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Customer Segmentation Using Artificial Neural Network

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Abstract: Customer segmentation is an important method both in customer relationship management literature and software since it directly relates to customer satisfaction of the companies. The most common way to separate customers into two distinct groups is to tag a group of customers with a special label. In this paper, company's likely segmented customer data and related statistical data are used to train and test a neural network-based machine learning model, namely Multi-layer Perceptron (MLP). Once the related features are tailored for artificial neural network training and the hyperparameters are tuned accordingly by deploying an extensive grid search algorithm, the system achieved a good generalization of customer segmentation strategy and hence a good overall accuracy within a few epochs. The proposed system can be integrated into company's data framework such that it can frequently analyse the customer-related data tables and can decide whether a customer is to be promoted or is to remain unchanged. This automatic decision mechanism can improve company's customer satisfaction.

Keywords—Artificial Neural Networks (ANN), Customer Segmentation, Machine Learning (ML), Multi-layer Perceptron (MLP), Customer Satisfaction.

I. INTRODUCTION

Customer segmentation is the process of separating your customers into groups based on what certain traits (e.g., personality, interests, habits) and factors (e.g., demographics, deposits, salary, age, products) they share. It offers a simple way of organizing and managing your company's relationships with your customers. This process also makes it easy to tailor and personalize your marketing, service, and sales efforts to the needs of specific groups. This helps boost customer loyalty and conversions. We are using ANN Algorithm for this purpose. Artificial Neural Network (ANN) is a deep learning algorithm that emerged and evolved from the idea of Biological Neural Networks of human brains. An attempt to simulate the workings of the human brain culminated in the emergence of ANN. The ANN Algorithm take geographic location, age, gender, salary, product number, credit card, credit score, active member, deposit as the input parameter and train them on the output parameter whether customer will exit the bank or not. Based on these data the training of the model is done. Once the training is completed then we will input customer data base on the above input parameter and segment the customer whether it will exit the bank or not with accuracy score. Once the customer is segmented the bank can use the data of the customer who will exit the bank and try to retain the customer through customer retention techniques. These will help the bank to understand their customer and improve their retention rate. The final model generates the output using the knowledge it gained from the data on which it was trained. In the final phase, we get the accuracy of our algorithm and get to know how our algorithm is working with the

new data set. The rest of the paper is organized as follows: section II gives related work for customer segmentation. Section III gives in detail of Artificial Neural Network and Multi-Layer Perceptron. In section IV, proposed methods with all steps discussed. Section V discusses the results. Finally, section VI gives future direction and concludes the work.

II. RELATED WORK

Many researchers have used different Machine Learning algorithms on different Datasets.

Ramendra Thakur et al. [1] uses the customer portfolio management (CPM) approach to examine how a company can define the value of customers and segment these customers into portfolios. By segmenting customers into portfolios, an organization can better understand the relative importance of each customer to the company's total profit. Such an understanding will help companies retain valuable customers create additional value with these customers through relationship development.

Katharina Windler et al. [2] purposes to develop and apply a methodology for identifying, assessing and segmenting customers for business solutions. Firstly, criteria for evaluating solution customers are identified from the literature. These criteria are then refined and differentiated through interviews with 23 solution project managers. Secondly, a longitudinal case study with three solution suppliers and five of their customers is conducted to transfer the selection criteria into a managerial methodology which is validated by both solution suppliers and customers.

Şükrü Ozan et al.[3] used different classification methods to discriminate between premium and standard customers belonging to a company's database are compared. Two-dimensional payment information of customers are used as input variables (features) and the methods are compared according to their separation performances.

Kansal et al.[4] use three different clustering algorithms (k-Means, Agglomerative, and Meanshift) are been implemented to segment the customers and finally compare the results of clusters obtained from the algorithms. By applying clustering, 5 segments of cluster have been formed labelled as Careless, Careful, Standard,Target and Sensible customers.

Kayalvily Tabianan et al. [5], uses the clustering to optimize the experimental similarity within the cluster and to maximize the dissimilarity in between clusters. In their study there are relationship between three clusters: event type, products, and categories. The proposed approach analyzed the groups that share similar criteria to help vendors to identify and focus on the high profitable segment to the least profitable segment. This type of analysis can play important role in improving the business. Grouping their customer according to their similar behavioral factor to sustain their customer for long-term and increase their business profit. It also enables high exposure of the e-offer to gain attention of potential customers. In order to process the collected data and segment the customers, an learning algorithm is used which is known as K-Means clustering.

