NITTE MEENAKSHI INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION, AFFILIATED TO VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM, APPROVED BY AICTE & GOVT.OF KARNATAKA

COURSE REPORT

ON

Introduction to Machine Learning

Submitted in partial fulfillment of the requirement for the award of Degree of

Bachelor of Engineering

in

Computer Science and Engineering

Submitted by:

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CERTIFICATE

This is to certify that the **Course Repor**t titled *"Used Car Price Prediction*" is an authentic work carried out by **Shreya Roy(1NT18CS155)** and **Soumya Ramesh (1NT18CS216)** bonafide students of Nitte Meenakshi Institute of Technology, Bangalore in partial fulfillment for the award of the degree of Bachelor of Engineering in **COMPUTER SCIENCE AND ENGINEERING** of Visvesvaraya Technological University, Belagavi during the academic year 2021-2022.

Name Signature of the Faculty Incharge

Name and Signature of the HOD

Dr. Saroja Devi H

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ABSTRACT

The pre-owned car market is expected to outpace the new car market, with the industry expected to clock a healthy growth rate of 15 per cent in FY22. Determining whether the listed price of a used car is a challenging task, due to the many factors that drive a used vehicle’s price on the market. In this project we are using machine learning models such as naive bayesian classifier, linear regression model and decision tree model. The dataset is taken from Kaggle and is collected by Avi Kasliwal. It has more than 6000 rows of data. For validation, we will be using K-Fold cross validation and Train-Test Split validation. The results of the project will include visual graphs and plots of the testing data, identifying the relations and dependencies of the different attributes of the dataset, all the plots related to the machine learning algorithms being used, predicted price attribute csv file, plots of any observed characteristics or trends, from the result.

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3. INTRODUCTION

3.1 Motivation

According to a study, the Indian used car market would increase to more than 70 lakh vehicles by 2025-26, up from 38 lakh in 2020-21, and will grow at a rate of 12-14 percent in the next few years. The pre-owned automobile sector is expected to grow at a 15% annual rate in FY22, according to the OLX Autos-CRISIL Study 2021, with the COVID-19 epidemic, digitalization, changing demographics and ambitions, first-time customers, and the availability of financing options serving as growth drivers. According to the study, many customers had previously avoided purchasing personal vehicles, particularly in metro areas, due to the growth of shared mobility providers such as OLA and Uber. The pandemic has had an effect on the market and customer behavior, reigniting enthusiasm in owning a personal automobile[1].

The extensive market demand and these challenges have made us choose Used Car Price Prediction as our Problem domain, as it not only provides a great and enriching experience for us, but also translates to real- life problems faced by all of us , motivating us to find a solution to this problem.

3.2 Problem Domain

It's difficult to anticipate how much a secondhand car will sell for. It necessitates extensive domain knowledge as well as automotive feature estimates. The brand model, age of the car, color of the car, kilometers driven, owner and seller type, and fuel type of the car are all key factors to consider when calculating the price of used cars. We can investigate a wide variety of choices to increase the accuracy of our forecasts; the list of attributes is not limited[2].

3.3 Aims and Objectives

The aim of this project is to predict the price of used cars using the datasets.

Objectives:

1. To pre-process the datasets and clean them.
2. To train the different regression models and fit the data.
3. To validate the models & find the best machine learning model
4. To predict the Price of the Used Cars.

4. DATA SOURCE AND DATA QUALITY

We got the data from Kaggle, which is an open source and community-maintained website that was gathered by Avi Kasliwal. The dataset is called 'Used Car Price Prediction'.

The train-data.csv contains the training data. It has 6019 rows and 14 columns in the training data. The dataset [3] contains both numerical and categorical data, with numerical data in the selling price and kilometers driven columns and categorical data in the remaining input fields. The attributes include:

1. Index: It stores data from 0 to 6018.
2. Name: The brand and model of the car. It includes over 1400 unique car names or models from well-known 29 car brands such as Maruti, Hyundai, Datsun, Jeep, BMW, Mahindra, Ford, Nissan, Tata, Chevrolet, Toyota, Jaguar, Mercedes-Benz, Audi, Skoda, Volvo, MG, Force, Isuzu, Opel Corsa, Ambassador, Kia, Renault, Fiat, Volkswagen, and many others.
3. Location: It denotes the year in which the car is being sold or is available for purchase. Our database includes a variety of automobiles purchased between 2001and 2019.
4. Year: The year or edition of the model.
5. Kilometers_Driven: It reflects the total number of kilometers driven by a vehicle. Our data includes a variety of vehicles that have traveled between 1 and 800,000 kilometers.
6. Fuel_Type: This reflects the type of fuel used by the car. It will be one among Petrol, Diesel, Electric, CNG, LPG.
7. Transmission: This represents the type of transmission used by the car. It will be one among Automatic or Manual.
8. Owner_type: Whether the ownership is Firsthand, Second hand or other.
9. Mileage: The standard mileage offered by the car company in kmpl or km/kg
10. Engine: The displacement volume of the engine in cc.
11. Power: The maximum power of the engine in bhp.
12. Seats: The number of seats in the car.
13. New_Price: The price of a new car of the same model.
14. Price: The price of the used car in INR Lakhs.

