CAR RESALE VALUE PREDICTION

TEAM ID:PNT2022TMID34868

CAR RESALE VALUE PREDICTION

NALAIYA THIRAN PROJECT BASED LEARNING ON PROFESSIONAL READLINESS FOR INNOVATION, EMPLOYNMENT AND ENTERPRENEURSHIP

A PROJECT REPORT

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1.INTRODUCTION

1.1 Project Overview

Category: Applied Data Science

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Skills Required:

Python,Python Web Frame Works,Python For Data Visualization,Data Preprocessing Techniques,Machine Learning,IBM Cloud,IBM Watson Studio,Python-Flask

Project Description:

The huge requirement of used cars and lack of experts who can determine the correct valuation, there is an utmost need of bridging this gap between sellers and buyers. This project focuses on building a system that can accurately predict the resale value of cars based on minimal features like kms driven, year of purchase, fuel type etc. without manual or human interference and hence it remains unbiased.

In this project we have used machine learning techniques for developing Car resale value prediction systems considering different features of the car. Currently, only few features are used to predict resale value of the car. This can be extended to more features and including more input sets.

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1.2 Purpose

This project aims to provide a model that can predict a used vehicle's price using machine learning. With this model, vehicle purchasers will determine a particular used car's reasonable price given certain conditions. In this sense, people are less likely to purchase an overpriced car. Meanwhile, a reasonable price can also be beneficial for sellers. Based on the model's prediction, sellers can set prices either higher if they are not in much hurry to sell the car or lower if they need funds right away. Consequently, both sellers and buyers can save much time and effort selling or searching second-hand vehicles in the market.

Furthermore, the proposed model can depict used vehicles' depreciation over the years. It helps consumers decide which model to purchase should they want to sell it sometime in the future. Moreover, car manufacturers like Mercedes-Benz, Toyota, and Honda can learn which model should be produced more if they intend to be competitive in the used cars market.

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2. LITERATURE SURVEY

2.1 Existing Problem

Used car resale market in India was marked at 24.2 billion US dollars in 2019.With difficult economic conditions, it is likely that sales of second-hand imported (reconditioned) cars and used cars will increase. In many developed countries, it is common to lease a car rather than buying it outright. After the lease period is over, the buyer has the possibility to buy the car at its residual value, i.e. its expected resale value. Thus, it is of commercial interest to sellers/financers to be able to predict the salvage value (residual value) of cars with accuracy.

some of the possible risks involved in buying a used car is:

- History of the vehicle.
- Condition of the car.(Interior, Exterior,Framing,Tyres, Engine,Mileage,)Value for money.
- Accident Repaired/Repainted Parts.
- The Dealership.
- Maintenence records:Registration Certificate,Car Insurance,Finance. etc..

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2.2 References

S.No	TITLE	PROPOSED WORK	TOOLS USED/ ALGORITHM	TECHNOLOGY	ADVANTAGES/ DISADVANTAGES
1.	**Used Car Price Prediction using Machine Learning: A Case Study**	To predict the resale price of used cars given many factors such as mileage, fuel type, fiscal power , mark , model, and the production year of the car.	Gradient boosting regressor(GBR).	Machine Learning	Advantages: ❖ Gradient Boosting Regressor outperformed other tested models and approximately reached 0.80 of R^2 score Disadvantages: ❖ The results still remain with no significance if regression assumptions are not validated.
2.	**Prediction of Resale Value of the Car Using Linear Regression Algorithm**	For accurately predicting the resale value of the vehicle based on most significant attributes that are been selected on the basis of highest correlation.	Linear Regression model	Machine Learning	Advantages: ❖ The Linear Regression model for prediction of resale value of the car is providing an accuracy of 90%. Disadvantages: ❖ Linear Regression Model is giving an error of 10%.

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3.	**Decision Support In Car Leasing: A Forecasting Model For Residual Value Estimation**	To support pricing decisions in the car leasing industry.	Support Vector Regression (SVR)	Machine Learning	Advantages: ❖ Widely automated and helps to achieve feasibility. Disadvantages: ❖ Empirical results do not warrant any conclusions regarding the methodolgy's suitability for residual value estimation tasks.
4.	**Predicting the Price of Second-hand Cars using Artificial Neural Networks**	The aim of this study is to assess whether it is possible to predict the price of second-hand cars using artificial neural networks.	Artificial Neural Networks	Machine Learning	Advantages: ❖ Four different machine learning algorithms are used to predict the price of the second-hand cars . Disadvantages: ❖ The average residual value was reasonably low

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2.3 Problem Statement Definition

Customer Problem Statement ：

A well-articulated customer problem statement allows us to find the ideal solution for the challenges our customers face. Throughout the process, you'll also be able to empathize with your customers, which helps you better understand how they perceive your product or service.

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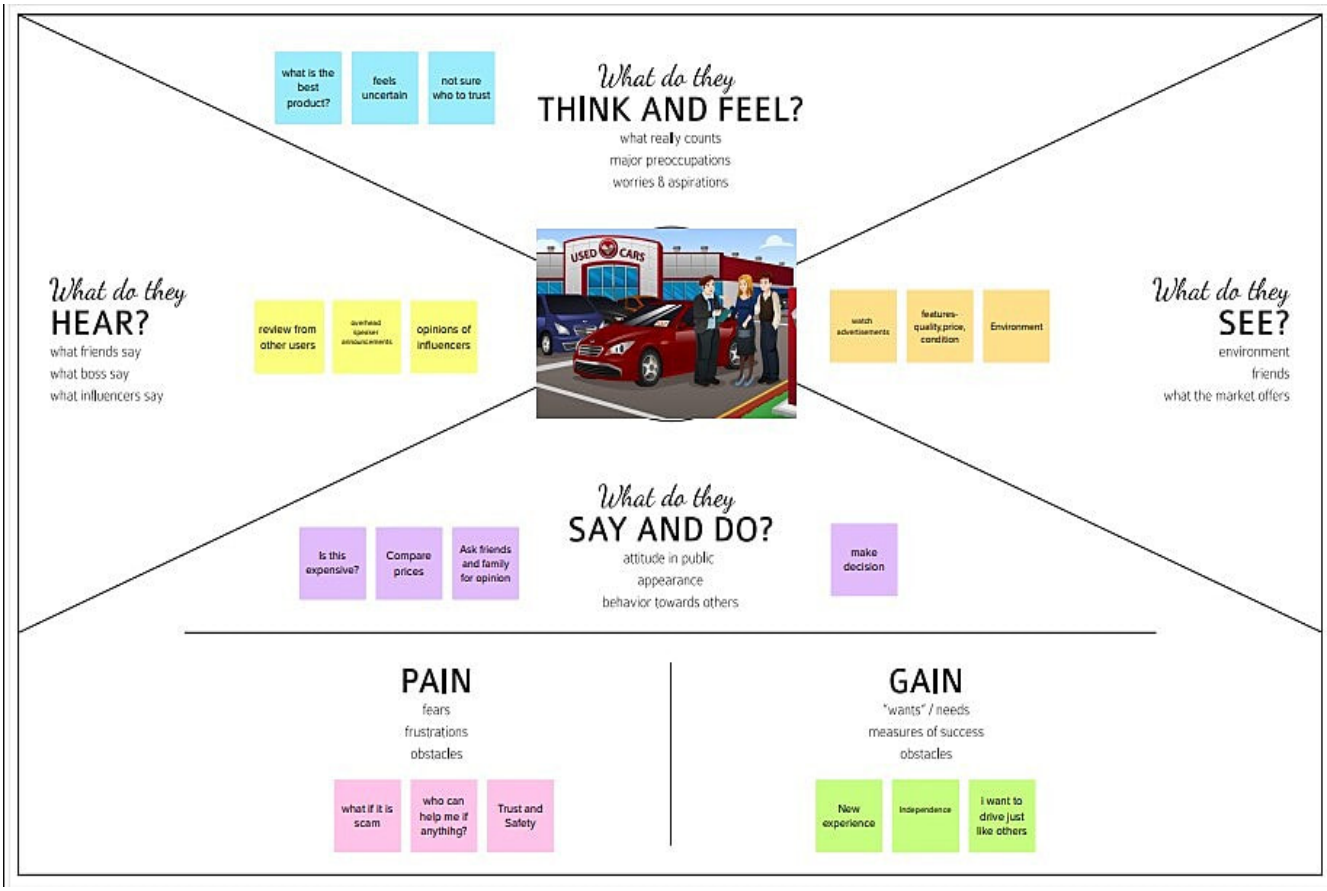
3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