III. ARTIFICIAL NEURAL NETWORKS (ANN) AND MULTI-LAYER PERCEPTRON

A. Artificial Neural Network: To understand the concept of the architecture of an artificial neural network, we have to understand what a neural network consists of. In order to define a neural network that consists of a large number of artificial neurons, which are termed units arranged in a sequence of layers. There are various types of layers available in an artificial neural network.

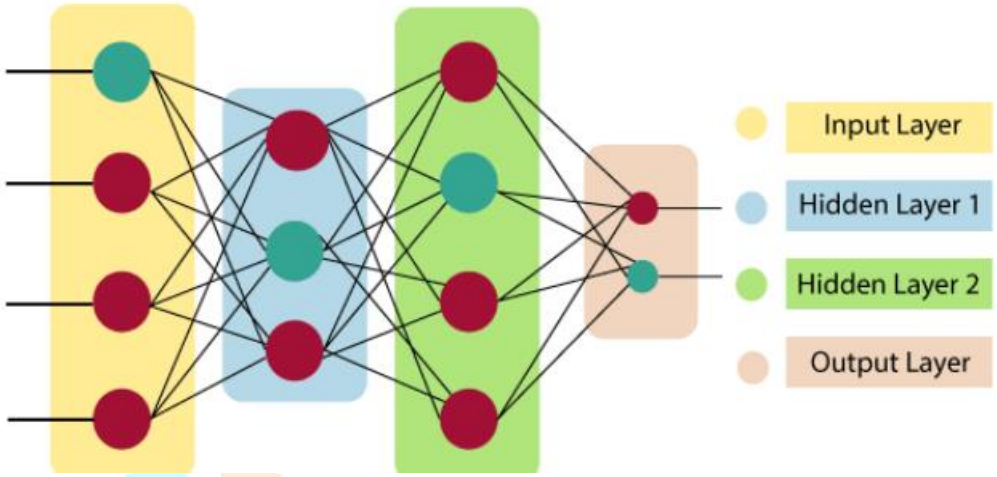


Figure 1: Architecture of Artificial Neural Network

Input Layer: As the name suggests, it accepts inputs in several different formats provided by the programmer.

Hidden Layer: The hidden layer presents in-between input and output layers. It performs all the calculations to find hidden features and patterns.

Output Layer: The input goes through a series of transformations using the hidden layer, which finally results in output that is conveyed using this layer. The artificial neural network takes input and computes the weighted sum of the inputs and includes a bias. This computation is represented in the form of a transfer function. It determines weighted total is passed as an input to an activation function to produce the output. Activation functions choose whether a node should fire or not. Only those who are fired make it to the output layer.

B. Multi-Layer Perceptron : It can be used to solve complex nonlinear problems. It handles large amounts of input data well. Makes quick predictions after training. The same accuracy ratio can be achieved even with smaller samples. It has the following steps.

Step 1: Initialize the weights and bias with small-randomized values.

Step 2: Propagate all values in the input layer until the output layer (Forward Propagation)

Step 3: Update weight and bias in the inner layers (Back Propagation)

Step 4: Do it until that the stop criterion is satisfied

Forward Propagation: In Forward Propagation each neuron is initialized with weights and bias. calculate the activation unit al(h) of the hidden layer. The number of layers and the number of neurons is referred to as hyperparameters of a neural network.

Back Propagation: Cross-validation techniques must be used to find ideal values for the MLP. The weight adjustment training is done via backpropagation so that we can get a precise output for a specific input neuron.

