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Predicting Customer Churn using Neural Networks

Palakodeti Mounika Venkata Supraja
PG scholar, Department of MCA, CDNR collage, Bhimavaram, Andhra Pradesh.
K.Suparna
(Assistant Professor), Master of Computer Applications, DNR collage, Bhimavaram, Andhra Pradesh.

Abstract In today's competitive telecom industry, retaining customers is as crucial as acquiring new ones. Customer churn—when a user discontinues service—is a major concern that can significantly impact a company's revenue. Traditionally, surveys were employed to identify dissatisfied customers, but these methods are labor-intensive and time-consuming. Some companies have adopted machine learning techniques for churn prediction; however, many of these models lack the accuracy needed for proactive retention strategies.

In this project, we propose a Neural Network-based approach to accurately predict customer churn. The model is enhanced with hyperparameter tuning to identify the optimal number of layers and neurons for improved performance. The dataset used is the publicly available "Customer Churn" dataset from Kaggle. Extensive data preprocessing steps—including normalization, categorical encoding, and exploratory data analysis—were conducted to prepare the data. The model's effectiveness is evaluated using metrics such as accuracy, precision, recall, F1-score, confusion matrix, and ROC curve. The final model achieved high prediction accuracy, demonstrating that deep learning combined with hyperparameter optimization can provide telecom companies with actionable insights to reduce customer attrition.

INTRODUCTION

In today's highly competitive business landscape, retaining customers is paramount for sustained success. Customer churn, or the loss of customers, poses a significant challenge for businesses across various industries. Identifying and predicting customer churn has become a crucial focus area for companies aiming to proactively address customer dissatisfaction and prevent attrition. One powerful tool in this endeavor is neural networks, a subset of machine learning algorithms inspired by the structure and function of the human brain.

Neural networks excel at uncovering complex patterns in vast datasets, making them well-suited for predicting customer behavior, including churn. This paper aims to explore the application of neural networks in predicting customer churn. We will delve into the conceptual framework of neural networks, discuss the challenges associated with customer churn prediction, and showcase the potential benefits of leveraging neural networks in this domain.

By harnessing the predictive capabilities of neural networks, businesses can gain valuable insights into customer behavior, enabling them to implement proactive retention strategies, enhance customer satisfaction, and ultimately foster long-term relationships with their clientele. Through this exploration, we aim to provide a comprehensive understanding of how neural networks can be leveraged as a powerful tool in the fight against customer churn.

LITERATURE SURVEY

1. Dalli, A. Impact of hyperparameters on deep learning model for customer churn prediction in telecommunication sector. Math. Probl. Eng. 2022, 1–11 (2022).

In this paper, in order to predict a customer churn in the telecommunication sector, we have analysed several published articles that had used machine learning (ML) techniques. Significant predictive performance had been seen by utilising deep learning techniques. However, we have seen a tremendous lack of empirically derived heuristic information where we had to influence the hyperparameters consequently. Here, we had demonstrated three experimental findings, where a Relu activation function was embedded and utilised successfully in the hidden layers of the deep network.

2. Kumar, S. & Chandarkala, D. A survey on customer churn prediction using machine

learning techniques. Int. J. Comput. Appl. 154(10), 13–16 (2016).

The fast expansion of the market in every sector is leading to superior subscriber base for service providers. Added competitors, novel and innovative business models and enhanced services are increasing the cost of customer acquisition. In such a fast set up, service providers have realized the importance of retaining the on-hand customers. It is therefore essential for the service providers to prevent churn- a phenomenon which states that customer wishes to quit the service of the company.

3. Rodan, A., Faris, H., Alsakran, J. & Al-Kadi, O. A support vector machine approach for churn prediction in telecom industry. Int. J. Inf. 17(8), 3961–3970 (2014).

Customer churn is an important and challenging problem that facestelecommunication companies worldwide. Recently, companies have been investingmore in developing accurate prediction models which can forecast which customersare about ending their subscriptions or switching to another competitor serviceprovider. These models can help Customer Relationship Management (CRM) indesigning effective strategies to retain current customers. In this paper, a SupportVector Machine (SVM) model is developed for predicting customer churn in a localtelecommunication company.

4. Foju, S. W., Subramanian, S. & Khdr, M. H. Customer churn prediction in telecommunication industry using deep learning. Inf. Sci. Lett. 11(1), 185–198 (2022).