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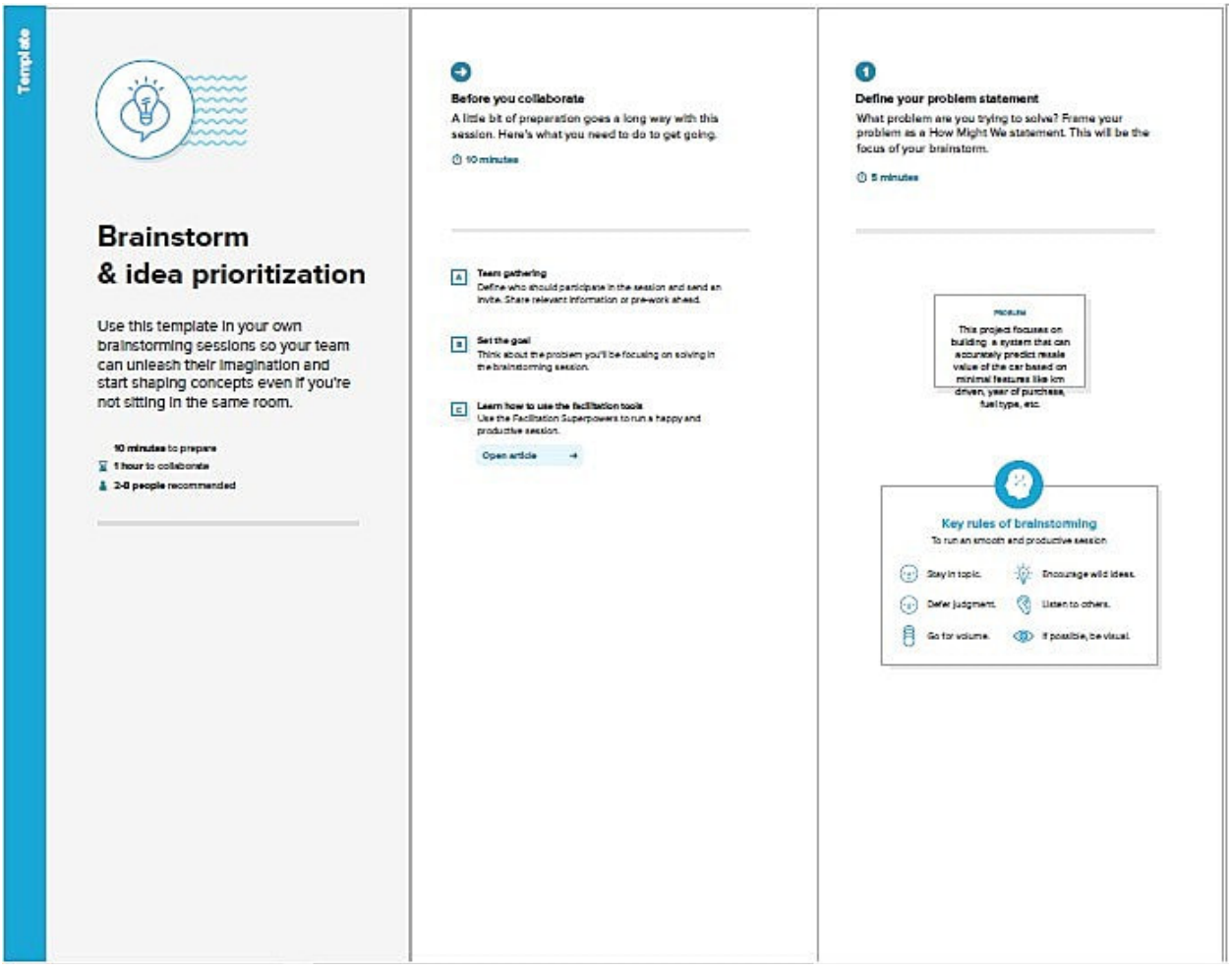
3.2 Ideation & Brainstorming

Step-1: Team Gathering, Collaboration and Select the Problem Statement



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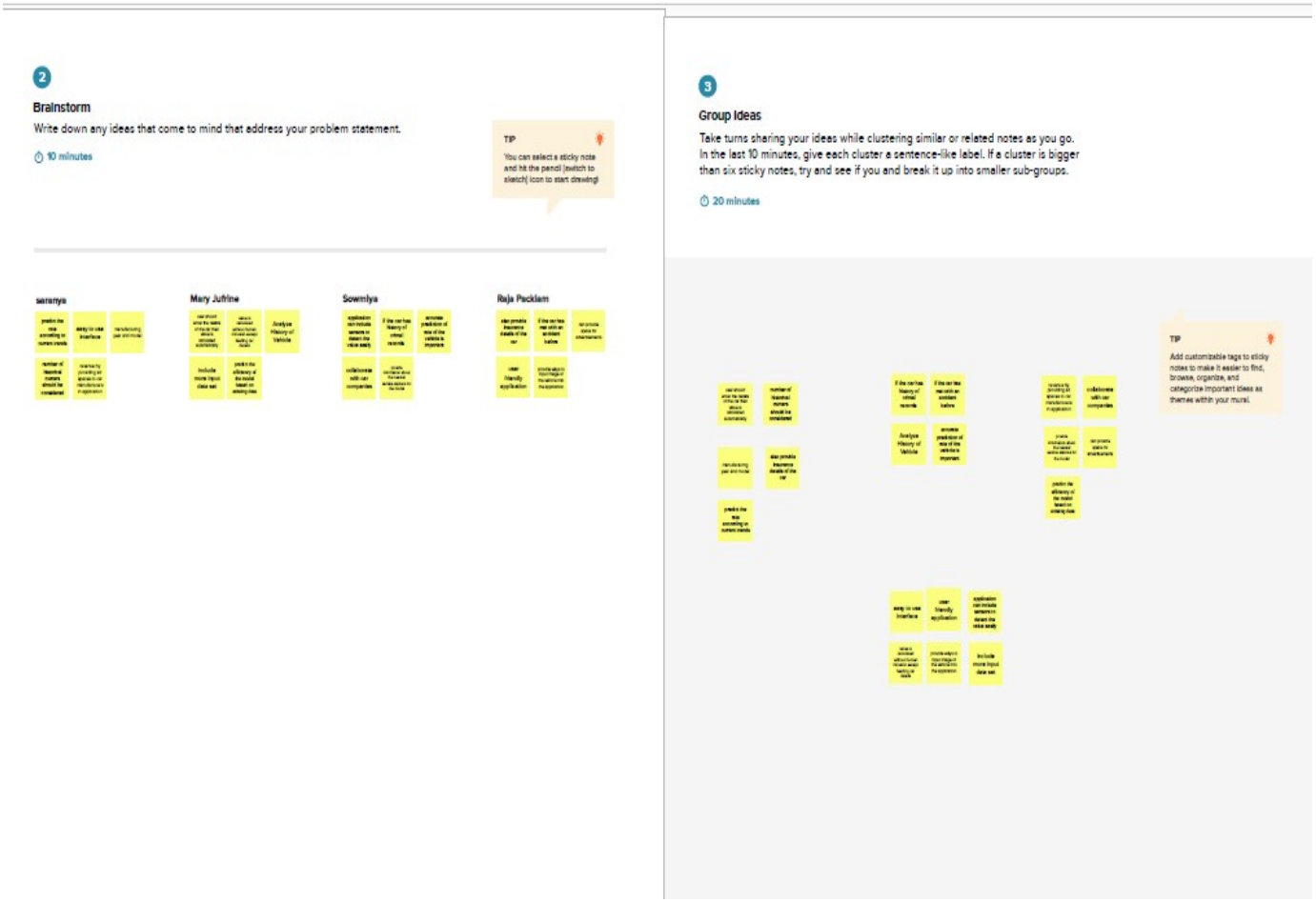
Step-2 : Brainstorm,Idea Listing and Grouping