test-data.csv contains the test data. There are 1234 rows and 13 columns in the test data. It contains the first 13 columns. We need to predict the price of the used car after training the model.

5. DATA PREPROCESSING

The dataset selected by us showed inconsistencies in terms of the entries having null values. Also the Dataset has units as strings, which causes irregularities while computing if not corrected. Due to the huge size of the datasets, they have to be cleared of the duplicate and unnecessary values which have no effect on our model computation. The model name and Brand name of cars have to be considered separately so as to make our dataset less complex to process.

6. MACHINE LEARNING METHODS

The project deals with , implementing and analyzing two Machine Learning Algorithms , namely the Linear Regression model, the Naive Bayes Classifier and the Decision Tree algorithm , thus driving a comparison between them to see which gives the best result in terms of accuracy and least amount of error.

The goal behind making use of these models is to resolve the problem , by predicting the price of Used Cars , as closely and accurately in real time as possible.

Following is brief explanation about the Machine Learning Models that will be used in the project:

1. Linear Regression Model :

Linear regression is one of the easiest and most popular Machine Learning algorithms. It is a statistical method that is used for predictive analysis. Linear regression makes predictions for continuous/real or numeric variables such as **sales, salary, age, product price,** etc. Linear regression algorithm shows a linear relationship between a dependent (y) and one or more independent (y) variables, hence called linear regression. Since linear regression shows the linear relationship, which means it finds how the value of the dependent variable is changing according to the value of the independent variable.[4]

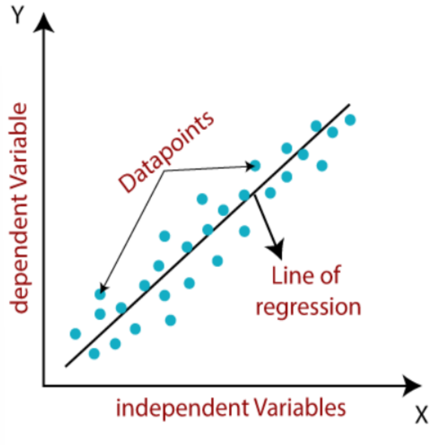


Fig1: Linear Regression

Mathematically, we can represent a linear regression:

$$y= a_0+a_1x+ \varepsilon$$

Here,

Y= Dependent Variable (Target Variable)

X= Independent Variable (predictor Variable)

a0= intercept of the line (Gives an additional degree of freedom)

a1 = Linear regression coefficient (scale factor to each input value).

ε = random error

The values for x and y variables are training datasets for Linear Regression model representation[4].

2. Random Forest Regression:

Random Forest Regression is a supervised learning algorithm that uses ensemble learning methods for regression. Ensemble learning method is a technique that combines predictions from multiple machine learning algorithms to make a more accurate prediction than a single model.[5]

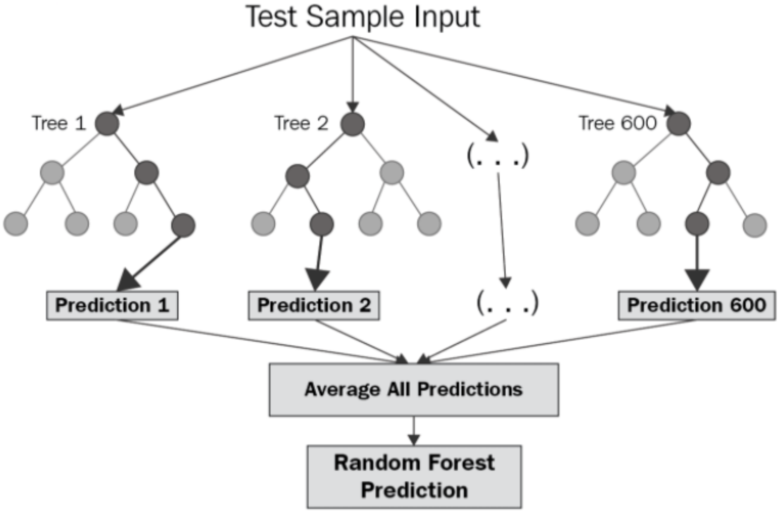


Fig 2. Random Forest Tree

The steps of the algorithm include:

