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CUSTOMERCHURNPREDICTION USING RANDOMFOREST

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Abstract

The Telecommunication Industry is focusing on customer churn detection to retain customers and reduce churn rates. Churn is caused by competitors' exiting offers or network issues, impacting future revenue and service length. A machine learning model, using Random Forest, can predict customers likely to cancel subscriptions, offering better services and reducing churn rates, ultimately boosting profitability in the industry.

Keywords: Telecom churn, Random Forest.

1.Introduction

Churners are customers who discontinue [1] a product or service, often predicted by a churn model. This model is used in various industries, including telecommunications, to predict future customer departures. Mobile telephone organizations [2-10] worldwide are developing their own churn models to retain customers. The churn management approach is crucial for building a model, and an automated application is being developed as a default. In the digital era, customers may use multiple telecommunication companies, and random forest analysis can provide valuable insights.

The telecommunications sector is a major industry in developed countries, but service companies face challenges due to customer churn. With advancements in technology [11-15] and the increasing number of operators, competition has increased, leading to companies implementing complex strategies to survive. Three main approaches have been introduced: acquiring new customers, upselling existing ones, and increasing customer holding periods. However, the third approach is the most successful, as maintaining existing customers costs less and is easier to retain than upselling. To implement this strategy, companies must reduce customer churn, or customer movement from one provider to another. Foreseeing customers expected to leave the company can provide significant revenue, and random forest technology is highly efficient in predicting this situation.

In the telecommunications industry, data mining techniques [15-24]have been used to classify and predict client attrition. In the realm of e-commerce, customer churn is a significant issue. Due to cost constraints, conventional churn prediction models are simple and basic, based on available data from an e-commerce platform Customers who haven't logged in or made any purchases are deemed lost. Customers who are at risk of being lost can be precisely identified with data mining and analysis, also, they can be restored in a timely manner using efficient marketing methods.

Although customer acquisition is unpredictable, a customer [25-38] churn predictions model can help ecommerce enterprises figure out what created a lack and how to eliminate it in the future. The most extensively used customer turnover prediction model is the regularity, repetition, and financial value approach The term "churn" was coined by combining the English terms "change" and "turn" to represent the phenomenon of a consumer leaving.

2 .Literature survey

Irfan Ullah et al., [1] identified churn factors that are essential in determining the root causes of churn. By knowing the significant churn factors from customers' data, Customer Relationship Management (CRM) can improve productivity, recommend [39-40] relevant promotions to the group of likely churn customers based on similar behaviour patterns, and excessively improve marketing.

Kavitha V et al., [2] used a Random Forest, to predict the customers who are likely to cancel the subscription which can offer them better services and reduce the churn rate. By preprocessing and feature selection, the data set for training and testing. For the above-mentioned [41-45] algorithm, it is necessary to do some feature engineering to have more efficient and accurate results.

Krishna Sai and Sasikala [3] implemented an EDA using Visualization, statistical tests for feature selection and Data mining methods for predicting the likely churners by utilizing a Logistic Regression Model. Here dataset has been analysed by using the data visualization techniques before entering into the modeling process.

Omar Adwan et al., have used Multi-layer perceptron neural network (MLPNN): Modelling and Analysis tor to another commercial competitor, which leads to a loss of serious profits [4]. Actual customer data from a large [46-50] Jordanian telecommunications company was provided for this investigation. Using MLP Neural Networks: Modelling and Analysis, they predict Customer Churn in the Telecommunications Industry.

Babu and Ananth have proposed that it is the procedure of finding the information concealed in huge informational collections, incorporates different strategies and calculations to play out an effective investigation of informational indexes, the order is the strategy that is utilized to recognize the information and make forecasts about the future remain constant [6].

Fatih Kayaalp, has proposed that the churn analysis is one of all the analyses used worldwide in subscription-oriented industries to research client behaviour and predict customers UN agency can leave the mass service of an organization [7]. To keep the review up thus far, studies revealed within the past five years, primarily within the past two years, are enclosed.

ULLAH et al. have developed a model whose outcomes show that the proposed stir expectation model gave better agitate order utilizing the RF calculation and the client profile using k-means grouping [13]. In expansion, it also gives beat variables to the standards produced using the chosen characteristic classifier calculation.

Ahmed and Shabib Aftab suggested an approach that require some investment and assets to create top-notch programming because main modules that are anticipated to be imperfect are tried [17]. They have presented an order system that utilizes the Multi Filter highlight choice procedure, and MLP is used to foresee blunder-inclined programming modules [51]. As indicated by the outcomes, the structure proposed utilizing the class harmony method functioned admirably in all the datasets.