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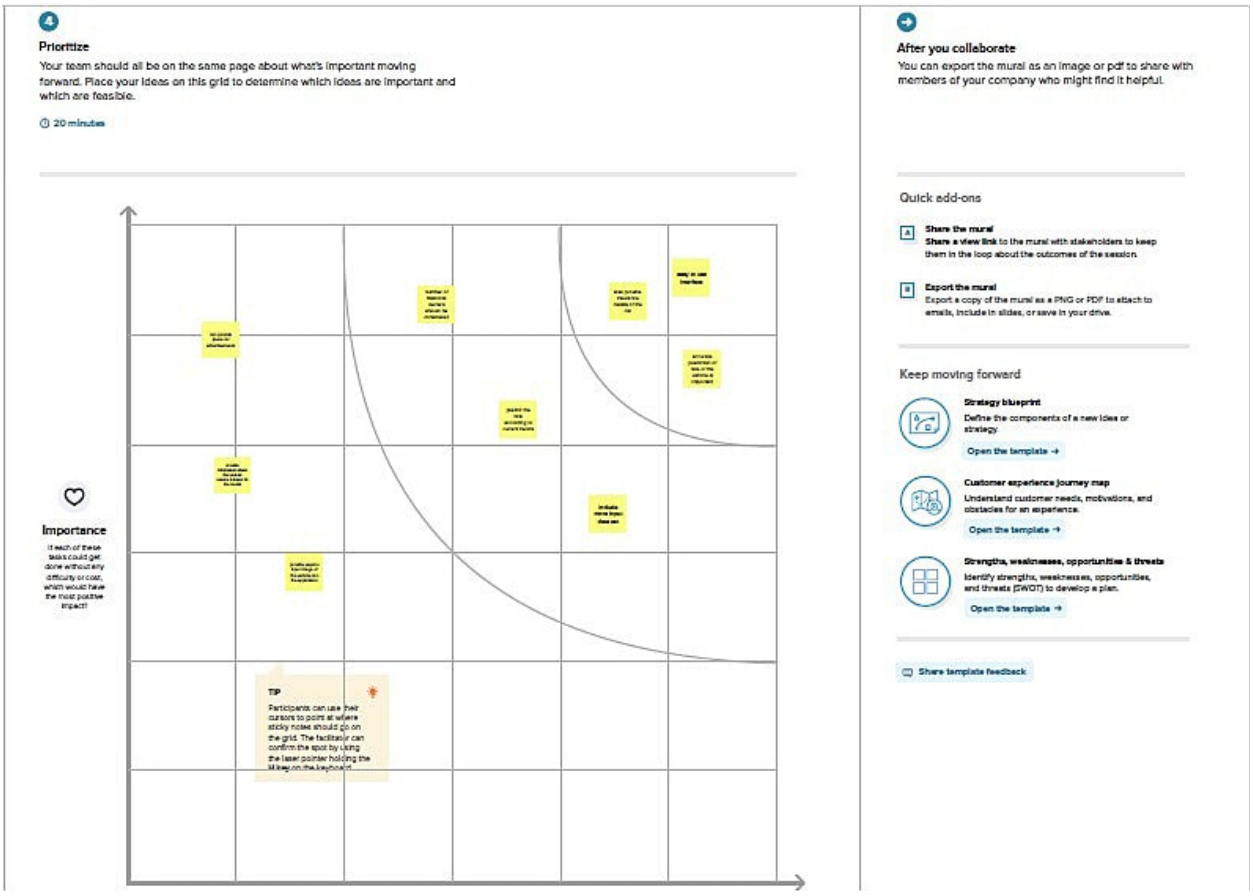
Step-3: Idea Prioritization



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3.3 Proposed Solution

S. No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	The huge requirement of used cars and lack of experts who can determine the correct valuation, there is an utmost need of bridging this gap between sellers and buyers. This project focuses on building a system that can accurately predict the resale value of cars based on minimal features like kms driven, year of purchase, fuel type etc. without manual or human interference and hence it remains unbiased. In this project we have used machine learning techniques for developing Car resale value prediction systems considering different features of the car. Currently, only few features are used to predict resale value of the car. This can be extended to more features and including more input sets.
2.	Idea / Solution description	There are two main goals to achieve in this data science project: First to estimate the price of used cars by taking into account a set of features, based on historical data, second to get a better understanding on the most relevant features that help determine the price of a used vehicle. The accurate prediction can be achieved by providing the various details of the vehicles such as the specifications which includes the model, the year of making, fuel type and also the other details such as the number of kilometres the car has run, the average mileage of the vehicle, the timeline of the car usage etc. Along with the deep learning algorithm used by the application based on the historical data fed into the system, the application will be able to predict the average price to which the car can be sold in a more accurate manner by feeding more number of data sets .Finally the selling price will be calculated and dispayed to the user. This application can be useful for both kinds of people who wish to sell their vehicles and also those who are willing to buy the vehicle to predict the accurate price.
3.	Novelty / Uniqueness	The application can include the feature of displaying the nearest car service stations relevant to the model of the car which is specified by the user , to the current location.

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4.	Social Impact / Customer Satisfaction	This application can impact the society greatly because the users can know the resale value of the vehicles without much effort only to feed the system with the basic information about their cars. Hence a buyer can be prevented from fraudulent practices and a person who wishes to sell their car can know the full value of their vehicle based on the existing selling values of similar models of cars in the market.
5.	Business Model (Revenue Model)	The changing lifestyle is encouraging people to gradually move from two-wheeler to four-wheeler and from four-wheeler to latest car models. The overall lifecycle of this scenario is giving a huge push to the user car market and ensuring promising opportunities to the companies engaged in car selling and buying services. However, the advent of technology has changed the shopping trends and needs of the customers. The increasing usage of mobile applications has changed the way people look for small or big things to buy. And buying or selling a car is not left as an exception. Certified firms or companies that deal in the used car buy and sell services have already recognised the changing market trends and have taken the initiative to set up their own car buy and sell application that directly connects buyers to sellers.
6.	Scalability of the Solution	In the automotive industry, machine learning is the most often associated with product innovation . More than 78% of automotive companies invest in Machine Learning to regularly improve their user experience. Hence this solution is scalable for further enhancements enough to fit all kinds of consumers.

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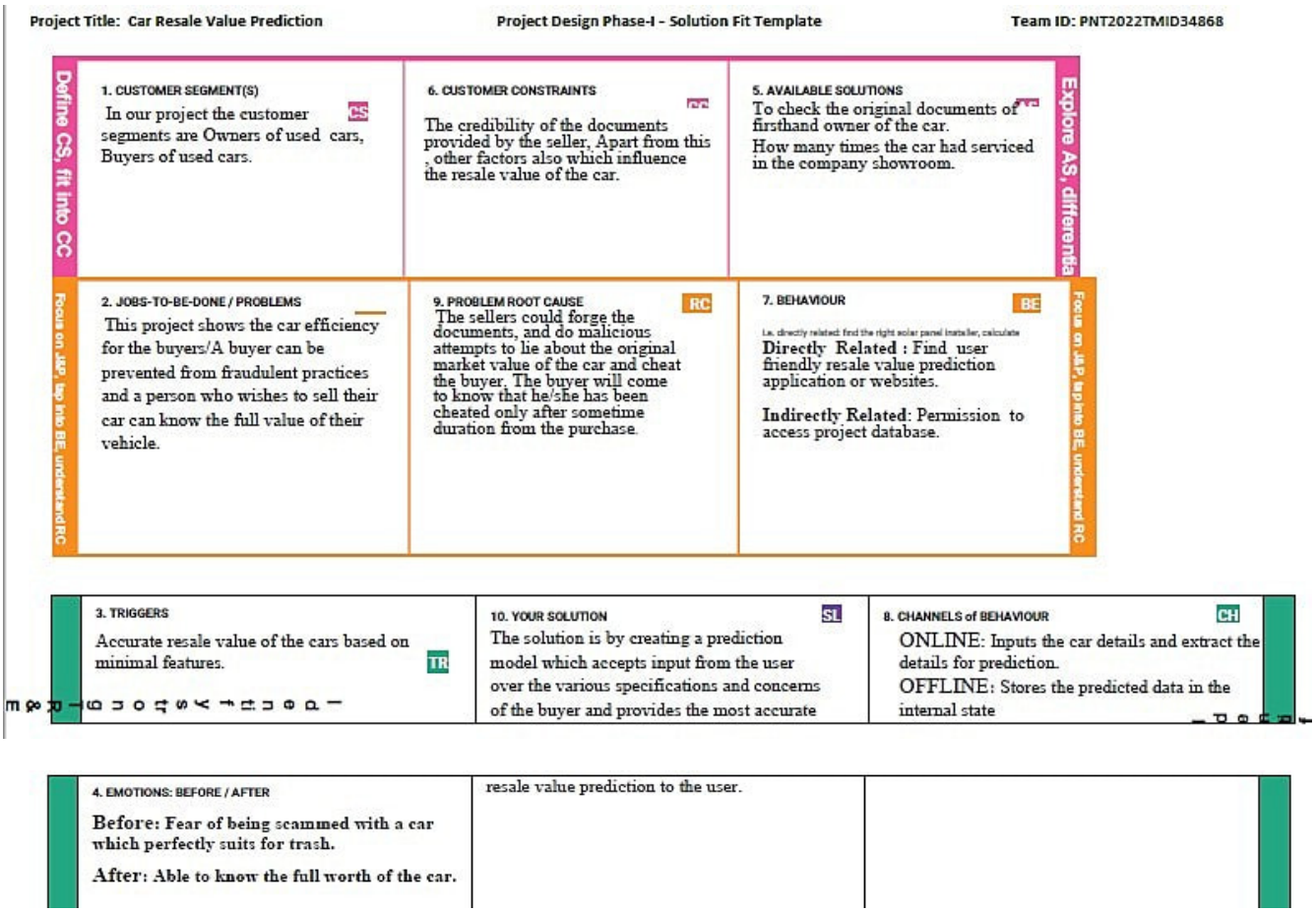
3.4 Problem Solution fit