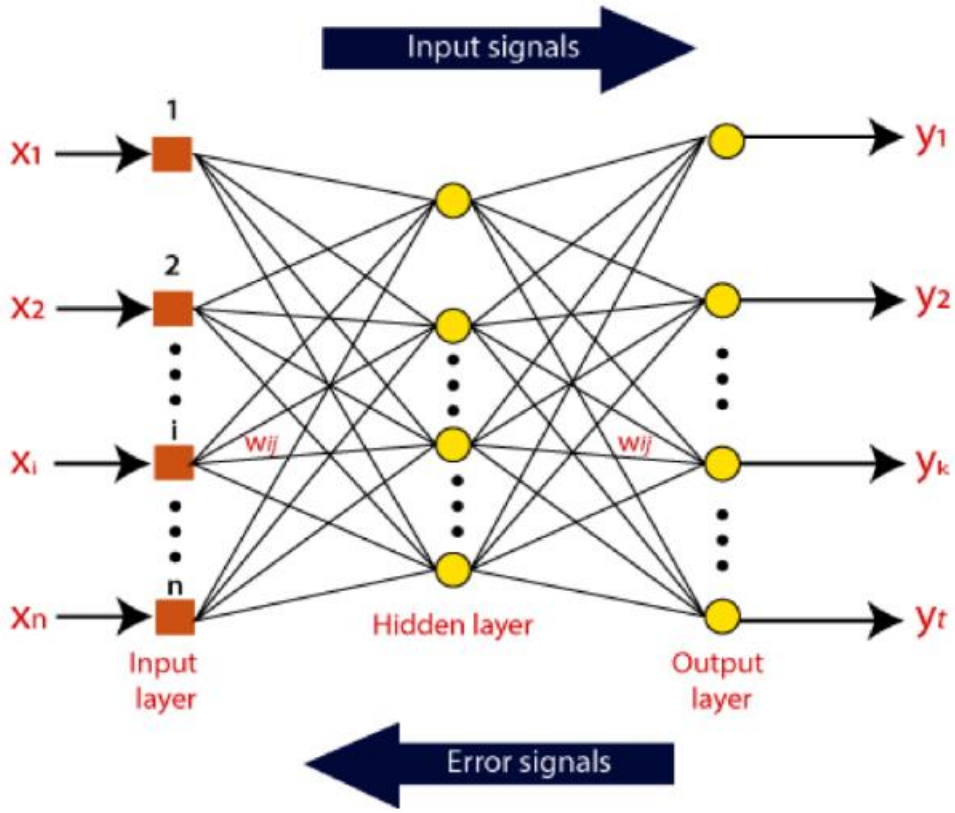


Figure 2: Multilayer Perceptron

IV. PROPOSED METHODS

The Figure 3 shows the Design Approach for the proposed System. first phase is data collection. We will be collecting data sets from an online platform. The dataset contains data of customers from the bank which will be used to predict whether a customer will be there with bank or exit the bank. Then features and labels of the dataset are identified. After that, the dataset is divided into two sets, one for training where most of the data is used and the other one is testing. In the training set, we are using the Multilayer Perceptron Model to train the data set. After the system has done learning from training datasets, newer data is provided without outputs. The final model generates the output using the knowledge it gained from the data on which it was trained. In the final phase, we get the accuracy of our algorithm and get to know how our algorithm is working with the new data set.