- Pick at random k data points from the training set.
- Build a decision tree associated with these k data points.
- Choose the number N of trees you want to build and repeat steps 1 and 2.
- For a new data point, make each one of your N-tree trees predict the value of y for the data point in question and assign the new data point to the average across all of the predicted y values.[5]

The advantages of using this method is:

- It reduces overfitting in decision trees and helps to improve the accuracy
- It is flexible to both classification and regression problems
- It works well with both categorical and continuous values
- It automates missing values present in the data
- Normalizing of data is not required as it uses a rule-based approach.[6]

However, despite these advantages, a random forest algorithm also has some drawbacks.

- It requires much computational power as well as resources as it builds numerous trees to
- combine their outputs.

- It also requires much time for training as it combines a lot of decision trees to determine the class.Due to the ensemble of decision trees, it also suffers interpretability and fails to determine the significance of each variable.[6]

3. Decision Tree Regression Algorithm :

Decision Tree is a Supervised learning technique that can be used for both classification and Regression problems. Regression trees are needed when the response variable is numeric or continuous. Classification trees, as the name implies, are used to separate the dataset into classes belonging to the response variable. It is a tree-structured classifier, where internal nodes represent the features of a dataset, branches represent the decision rules and each leaf node represents the outcome. In a Decision tree, there are two nodes, which are the Decision Node and Leaf Node. Decision nodes are used to make any decision and have multiple branches, whereas Leaf nodes are the output of those decisions and do not contain any further branches. It is called a decision tree because, similar to a tree, it starts with the root node, which expands on further branches and constructs a tree-like structure.[7]

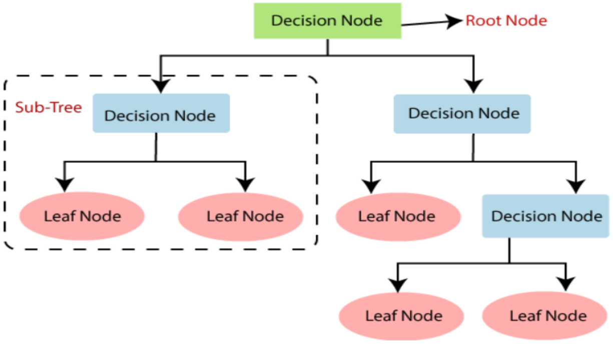
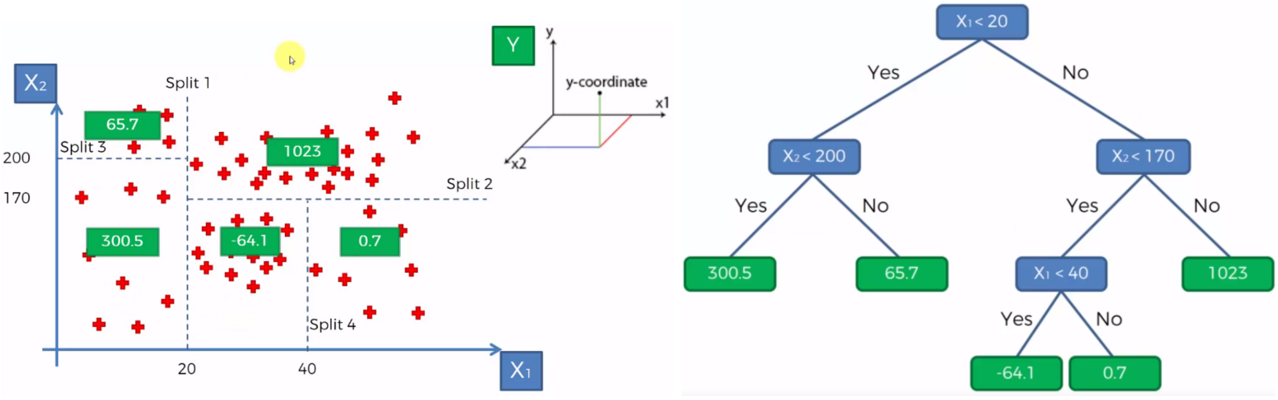