3.Proposed methodology

The concept of improvement is finding the most effective answer for future problems by gaining expertise from the present examples within the machine learning method. Customer churn prediction has been performed using different methods, techniques, data processing, machine learning, and hybrid technologies. Most of them used call trees because it is a recognized way to seek out client churn. However, it does not apply to complicated issues. However, the study shows that reducing the information improves the accuracy of the Random Forest. In some cases, machine learning algorithms square measure used for client prediction and historical analysis.

Here projected review methodology consists of a few phases, as depicted in Fig. 1. The dataset obtained from the Kaggle with 7044 alternatives and 21 attributes was taken as input. Within the 1st 2 phases, knowledge preprocessing and analysis are performed. Then, the information has been parted into two sections, train, and test set in the proportion of 70% and 30% separately. The most well-liked prophetical models are applied within the prediction method: random forest and ensemble techniques square measure applied to visualize the impact on the accuracy of models. Finally, a giant knowledge platform should create the churn prophetical system curve.

To create the churn prophetical system, a giant knowledge platform should be put in. Jupyter libraries were picked because it is a free and open-source structure. The importance of this kind of analysis within the market is to assist organizations in building much profit. Overall, the findings recommend that a neural network learning algorithmic program may provide a viable various to applied math prophetical approaches in client churn prediction. The final results of all the algorithmic program can show that algorithmic program is best appropriate for churn prediction. **Random forest model (RF)**

Random Forest is appropriate for a large dataset. Random Forest architecture is depicted in Fig. 3. A technique that mixes several classifiers to supply solutions to complicated issues. Similarly, a random forest algorithmic program creates call trees on information sum, gets the prediction from every one of them, and eventually selects the simplest answer by suggesting that of the ballot.

Steps concerned in random forest algorithm.

- 1.n scope of arbitrary records square measure taken from the data set having k scope of records.
- 2.Individual decision trees are worked for every model.
- 3.Each decision tree will make an outcome.

The outcome is separately established on Majority Voting or Averaging for Classification and backsliding.

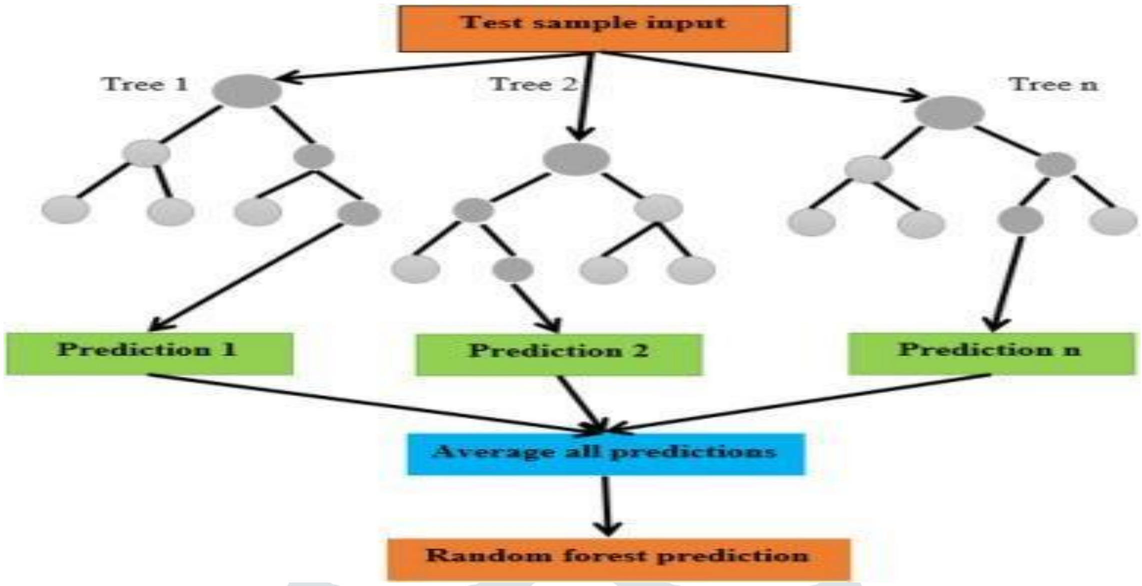

Fig:1

Algorithm for Random Forest Work:

1. Step 1: Select random K data points from the training set.
2. Step 2: Build the decision trees associated with the selected data points (Subsets).
3. Step 3: Choose the number N for decision trees that you want to build.
4. Step 4: Repeat Step 1 and 2.
5. Step 5: For new data points, find the predictions of each decision tree, and assign the new data points to the category that wins the majority votes.