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4.REQUIREMENT ANALYSIS

4.1 Functional requirement

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Entering details	Enter Registeration number Enter the specifications details
FR-2	Data visualization and Data preprocessing	Performs visualization via matplotlib Performs visualization via seaborn Performs preprocessing via numpy Performs preprocessing via pandas
FR-3	Implementing Machine Learning algorithms	Implementing Regression algorithms
FR-4	Evaluate prediction	Evaluate the dataset details with the model which has already builded

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4.2 Non-Functional requirements

Non-functional Requirements:

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The System is used for detecting the car price accurately based on the details collected from the user. By Implementing lasso regression, linear regression and ridge regression algorithms to the collected details and predict the price of second hand car
NFR-2	**Security**	This System doesn't share any details of the customer with third persons . Even though the System does not save the details of the customer who check their car resale price.
NFR-3	**Reliability**	The reliability of the system would be really good. Probability of giving inaccurate price is very low. As the system is working based on the machine learning algorithm, it would easily predict and give the correct price.
NFR-4	**Performance**	The performance would be good because it is deployed in cloud environment. The collected details from the user would be processed and executed within a second using the machine learning algorithm.
NFR-5	**Availability**	The availability of the System is based on the cloud infrastructure environment. There will be a high availability of software until the cloud environment facing any issues.
NFR-6	**Scalability**	This System is a Saas application. So, it is highly scalable, allowing business to access and services as they grow.

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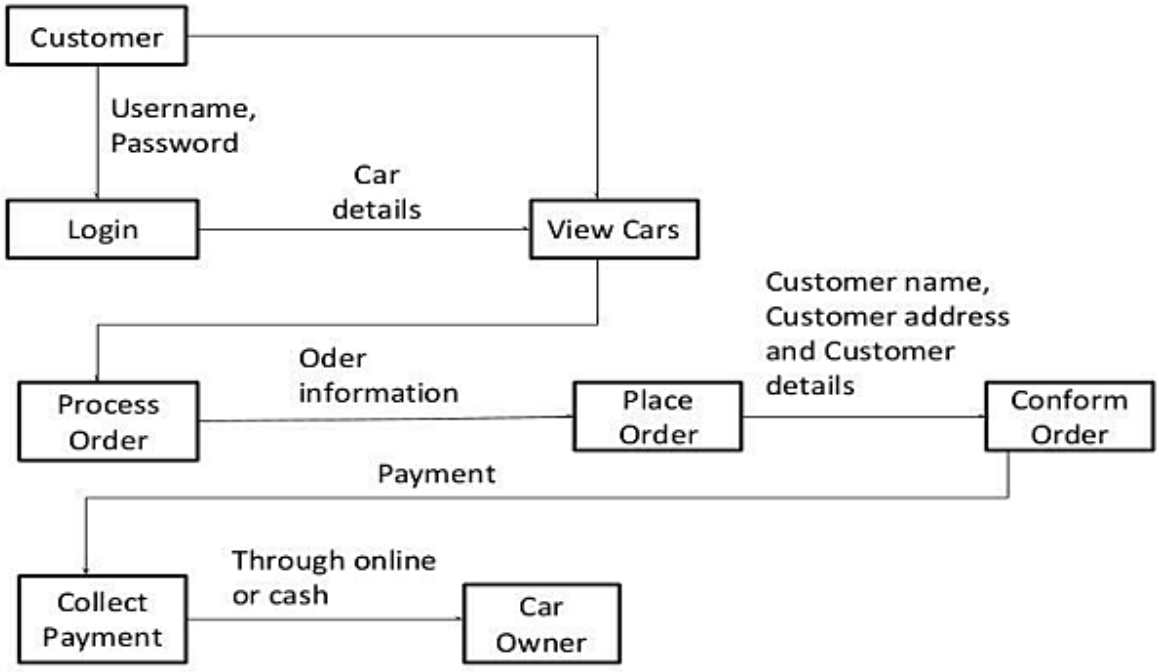
5.PROJECT DESIGN

5.1 Data Flow Diagrams



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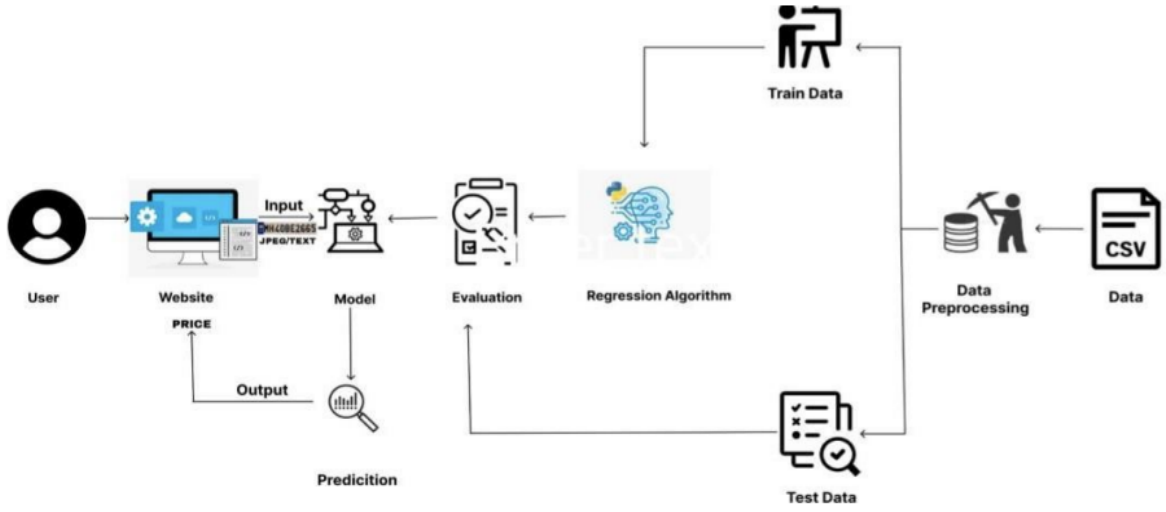
5.2 Solution & Technical Architecture

Technical Architecture:



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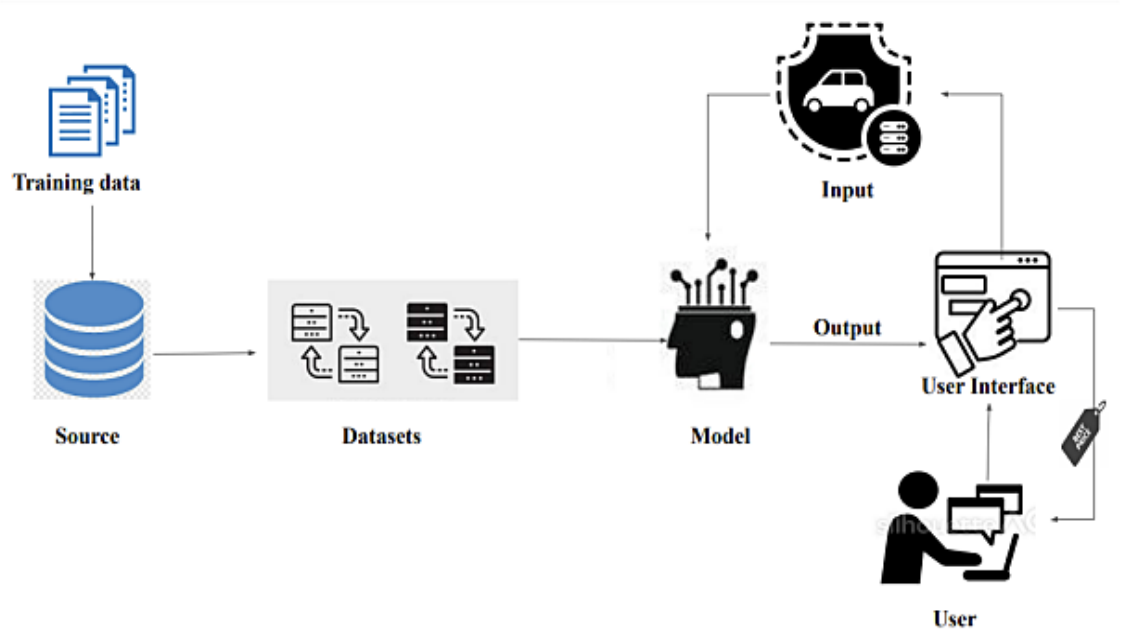
Solution Architecture Diagram:



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5.3 User Stories

User Stories

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (web user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
Customer (web user)	Confirmation	USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-3
Customer (web user)	Registration	USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-3
Customer (web user)	Registration	USN-4	As a user, I can register for the application through Gmail	I can register and access the dashboard through my Gmail Id	Medium	Sprint-1
Customer (web user)	Login	USN-5	As a user, I can log into the application by entering email & password	I can login to the application by providing my credentials.	High	Sprint-2
Customer (web user)	Dashboard	USN-6	After logging into the application I can view different fields for user entry.	I can fill in the details in the respective fields.	High	Sprint-1
Administrator	Login	USN-7	As an admin I can login using username and password.	I can access my account to view my dashboard.	High	Sprint-3
Administrator	Training the model	USN-8	As an admin I can train the prediction model through various datasets	I can train the prediction model.	High	Sprint-2
Administrator	Providing user friendly Interface	USN-9	As an admin I can provide specific labels for specific fields.	The user will be able to enter relevant data in each field.	High	Sprint-1
Customer (Web user)	View options	USN-10	As a customer I can view the different options of cars.	I can know the various options of used cars whose values can be predicted.	Medium	Sprint-2
Customer (Web user)	Data Entry	USN-11	As a user I can provide data in the relevant fields	The data can be processed so that the prediction is displayed correctly.	High	Sprint-3

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6.PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	User Entering details	USN-1	Enter Registeration number	10	High	Saranya,Mary Jufrine.
Sprint-1		USN-2	Enter the specification details	10	High	Sowmiya Raja Packiam.
Sprint-2	Data visualization and Data preprocessing	USN-3	The main goal of data visualization is to make it easier to identify patterns, trends and outliers in large data sets. • Performs visualization via matplotlib • Performs visualization via seaborn	10	High	Mary Jufrine,Raja Packiam.
Sprint-2		USN-4	Preprocessing increases the accuracy and efficiency of a machine learning model. • Performs preprocessing via numpy • Performs preprocessing via pandas	10	High	Mary Jufrine,Sowmiya.
Sprint-3	Implementing Machine Learning algorithms.	USN-5	In Machine Learning ,we use various kinds of algorithms to allow machines to learn the relationships within the data provided.	10	High	Saranya,Sowmiya
Sprint-3		USN-6	Implementing Regression algorithms which is a machine Learning technique where the model predicts the output as a continuous numerical value.			Raja Packiam,Mary Jufrine.
Sprint-4	Evaluate prediction	USN-7	Evaluate the dataset details with the model which has already builded.	20	High	Saranya,Raja Packiam

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Project Tracker, Velocity & Burndown Chart: (4 Marks)

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	10	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	10	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	10	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

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6.2 Sprint Delivery Schedule

Milestone Template:

Sprint	Sprint Topic	Start Date	Expected Delivery
Sprint 1	User Entering details	24-10-2022	29-10-2022
Sprint 2	Data visualization and Data preprocessing	31-10-2022	05-11-2022
Sprint 3	Implementing Machine Learning Algorithms	07-11-2022	12-11-2022
Sprint 4	Evaluate prediction	14-11-2022	19-11-2022

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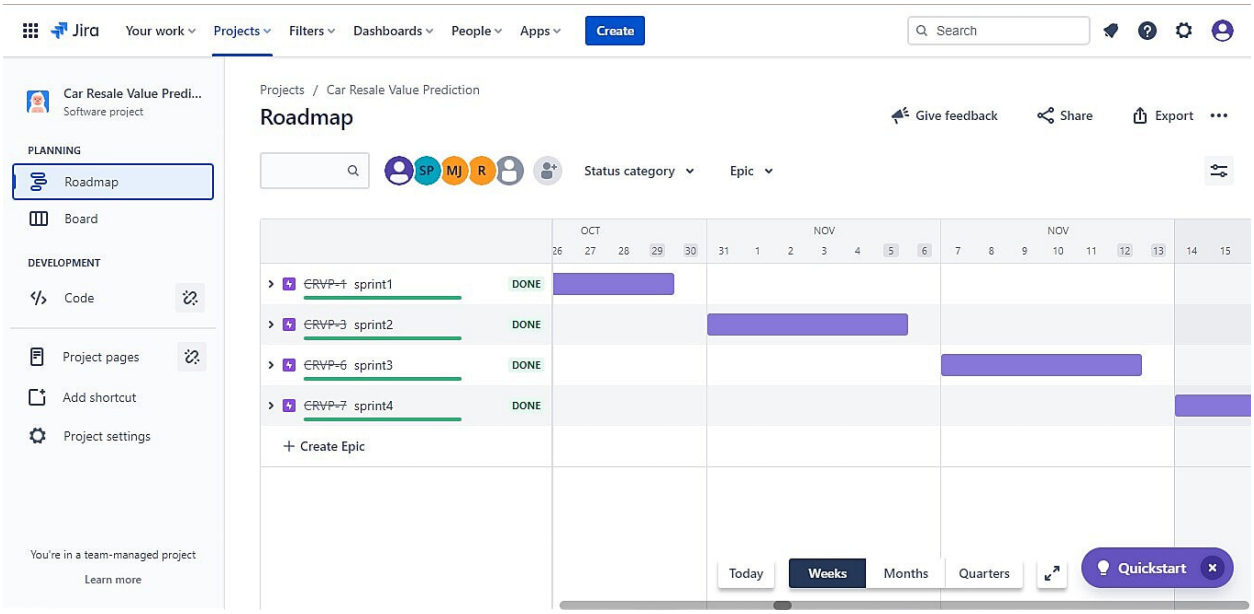
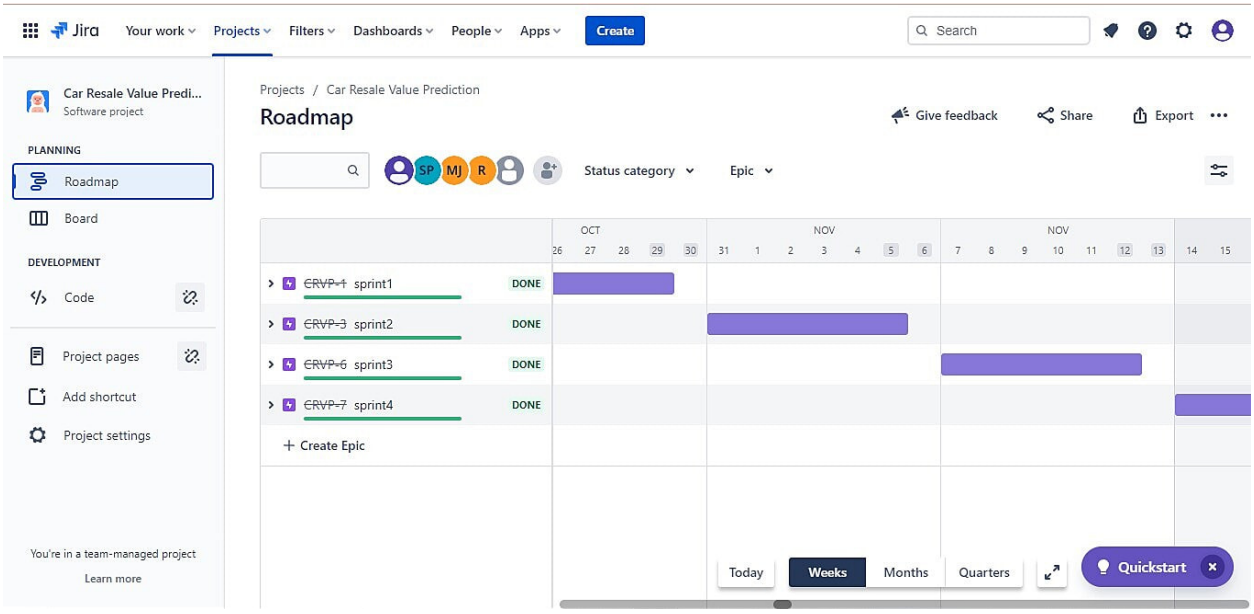
6.3 Reports from JIRA