Fig 3 : Structure of a Decision Tree



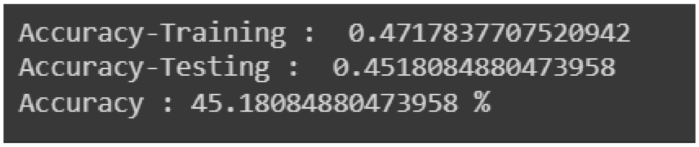
(a) (b)

Fig 4 : Decision Tree Regressions

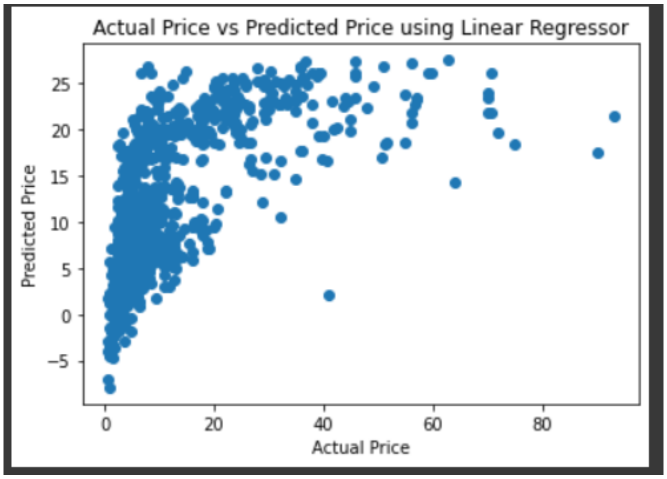
7. RESULTS AND DISCUSSION

We have used three regression models namely, the Linear Regression model, Random Forest Regressor , Decision Tree Regression Model. All these models have been validated using the train-test split method with test size being 20% of the training data.

7.1 Linear Regression



```
Accuracy-Training :  0.4717837707520942
Accuracy-Testing :  0.4518084880473958
Accuracy : 45.18084880473958 %
```



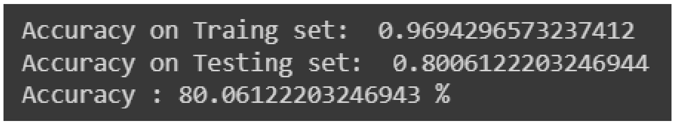
(a) (b)

Fig 5. Accuracy of Linear regression

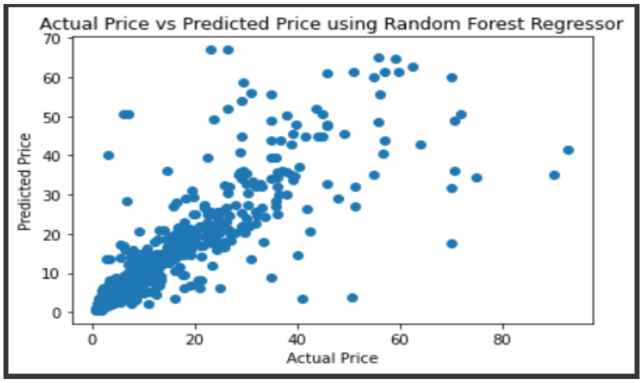
Observations -

1. We can clearly see that Linear Regression Model gives the lowest accuracy our of all the models, being at only 45.18%
2. We can observe that the graph is not very linear in nature , thus we can infer it gives a lesser accuracy for our dataset, using this model.

7.2 Random Forest Regressor



```
Accuracy on Traing set:  0.9694296573237412
Accuracy on Testing set:  0.8006122203246944
Accuracy : 80.06122203246943 %
```



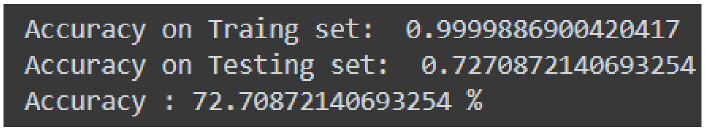
(a) (b)