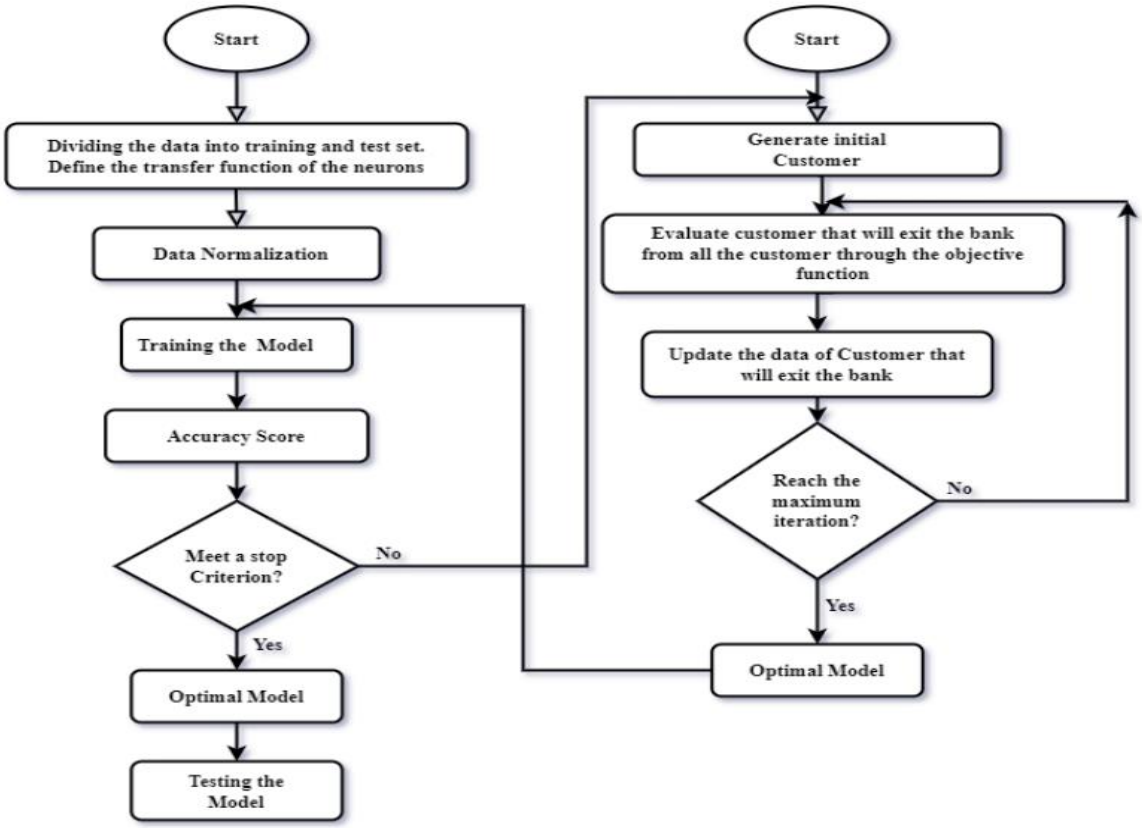


Figure 3: Design Approach for the proposed System

V. RESULTS & DISCUSSION

We have used the different libraries of Python such as NumPy, Pandas, TensorFlow[6], Matplotlib, sklearn.model_selection, sklearn.metrics and os. The Figure 4 shows the General Overview of the Data Set in terms of Graph. It shows bar graph based on different categories like job, education, marital status, loan etc. These Process is done to take the summary from the Data Set.

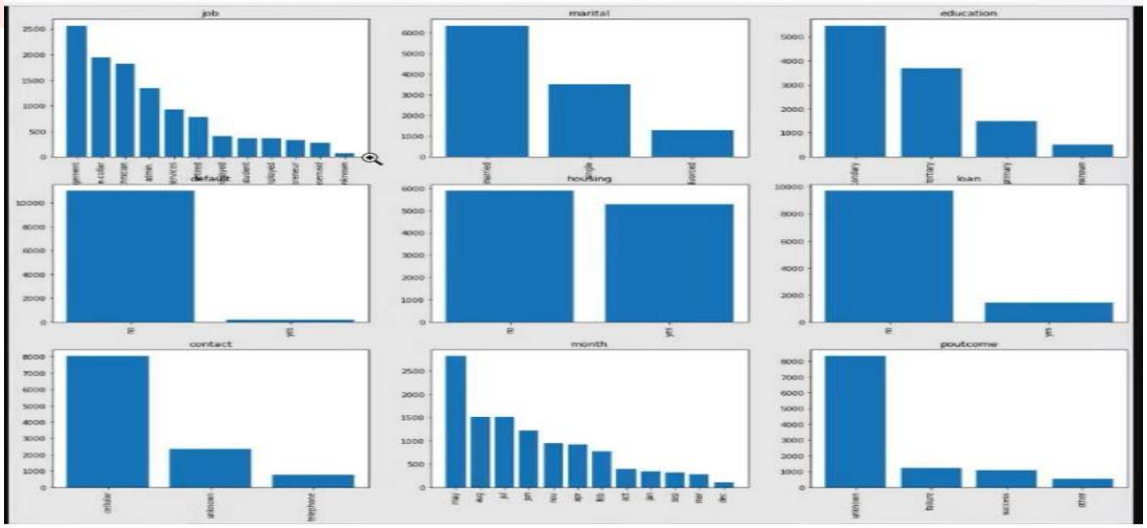


Figure 4: Graphical Representation of Data job, education, marital status, loan

The Figure 5 shows the General Overview of the Data Set in terms of Graph. It shows bar graph Range based on different categories like Balance, duration, day etc. These Process is done to take the summary of the range of data from the Data Set.

