuY29tIiwiYXVkIjoicmF3LmdpdGh1YnVzZXJjb250ZW50LmNvbSIsImtleSI6ImtleTUiLCJleHAiOjE3MTM5OTI5MDYsIm5iZiI6MTcxMzk5MjYwNiwicGF0aCI6Ii8xNDQ3MTM3NjIvMzIxNDM3ODcxLWFhMzdmMzk4LTA5NzgtNDdiNC1hZmQ0LTUzMDI3OWZlOTEyMy5wbmc_WC1BbXotQWxnb3JpdGhtPUFXUzQtSE1BQy1TSEEyNTYmWC1BbXotQ3JlZGVudGlhbD1BS0lBVkNPRFlMU0E1M1BRSzRaQSUyRjIwMjQwNDI0JTJGdXMtZWFzdC0xJTJGczMlMkZhd3M0X3JlcXVlc3QmWC1BbXotRGF0ZT0yMDI0MDQyNFQyMTAzMjZaJlgtQW16LUV4cGlyZXM9MzAwJlgtQW16LVNpZ25hdHVyZT1lNGVjNDM2OWQ0YjYzNDFjMjBhZjdmYjYwNGQzOWU4MjdiZDE4MGE5N2ZhNzdjOTU2YzI5NjA3MzcxNjY4YjAzJlgtQW16LVNpZ25lZEhlYWRlcnM9aG9zdCZhY3Rvcl9pZD0wJmtleV9pZD0wJnJlcG9faWQ9MCJ9.1J1i6zFXmanVkzbkWbMe9D8WGWOawU_mDxaxpq9aRAg)

**OptimizationModel2**[](https://private-user-images.githubusercontent.com/144713762/321437910-ee4db0ce-4105-4461-b7a3-e1f0f43a862c.png?jwt=eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJpc3MiOiJnaXRodWIuY29tIiwiYXVkIjoicmF3LmdpdGh1YnVzZXJjb250ZW50LmNvbSIsImtleSI6ImtleTUiLCJleHAiOjE3MTM5OTI5MDYsIm5iZiI6MTcxMzk5MjYwNiwicGF0aCI6Ii8xNDQ3MTM3NjIvMzIxNDM3OTEwLWVlNGRiMGNlLTQxMDUtNDQ2MS1iN2EzLWUxZjBmNDNhODYyYy5wbmc_WC1BbXotQWxnb3JpdGhtPUFXUzQtSE1BQy1TSEEyNTYmWC1BbXotQ3JlZGVudGlhbD1BS0lBVkNPRFlMU0E1M1BRSzRaQSUyRjIwMjQwNDI0JTJGdXMtZWFzdC0xJTJGczMlMkZhd3M0X3JlcXVlc3QmWC1BbXotRGF0ZT0yMDI0MDQyNFQyMTAzMjZaJlgtQW16LUV4cGlyZXM9MzAwJlgtQW16LVNpZ25hdHVyZT02ZTg5Mjg4MzdlY2JiNTI3NDVlZTg5MWY3Y2ExZjkzOTgwNGYzNjM5ZGMxMWQxNjA0MTE0MTgxYzk1M2Q2MDRhJlgtQW16LVNpZ25lZEhlYWRlcnM9aG9zdCZhY3Rvcl9pZD0wJmtleV9pZD0wJnJlcG9faWQ9MCJ9.Vimw5QBlkKvZtyiwIik_GY891Xm99bffptV5PXbkmVs)

* + 1. Were you able to achieve the target model performance?

I was able to achieve **74.9%** in **Optimization model 2**, which is very close to the target model performance of 75%.

* + 1. What steps did you take in your attempts to increase model performance?

I only dropped the column `**EIN**` in the **second optimization model** and used `**APPLICATION\_TYPE`, `CLASSIFICATION`, and `NAME**` value counts for **binning**; used 3 hidden layers, `relu` activation function in the first layer, and `sigmoid` activation functions in the second, third, and the output layer.

1. **Summary:** The following steps did help in obtaining better results:

* Dropping fewer columns,
* Creating more bins for rare occurrences in columns,
* Increasing the number of values for each bin,
* Adding more neurons to a hidden layer,
* Adding more hidden layers,
* Using different activation functions for the hidden layers.

In the final optimization model, an accuracy of approximately 74.5% was achieved.

Other machine learning methods to improve classification accuracy include Support Vector Machines (SVM), K-Nearest Neighbors (KNN), Naive Bayes, Nearest Centroid Classifier, Logistic Regression, Neural Networks, Ensemble Methods, etc.

These methods offer diverse approaches to handling classification tasks and can be explored alongside features engineering and hyperparameter tuning to enhance model accuracy.