This paper presents a new set of features for land-line customer churn prediction, including 2 six-month Henley segmentation, precise 4-month call details, line information, bill and payment information, account information, demographic profiles, service orders, complain information, etc. Then the seven prediction techniques (Logistic Regressions, Linear Classifications, Naive Bayes, Decision Trees, Multilayer Perceptron Neural Networks, Support Vector Machines and the Evolutionary Data Mining Algorithm) are applied in customer churn as predictors, based on the new features.

5. Gupta, V. & Jatain, A. Artificial intelligence based predictive analysis of customer churn. Formosa J. Comput. Inf. Sci. 2(1), 95–110 (2023).

The introduction of artificial intelligence (AI) and machine learning (ML) technologies in recent years has resulted in improved company performance. Customer churn forecast is a difficult problem in many corporate sectors, particularly the telecommunications industry. Because customer churns have a direct impact on a company's total revenue, telecommunications firms have begun to develop 76 models to reduce churns at an earlier stage. Previous research has revealed that AI and ML models are effective CCP solutions. According to this viewpoint, this study proposes a unique AI-based CCP model for Telecommunication Business Markets (AICCP-TBM).

PROPOSED METHOD

In the past companies were using survey's to identify churn rate but that survey required lots of man power and time. To overcome some companies were using Machine Learning algorithm but its prediction accuracy is not accurate.

So in propose work we are employing Neural Network algorithm to predict customer churn, propose algorithm will optimize training data using multiple layers and neurons which can help in dropping out irrelevant features and may help in better prediction accuracy.

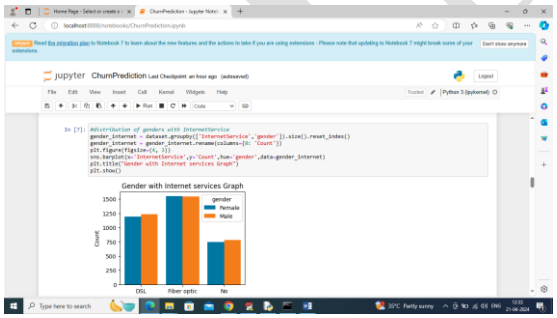
To further enhance neural network performance we are employing Hyper Parameters tuning using varied number of layers and neurons and then choosing model with best hyper parameters for final prediction.

Algorithm performance is measured in terms of accuracy, precision, recall, confusion matrix graph, ROC curve graph and FSCORE. To train algorithm we have utilized 'Customer Churn' dataset from KAGGLE repository.

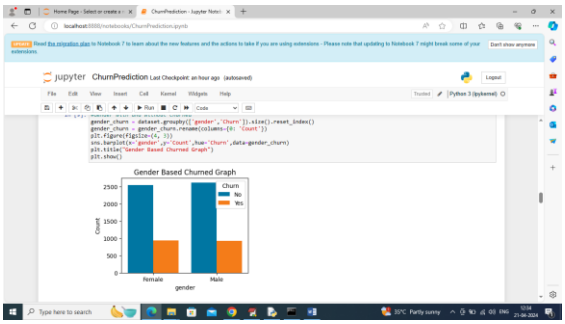
Before training model we have done extensive data processing and exploration mention below

1) Describing dataset numeric values in terms of min, max, mean etc.
2) Describing dataset categorical values in terms of min, max, mean etc.
3) Finding and displaying count of missing values
4) Visualizing graph of customers using multiple lines
5) Visualizing gender based graph using services with internet
6) Finding and visualizing graph of churn based on gender
7) Visualizing monthly charges with different number of amounts
8) Dataset categorical conversion
9) Scaling or normalizing dataset values
10) Splitting dataset with a ratio of 80:20 for training and testing
11) Training neural network with hyper parameters
12) Evaluating best model performance using various metrics

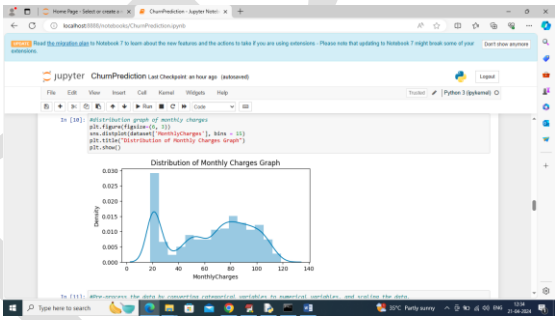
RESULT



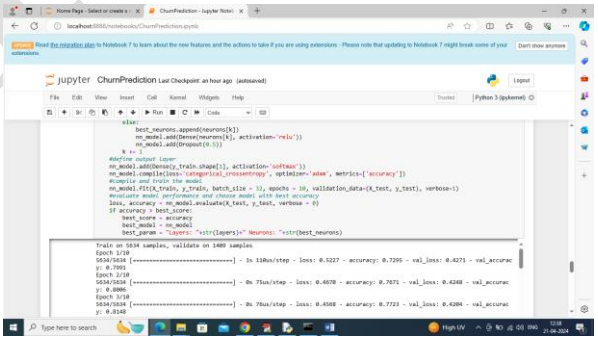
In above screen finding and visualizing graph of genders with different internet services