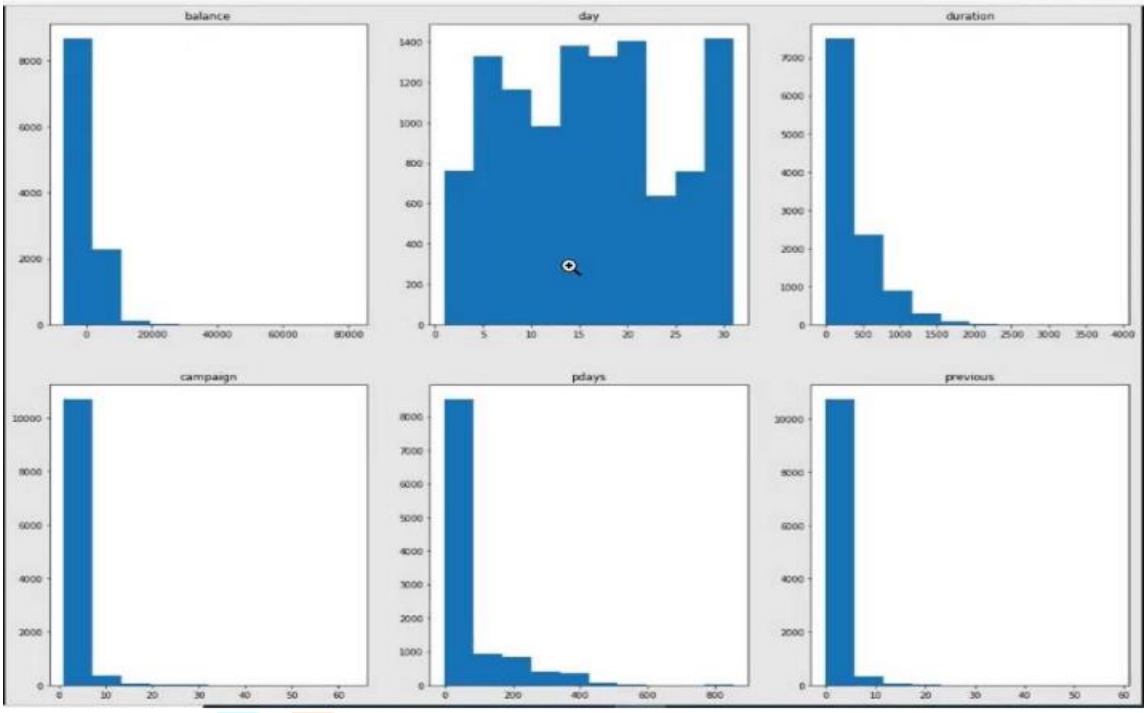


Figure 5: Graphical Representation of Data Balance, duration, day

The Figure 6 shows the Deposit Bar Graph of the customer data who have deposited and not deposited.

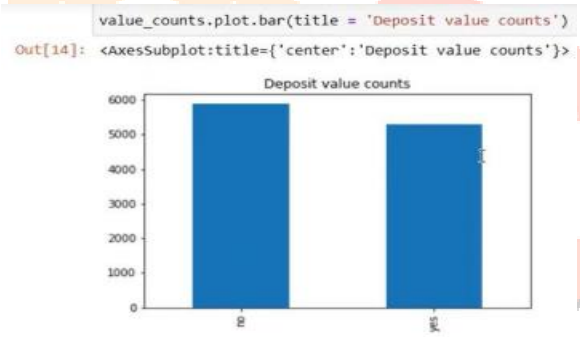


Figure 6: Deposit Bar Graph

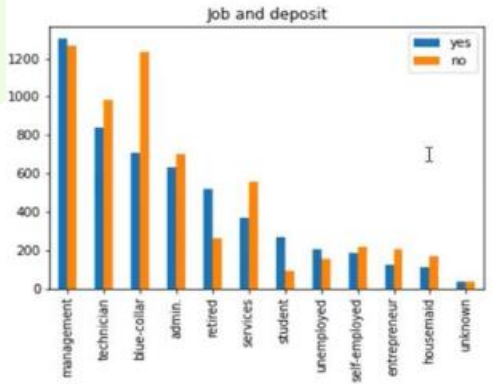


Figure 7: Job and Deposit Bar Graph

The Figure 7 shows the Job and Deposit Bar Graph of the customer data who have deposited and not deposited.

The Figure 8 displays the Marital Status and Deposit Bar Graph of the customer data who have deposited and not deposited.

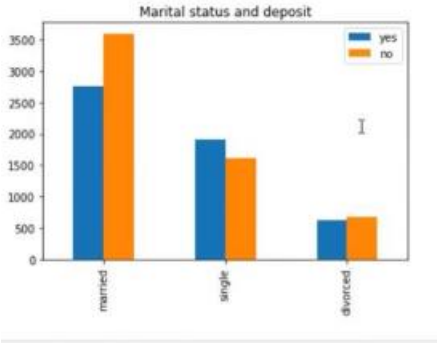


Figure 8: Marital Status and Deposit Bar Graph

The Figure 9 gives the Education and Deposit Bar Graph of the customer data who have deposited and not deposited.