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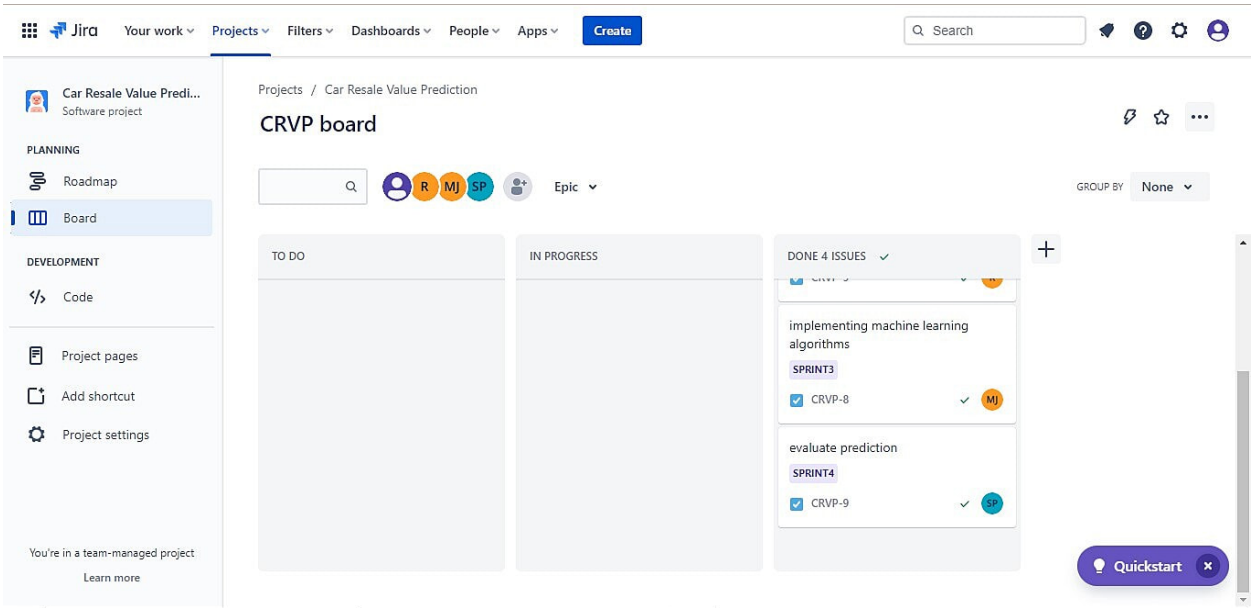

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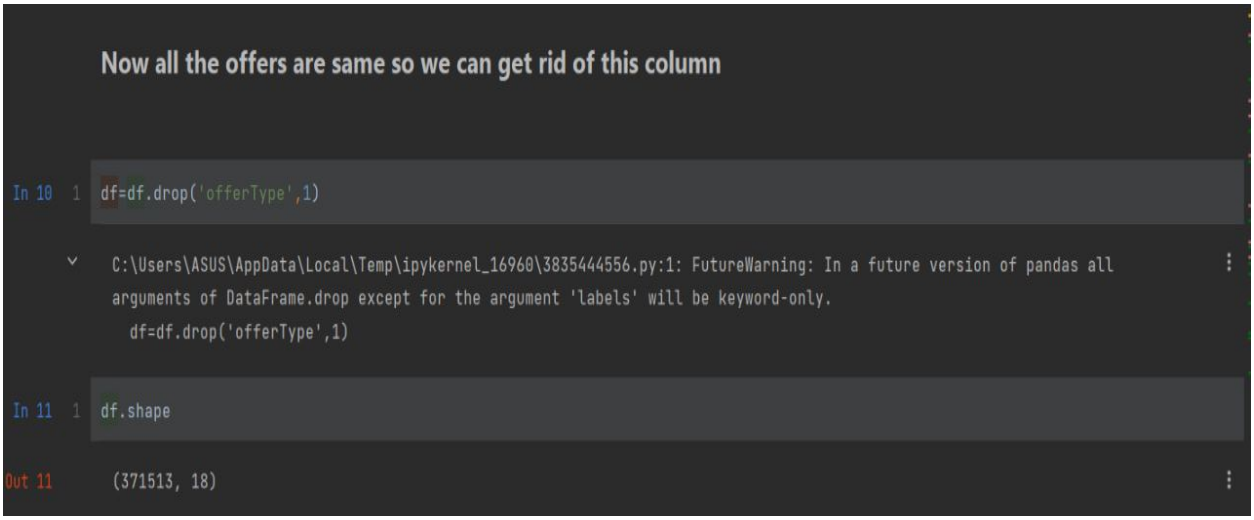
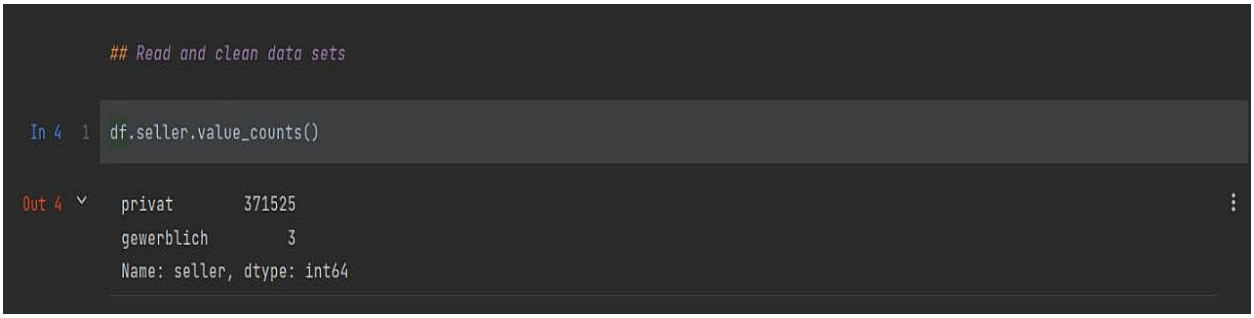
7. CODING AND SOLUTIONING

7.1 Feature 1

CODE:
MODEL BUILDING:





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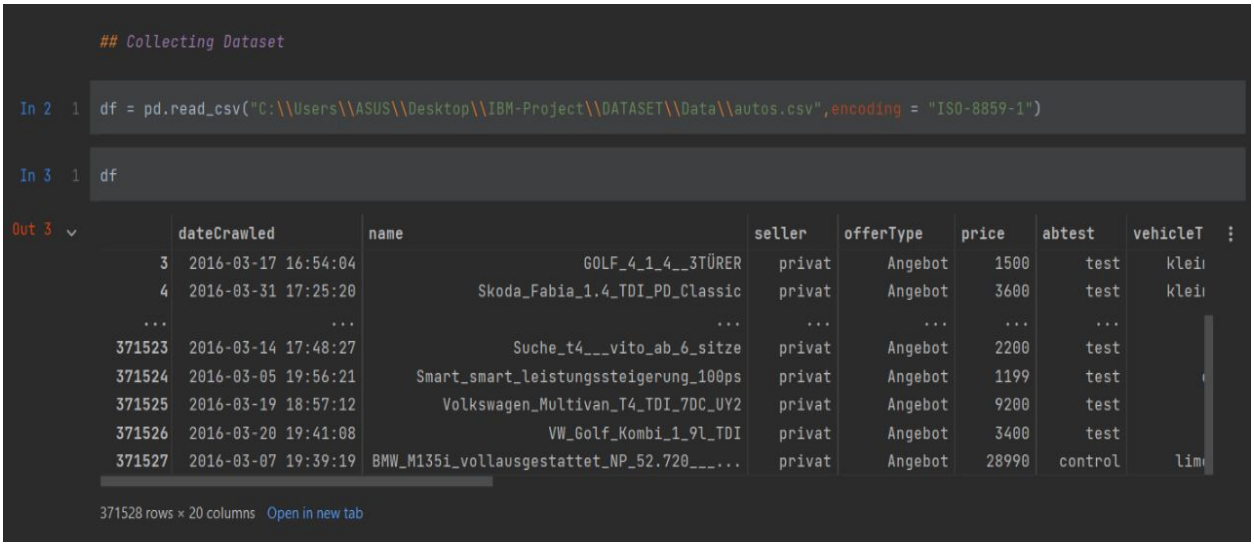


```
## Collecting Dataset
```