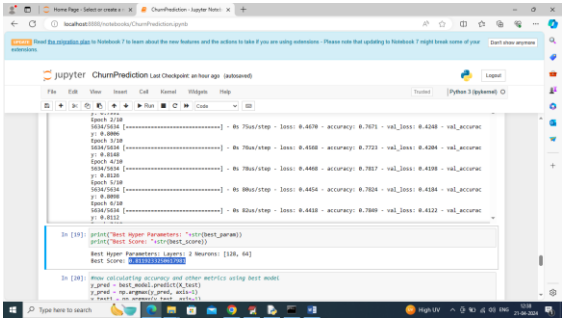
In above screen visualizing graph of gender based churn where no refers to 'Not Churn' and yes refers to Churn



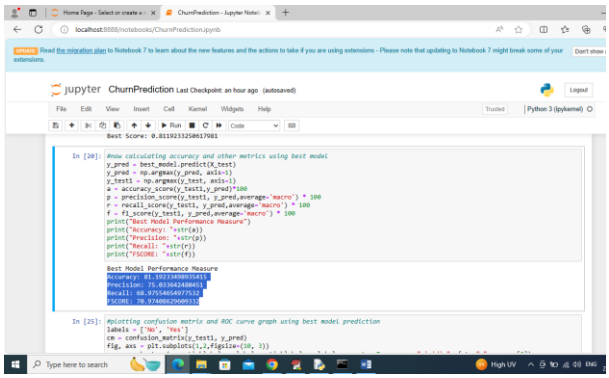
In above graph showing distribution of monthly charges where x-axis represents charge amount and y-axis represents percentage of charging



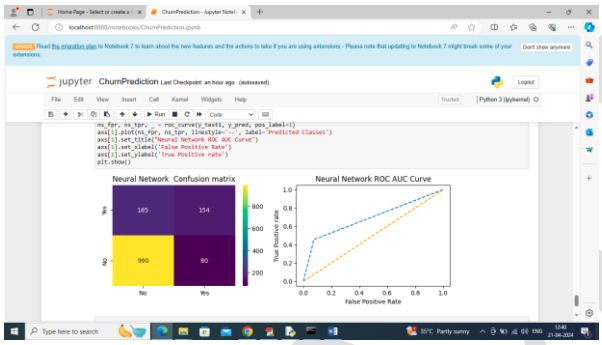
In above screen neural network training started and after training we can print best model parameter and its score



In above screen can see best layers and number of neurons along with best score as 81%



In above screen performing prediction using best model and then calculating accuracy, precision, recall and FSCORE



In above screen visualizing confusion matrix and ROC curve graph where confusion matrix graph x-axis represents Predicted Labels and y-axis represents True labels and then different color boxes like light blue and yellow in diagnol represents correct prediction count and all blue boxes represents incorrect prediction count which are very few. In ROC graph x-axis represents False Positive Rate and y-axis represents True Positive Rate and if blue lines comes below orange line then all predictions are incorrect or false and if goes above orange line then all predictions are correct or true.

Conclusion

The proposed neural network-based model for customer churn prediction effectively addresses the limitations of traditional survey methods and earlier machine learning techniques. By leveraging deep learning with hyperparameter tuning, the system adapts to complex patterns within telecom customer data, enabling more accurate identification of churn-prone users. Through rigorous preprocessing—including normalization, categorical encoding, and exploratory visualization—the model is trained on high-quality data, enhancing its predictive strength. Evaluation metrics such as accuracy, precision, recall, F1-score, confusion matrix, and ROC curve clearly demonstrate the model's robustness. Ultimately, this solution empowers telecom companies to take preemptive actions, offering tailored services or incentives to at-risk customers, thereby minimizing churn and preserving revenue streams.

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5. Gupta, V. & Jatain, A. Artificial intelligence based predictive analysis of customer churn. Formosa J. Comput. Inf. Sci. 2(1), 95–110 (2023).

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