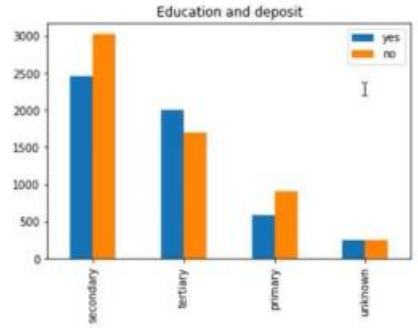
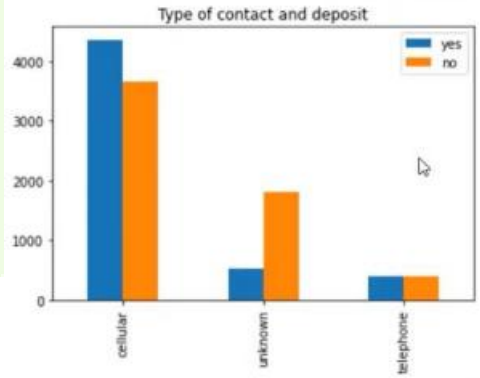


Figure:9 Education and Deposit Bar Graph

The Figure 10 shows the Type of Contact and Deposit Bar Graph of the customer data who have deposited and not deposited.



The Figure 11 represents the Balance and Deposit Bar Graph of the customer data who have deposited and not deposited.

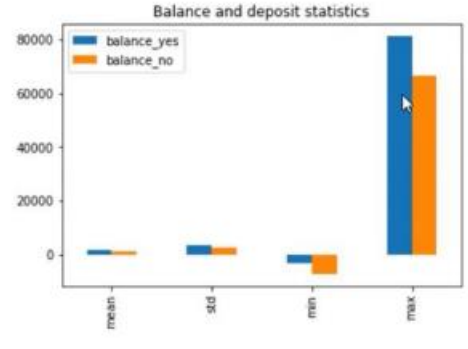


Figure : 11 Balance and Deposit Bar Graph

The Figure 12 shows the Age and Deposit Bar Graph of the customer data who have deposited and not deposited.

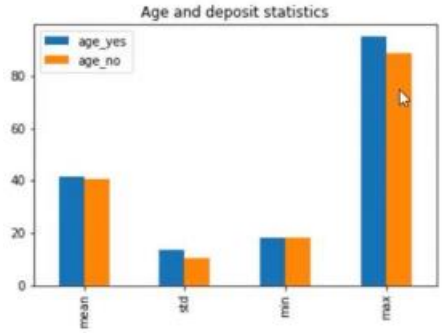


Figure 12: Age and Deposit Bar Graph

The Figure 13 shows the Campaign and Deposit Bar Graph of the customer data who have deposited and not deposited.

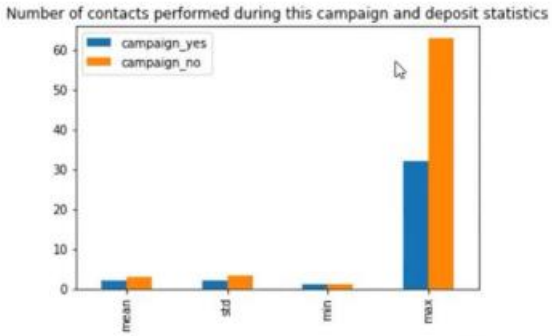


Figure 13: Campaign and Deposit Bar Graph

The Figure 14 displays the Contact Performed and Deposit Bar Graph of the customer data who have deposited and not deposited.

The Figure 15 shows the Mean % Subscription depending on account balance. Which gives the account balance range and subscription Percentage.

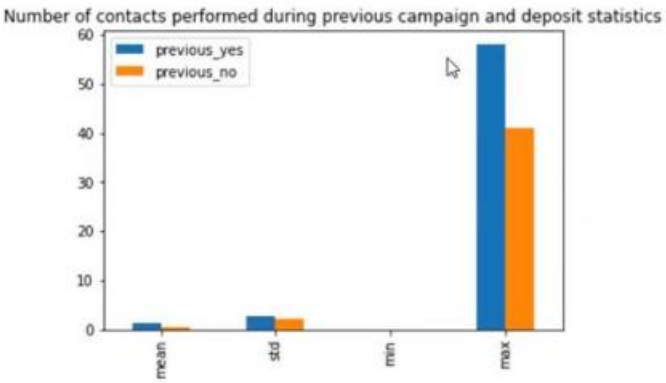


Figure 14: Contact Performed and Deposit Bar Graph

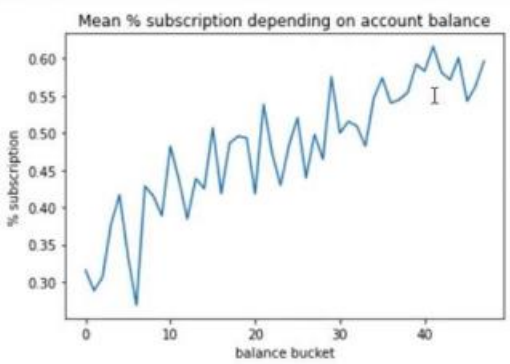


Figure 15: Mean % Subscription depending on account balance

The Figure 16 shows the Mean % Subscription depending on age. Which gives the age range and subscription Percentage.