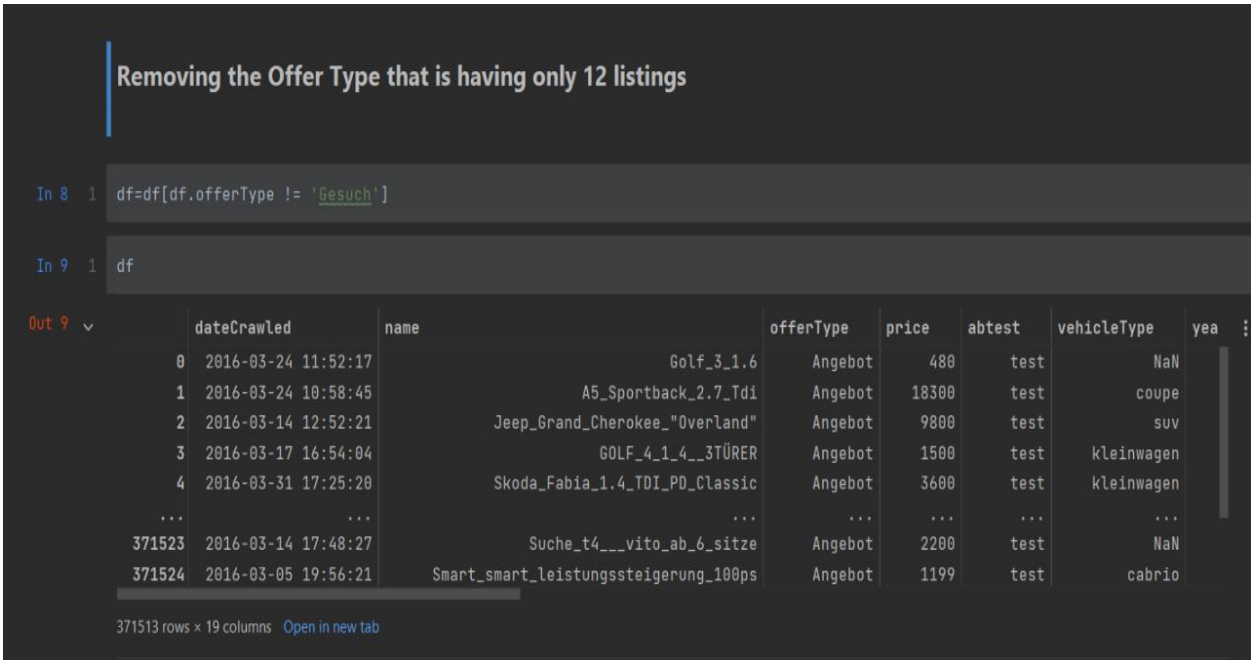
```
In 2  1  df = pd.read_csv("C:\\Users\\ASUS\\Desktop\\IBM-Project\\DATASET\\Data\\autos.csv",encoding = "ISO-8859-1")
```

```
In 3  1  df
```

Out 3

	dateCrawled	name	seller	offerType	price	abtest	vehicleT
3	2016-03-17 16:54:04	GOLF_4_1_4__3TÜRER	privat	Angebot	1500	test	klei
4	2016-03-31 17:25:20	Skoda_Fabia_1.4_TDI_PD_Classic	privat	Angebot	3600	test	klei
...	...	...	...	...	...	...	
371523	2016-03-14 17:48:27	Suche_t4___vito_ab_6_sitze	privat	Angebot	2200	test	
371524	2016-03-05 19:56:21	Smart_smart_leistungssteigerung_100ps	privat	Angebot	1199	test	
371525	2016-03-19 18:57:12	Volkswagen_Multivan_T4_TDI_7DC_UY2	privat	Angebot	9200	test	
371526	2016-03-20 19:41:08	VW_Golf_Kombi_1_9l_TDI	privat	Angebot	3400	test	
371527	2016-03-07 19:39:19	BMW_M135i_vollausgestattet_NP_52.720___...	privat	Angebot	28990	control	lim

371528 rows × 20 columns Open in new tab



Removing the Offer Type that is having only 12 listings

```
In 8  1  df=df[df.offerType != 'Gesuch']
```

```
In 9  1  df
```

Out 9

	dateCrawled	name	offerType	price	abtest	vehicleType	yea
0	2016-03-24 11:52:17	Golf_3_1.6	Angebot	480	test	NaN	
1	2016-03-24 10:58:45	A5_Sportback_2.7_Tdi	Angebot	18300	test	coupe	
2	2016-03-14 12:52:21	Jeep_Grand_Cherokee_"Overland"	Angebot	9800	test	suv	
3	2016-03-17 16:54:04	GOLF_4_1_4__3TÜRER	Angebot	1500	test	kleinwagen	
4	2016-03-31 17:25:20	Skoda_Fabia_1.4_TDI_PD_Classic	Angebot	3600	test	kleinwagen	
...	...	...	...	...	...	...	
371523	2016-03-14 17:48:27	Suche_t4___vito_ab_6_sitze	Angebot	2200	test	NaN	
371524	2016-03-05 19:56:21	Smart_smart_leistungssteigerung_100ps	Angebot	1199	test	cabrio	

371513 rows × 19 columns Open in new tab

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Now all the sellers are same so we can get rid of this column

```
In 6  1  df=df.drop('seller',1)
```

```
C:\Users\ASUS\AppData\Local\Temp\ipykernel_16960\2800324788.py:1: FutureWarning: In a future version of pandas all
arguments of DataFrame.drop except for the argument 'labels' will be keyword-only.
  df=df.drop('seller',1)
```

```
In 7  1  df.offerType.value_counts()
```

```
Out 7  Angebot    371513
Gesuch         12
Name: offerType, dtype: int64
```

OUTPUT:

Dropping unnecessary columns

```
In 18  1  df.drop(['name', 'abtest', 'dateCrawled','nrOfPictures', 'lastSeen', 'postalCode', 'dateCreated'], axis='columns', inplace=True)
```

```
In 19  1  df
```

Out 19

	price	vehicleType	yearOfRegistration	gearbox	powerPS	model	kilometer	monthOfRegistration
1	18300	coupe	2011	manuell	190	NaN	125000	5
2	9800	suv	2004	automatik	163	grand	125000	8
3	1500	kleinwagen	2001	manuell	75	golf	150000	6
4	3600	kleinwagen	2008	manuell	69	fabia	90000	7
5	650	limousine	1995	manuell	102	3er	150000	10
6	2200	cabrio	2004	manuell	109	2_reihe	150000	8
8	14500	bus	2014	manuell	125	c_max	30000	8
9	999	kleinwagen	1998	manuell	101	golf	150000	0

309166 rows × 11 columns Open in new tab

```
In 20  1  new_df = df.copy()
```

```
In 21  1  new_df.columns
```

```
Out 21  Index(['price', 'vehicleType', 'yearOfRegistration', 'gearbox', 'powerPS',
       'model', 'kilometer', 'monthOfRegistration', 'fuelType', 'brand',
       'notRepairedDamage'],
      dtype='object')
```

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PYTHON FLASK:

Metrics Evaluation

```
mae = mean_absolute_error(Y_test, y_pred)
mse = mean_squared_error(Y_test, y_pred)
rmse = np.sqrt(mse)
rmsle = np.log(rmse)
n,k = X_train.shape
r2=r2_score(Y_test,y_pred)
adj_r2= 1 - ((1-r2)*(n-1)/(n-k-1))
print(mae,mse,rmse,rmsle,r2,adj_r2)
```

```
1624.2919043250051 10729873.982609846 3275.648635401826 8.094271185069976 0.8454307332421266 0.8454228062472008
```

R^2 score is an indicator of accuracy of Regression Models, and the accuracy is measured as close to 1 of this value. Therefore, as seen Random Forest Regression is better than Multiple Linear Regression Model on this dataset when comparing their R^2 scores.

Metrics Evaluation

In 40
```
mae = mean_absolute_error(Y_test, y_pred_mlr)
mse = mean_squared_error(Y_test, y_pred_mlr)
rmse = np.sqrt(mse)
rmsle = np.log(rmse)
n,k = X_train.shape
r2=r2_score(Y_test,y_pred_mlr)
adj_r2= 1 - ((1-r2)*(n-1)/(n-k-1))
print(mae,mse,rmse,rmsle,r2,adj_r2)
```

```
3137.8941464372756 29434090.807211045 5425.319419832444 8.598832055907133 0.5759870208048181 0.5759652755458475
```

In 41
```
regressor = RandomForestRegressor(n_estimators =1000,max_depth=10,random_state=34)
```

In 42
```
regressor.fit(X_train,np.ravel(Y_train,order='C'))
```

Out 42

RandomForestRegressor

```
RandomForestRegressor(max_depth=10, n_estimators=1000, random_state=34)
```