4.Result

The results were obtained using Python 3.10.6 by utilizing the Jupyter Libraries from Anaconda. The various libraries used include numpy, pandas, matplotlib and seaborn. The results obtained in comparing the performance of the various algorithms are narrated step by step. Test and train dataset split

The customer churn dataset is split into training and testing data in a 70: 30 ratios respectively. The head of the dataset is shown intable.

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	MultipleLines	InternetService	OnlineSecurity	...	DeviceProtection
0	7590-VHVEG	Female	0	Yes	No	1	No	No phone service	DSL	No	...	No
1	5575-GNVDE	Male	0	No	No	34	Yes	No	DSL	Yes	...	Yes
2	3668-QPYBK	Male	0	No	No	2	Yes	No	DSL	Yes	...	No
3	7795-CFOCW	Male	0	No	No	45	No	No phone service	DSL	Yes	...	Yes
4	9237-HQITU	Female	0	No	No	2	Yes	No	Fiber optic	No	...	No

Table 1. The sample rows of the dataset.

Dataset and its description before and after datatype conversion

The raw dataset obtained has the attributes in different types of data like objects. So the data is categorized and converted to a feasible type. The dataset description for training with different models is displayed in fig and fig One hot encoding and label encoders were used to transform the categorical labels to numerical labels and for normalizing the labels as shown in fig.