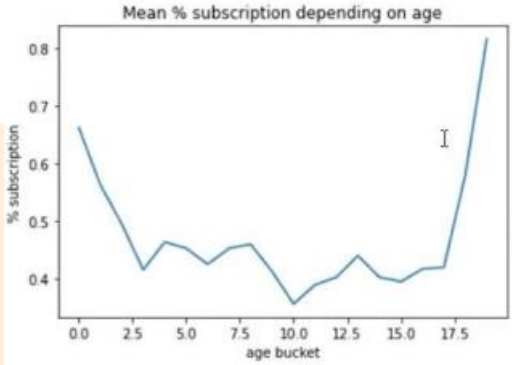


Figure 16: Mean % Subscription depending on age

The Figure 17 shows the Training Model on Input and Output Parameter with Accuracy Score and Loss Score.

```
In [52]: ann.add(tf.keras.layers.Dense(units=1,activation="sigmoid")) ## to know what is the number, just needs
         # having a sigmoid activation function allows to get not only ultimately the predictions,
         #but the probabilities that the binary outcome is one.

In [53]: ann.compile(optimizer= "adam", loss="binary_crossentropy", metrics=["accuracy"])
         #what's the Cassey gradient descent allows to do?
         # it is what will update the weights in order to reduce the loss error between your predictions and the

In [54]: ann.fit(x_train, y_train, batch_size=32,epochs=100)
         250/250 [==============================] - 0s 2ms/step - loss: 0.4873 - accuracy: 0.7981
         Epoch 3/100
         250/250 [==============================] - 1s 3ms/step - loss: 0.4583 - accuracy: 0.7981
         Epoch 4/100
         250/250 [==============================] - 1s 2ms/step - loss: 0.4361 - accuracy: 0.7999
         Epoch 5/100
         250/250 [==============================] - 1s 3ms/step - loss: 0.4184 - accuracy: 0.8120
         Epoch 6/100
         250/250 [==============================] - 0s 2ms/step - loss: 0.4052 - accuracy: 0.8180
         Epoch 7/100
         250/250 [==============================] - 1s 3ms/step - loss: 0.3947 - accuracy: 0.8245
```

Figure 17: Training Model on Input and Output Parameter

The Figure 18 shows the Testing Model with Input Parameter. Which show the Result as Customer will NOT EXIT the Bank with Accuracy Score of 0.917.