Fig 6. Accuracy of Random Forest Regression

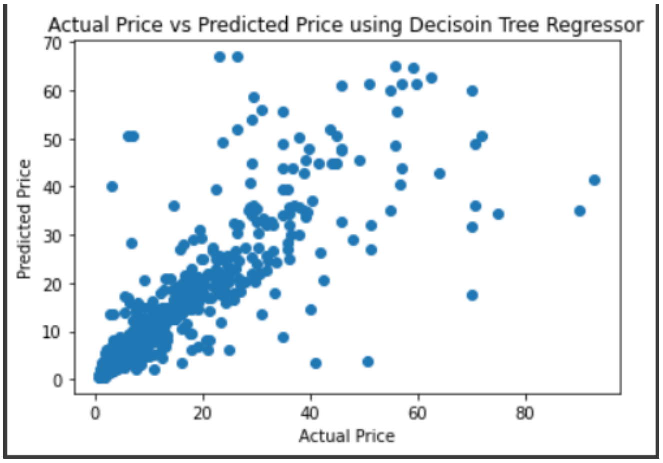
Observations -

1. Random Forest Regressor shows the maximum accuracy , scoring 80.06% accuracy rate on the dataset.
2. We can see that the values are not very scattered , implying that accuracy here is high.

7.3 Decision Tree Regression



```
Accuracy on Traing set:  0.9999886900420417
Accuracy on Testing set:  0.7270872140693254
Accuracy : 72.70872140693254 %
```



(a) (b)

Fig 7. Accuracy of Decision Tree Regression

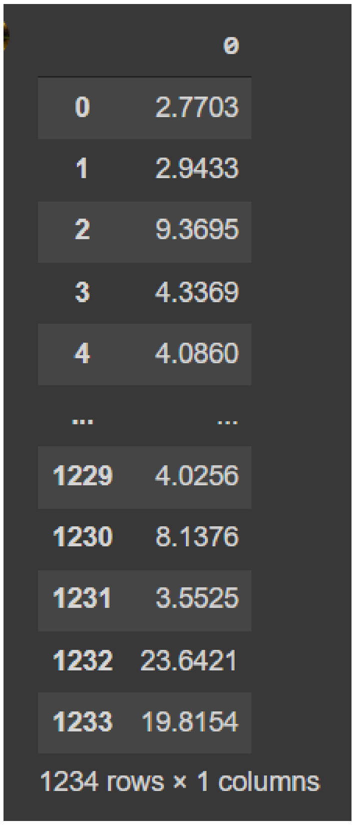
Observations-

1. We observe that the accuracy rate is in between that of the linear regressor and the random forest regressor model, having accuracy of 72.70%.
2. We see that though the plot points are not very far apart, they are relatively more scattered in comparison to the random forest regressor.

Thus, for the final prediction of price , we chose the Random Forest Regressor model, as it gives the highest accuracy when applied to our dataset. Thus, we can obtain the best results for our prediction problem using this model.

8. CONCLUSION AND FUTURE DIRECTION

From the calculated accuracy values and the plots, it can be concluded that the random forest regression provides the most accurate results. With this being known, the price of the used car is predicted in the test dataset.



```
              0
   0     2.7703
   1     2.9433
   2     9.3695
   3     4.3369
   4     4.0860
 ...        ...
1229     4.0256
1230     8.1376
1231     3.5525
1232    23.6421
1233    19.8154
1234 rows × 1 columns
```

Fig 8. Predicted price of used cars

9. LESSONS LEARNT

It was a highly educational experience for us. It helped us learn various new techniques and lessons of Machine Learning. It was also very empowering to achieve our desired results and see our efforts come to fruition .

10. REFERENCES

[1]https://economictimes.indiatimes.com/industry/auto/cars-uvs/indian-used-car-market-to-grow-12-14-in-next-few-years/articleshow/87335065.cms
[2]https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9532845
[3]https://www.kaggle.com/avikasliwal/used-cars-price-prediction/activity[4]https://www.javatpoint.com/linear-regression-in-machine-learning
[4] https://www.javatpoint.com/linear-regression-in-machine-learning
[5]https://levelup.gitconnected.com/random-forest-regression-209c0f354c84
[6]https://www.mygreatlearning.com/blog/random-forest-algorithm/#AdvantagesandDisadvantagesofRandomForest
[7]https://medium.com/pursuitnotes/decision-tree-regression-in-6-steps-with-python-1a1c5aa2ee

11. APPENDIX

11.1 Link to the chosen dataset

The dataset is taken from Kaggle website
Train dataset -
https://www.kaggle.com/avikasliwal/used-cars-price-prediction?select=train-data.csv
Test dataset -
https://www.kaggle.com/avikasliwal/used-cars-price-prediction?select=test-data.csv

11.2 Python Code Implementation

The project was implemented in the Google Colab environment and its code and implementation can be found at :

https://colab.research.google.com/drive/1nQX4IylC_1cQkg57pcR_BypGmkbplO21?usp=sharing

OR

The project can also be seen at:

https://github.com/roy-shreya/Used-Car-Price-Prediction