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 7043 entries, 0 to 7042
Data columns (total 21 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   customerID        7043 non-null   object
 1   gender            7043 non-null   object
 2   SeniorCitizen     7043 non-null   int64
 3   Partner           7043 non-null   object
 4   Dependents        7043 non-null   object
 5   tenure            7043 non-null   int64
 6   PhoneService      7043 non-null   object
 7   MultipleLines     7043 non-null   object
 8   InternetService   7043 non-null   object
 9   OnlineSecurity    7043 non-null   object
 10  OnlineBackup      7043 non-null   object
 11  DeviceProtection  7043 non-null   object
 12  TechSupport       7043 non-null   object
 13  StreamingTV       7043 non-null   object
 14  StreamingMovies   7043 non-null   object
 15  Contract          7043 non-null   object
 16  PaperlessBilling  7043 non-null   object
 17  PaymentMethod     7043 non-null   object
 18  MonthlyCharges    7043 non-null   float64
 19  TotalCharges      7043 non-null   object
 20  Churn             7043 non-null   object
dtypes: float64(1), int64(2), object(18)
memory usage: 1.1+ MB
None
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 7043 entries, 0 to 7042
Data columns (total 21 columns):
 #   Column            Non-Null Count  Dtype
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 3   Partner           7043 non-null   int64
 4   Dependents        7043 non-null   int64
 5   tenure            7043 non-null   int64
 6   PhoneService      7043 non-null   int64
 7   MultipleLines     7043 non-null   int64
 8   InternetService   7043 non-null   int64
 9   OnlineSecurity    7043 non-null   int64
 10  OnlineBackup      7043 non-null   int64
 11  DeviceProtection  7043 non-null   int64
 12  TechSupport       7043 non-null   int64
 13  StreamingTV       7043 non-null   int64
 14  StreamingMovies   7043 non-null   int64
 15  Contract          7043 non-null   int64
 16  PaperlessBilling  7043 non-null   int64
 17  PaymentMethod     7043 non-null   int64
 18  MonthlyCharges    7043 non-null   float64
 19  TotalCharges      7043 non-null   float64
 20  Churn             7043 non-null   int64
dtypes: float64(2), int64(19)
memory usage: 1.1 MB
None
```

Table 2. Dataset description

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	MultipleLines	InternetService	OnlineSecurity	...
0	7590	1	0	1	0	1	0	3	1	0	...
1	5575	2	0	0	0	34	1	0	1	1	...
2	3668	2	0	0	0	2	1	0	1	1	...
3	7795	2	0	0	0	45	0	3	1	1	...
4	9237	1	0	0	0	2	1	0	2	0	...

5 rows × 21 columns

Table 3. Dataset samples after conversion.

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	MultipleLines
customerID	1.000000	0.006073	-0.002197	-0.026779	-0.012816	0.007805	-0.006252	0.007550
gender	0.006073	1.000000	-0.001874	-0.001808	0.010517	0.005106	-0.006488	0.001806
SeniorCitizen	-0.002197	-0.001874	1.000000	0.016479	-0.211185	0.016567	0.008576	0.071049
Partner	-0.026779	-0.001808	0.016479	1.000000	0.452676	0.379697	0.017706	0.061417
Dependents	-0.012816	0.010517	-0.211185	0.452676	1.000000	0.159712	-0.001762	-0.011900
tenure	0.007805	0.005106	0.016567	0.379697	0.159712	1.000000	0.008448	0.176459
PhoneService	-0.006252	-0.006488	0.008576	0.017706	-0.001762	0.008448	1.000000	-0.844955
MultipleLines	0.007550	0.001806	0.071049	0.061417	-0.011900	0.176459	-0.844955	1.000000
InternetService	-0.012230	-0.000863	-0.032310	0.000891	0.044590	-0.030359	0.387436	-0.381534
OnlineSecurity	-0.000409	-0.000214	-0.208709	0.056157	0.179614	0.085500	0.146522	-0.249780
OnlineBackup	-0.006665	0.000788	-0.170002	0.059540	0.161106	0.107643	0.164540	-0.244690
DeviceProtection	-0.008100	0.005642	-0.172926	0.064584	0.157003	0.107656	0.156631	-0.237032
TechSupport	-0.004863	0.002805	-0.217566	0.047420	0.173036	0.084902	0.145215	-0.247977
StreamingTV	-0.008606	0.002992	-0.155266	0.054605	0.146505	0.078087	0.179510	-0.246600
StreamingMovies	-0.012090	0.002082	-0.149000	0.051632	0.136652	0.081169	0.175257	-0.241952

Table 4.Prediction of random forest algorithm

The prediction results of the RF algorithm by applying Randomized Search CV for hyperparameter tuning are displayed in fig. and fig. The best RF Training Score was 0.8038805992445953, test Performance was 0.7872340425531915 and AUROC was

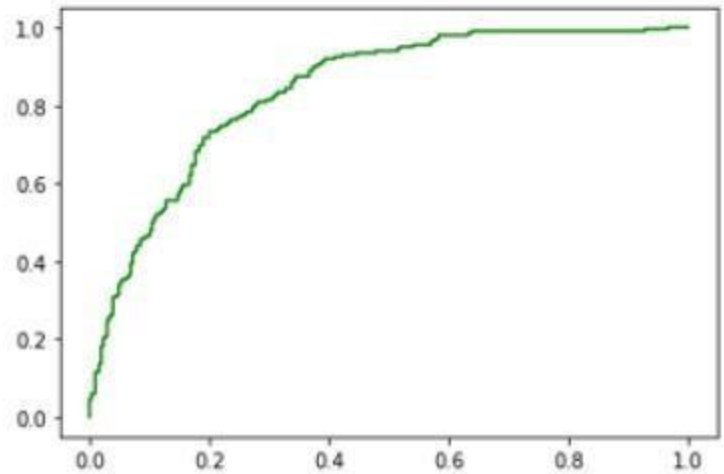
0.829097309685545.

RF AUROC: 0.839097309685545

	precision	recall	f1-score	support
0	0.82	0.91	0.86	518
1	0.64	0.46	0.53	187
accuracy			0.79	705
macro avg	0.73	0.68	0.70	705
weighted avg	0.77	0.79	0.78	705

Table

5. Final accuracy of Random Forest.



5.Conclusion

The importance of churn prediction will help many companies, mainly in telecom industries, to have a profitable income and achieve good revenue. Customer churn prediction is the major issue in the Telecom Industry, and due to this, companies are trying to keep the existing ones from leaving rather than acquiring a new customer. Three tree-based algorithms were chosen because of their applicability and diversity in this type of application. By using Random Forest, we will get more accuracy comparing other algorithms. Here we are using the dataset of some customers about their service plan and checking the values of them and have a precise prediction, which will help to identify the customers who are going to migrate to other company services. By this, the Telecom Company can have a clear view and can provide them some exiting offers to stay in that service. The obtained results show that our proposed churn model produced better results and performed better by using machine learning techniques. Random Forest produced better accuracy among the various methods. In the coming days, we will further research on lazy learning approaches to have better customer churn prediction. To know the changing behaviour of the customers, the study can be extended by using Artificial Intelligence techniques for trend analysis and customer prediction.

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