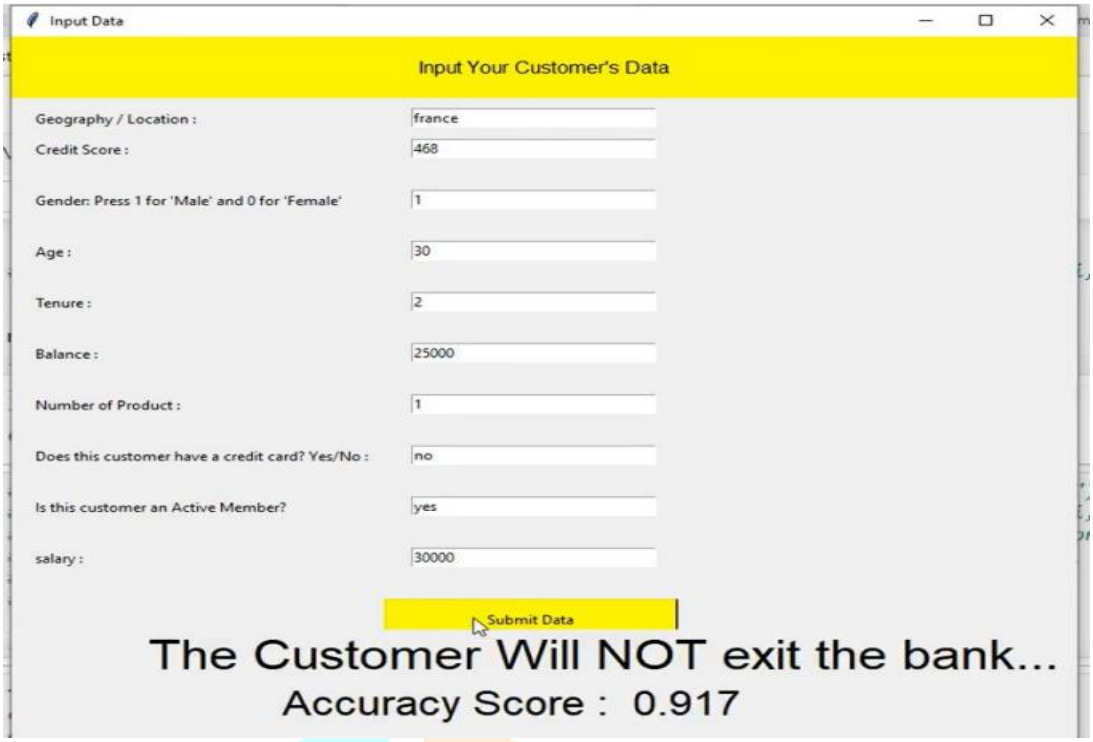


Figure 18: Testing the Model with Input Parameter

The Figure 6.19.2 shows the Testing the Model with Input Parameter. Which show the Result as Customer will EXIT the Bank with Accuracy Score of 0.917.

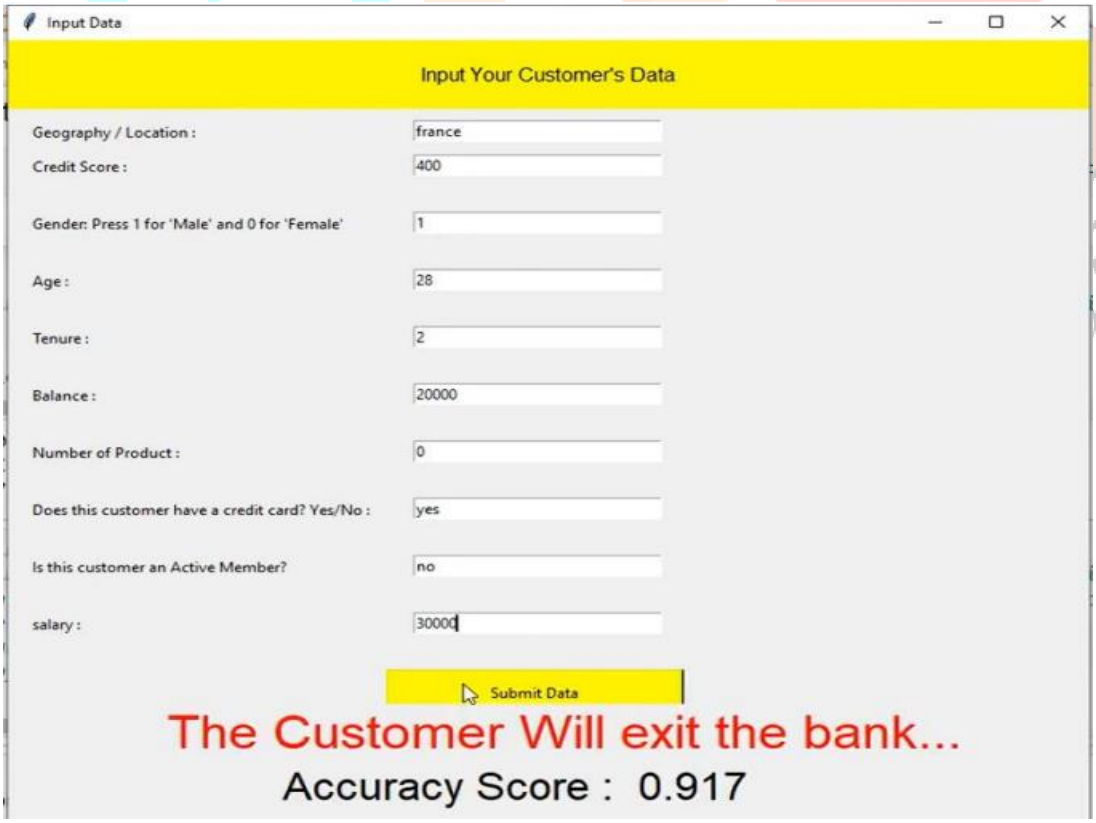


Figure 6.19.2 Testing the Model with Input Parameter

VI. CONCLUSION AND FUTURE WORK

In this paper we have used Artificial Neural Network (ANN) algorithm to segment customer with accuracy of 91.7%. The system is developed in python and can be used for small and medium-size companies, Banks to segment their customer and understand their customer retention problem. To give different services to their segmented customers.

In future we can do Sentiment Analysis of communication between customers and customer representatives. We can find Probability of losing a customer at any time and enables the company to take some pre-emptive actions when necessary. This can be directly used in Industry for Customer Segmentation.

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