In 43
```
y_pred = regressor.predict(X_test)
```

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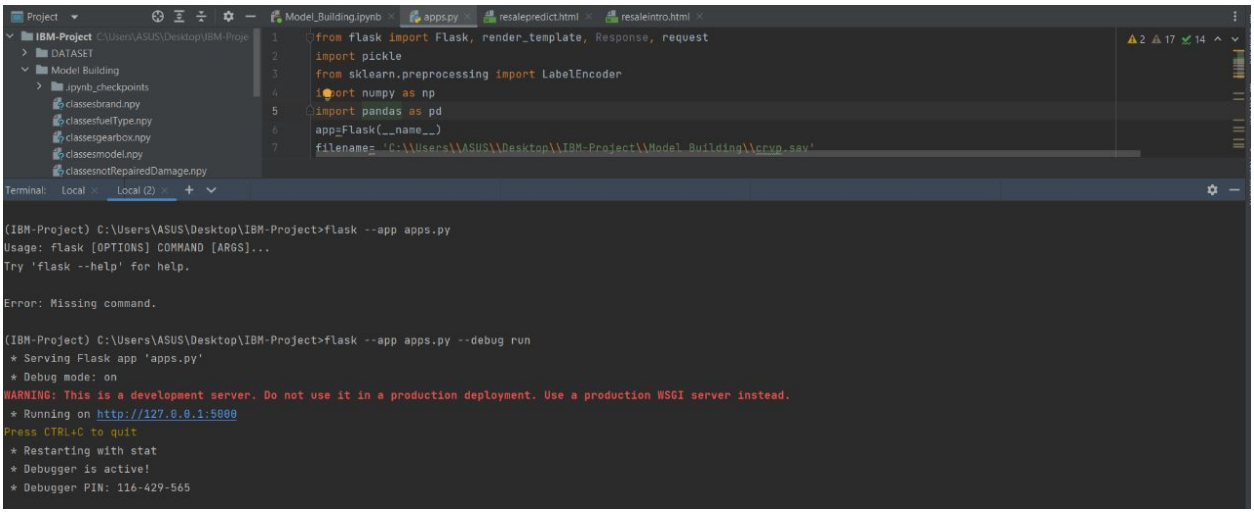
OUTPUT:



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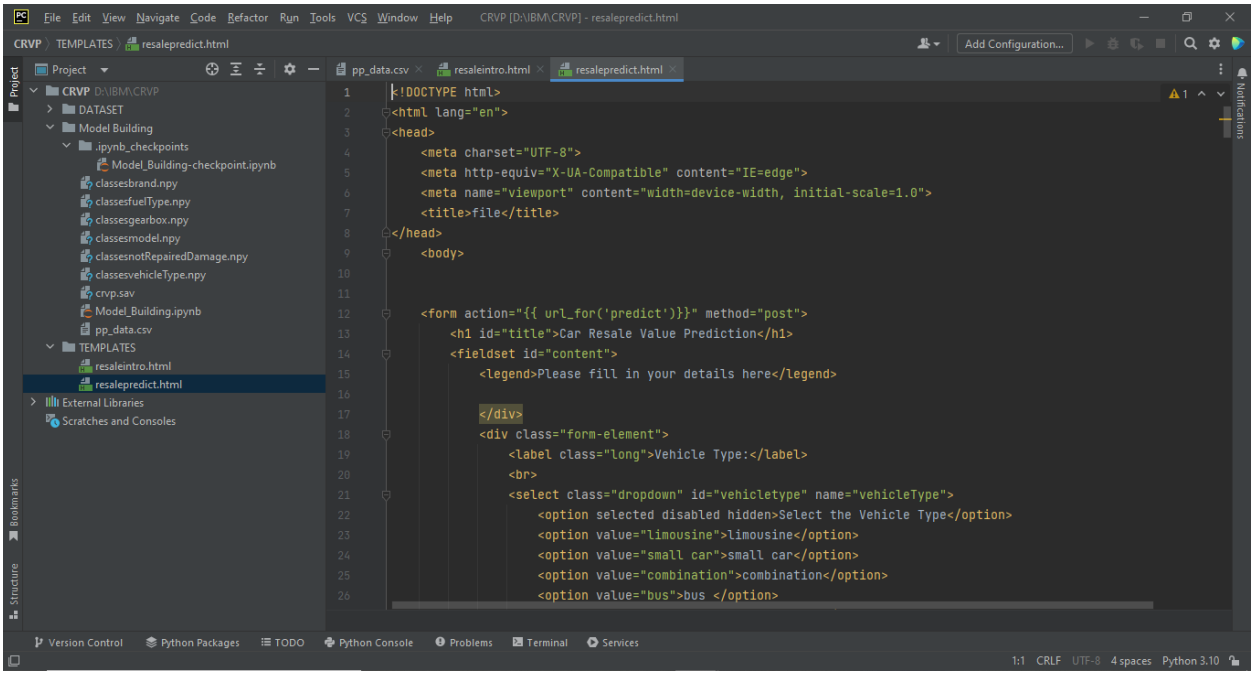
7.2 FEATURE 2

resalepredict.html



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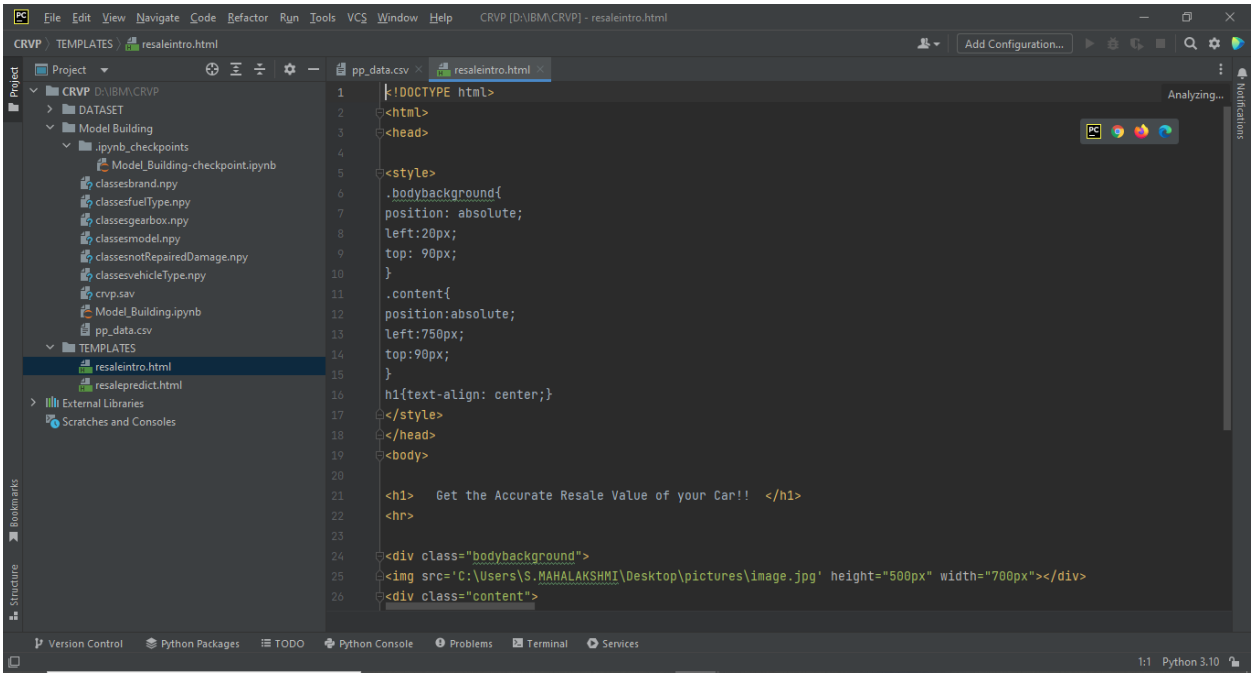
resaleintro.html



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8.TESTING:

8.1 Test Case

Test case ID	Feature Type	Component	Test Scenario	Expected Result	Actual Result	Status
HP_TC_001	Functional	Home Page	Check if the user can enter values in respective fields.	The user should be able to enter values.	Workingas expected	PASS
HP_TC_002	Functional	Home Page	Check if user can enter invalid inputs	The user is not allowed to enter invalid inputs	Unable to view the result	PASS
HP_TC_003	Functional	Home Page	Check if the output is displayed in the bottom of the page once the check button is clicked	The page should be updated with the predicted resale value at the bottom of the page	Working as expected	PASS
BE_TC_001	Functional	Backend	Check if all the routes are working properly	All the routes should properly work	Working as expected	PASS

M_TC_001	Functional	Model	Check if the model can handle missing values	The model should Not be able to predict with missing values	The model is not built to handle Missing data	FAIL
HP_TC_004	Functional	Home page	Check if the model can handle unseen year of purchase	model may get confused since that data is quite new and unseen to model	Unable to display the result	FAIL
M_TC_002	Functional	Model	Check if the model can handle Various datasets	The model should be able to accept various datasets by providing different input sets	Working as expected	PASS

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8.2 User Acceptance Test:

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Total
By Design	1	0	1	0	2
Duplicate	0	0	0	0	0
External	0	0	2	0	2
Fixed	4	1	0	1	6
Not Reproduced	0	0	0	1	1
Skipped	0	0	0	1	1
Won'tFix	1	0	1	0	2
Total					

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9.RESULTS:

9.1 Performance Metrics:

This project car resale value prediction analysis the used car details using machine learning. It predicts the present value of the used car prize. It predicts the value by using vehicle type, year of registration, gearbox, power ps, model, kilometer, month of registration an fuel type.It read the data from the dataset we upload. When the user enters the features of used car by selecting the options, it predicts the value by reading the dataset.

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10. ADVANTAGES AND DISADVANTAGES:

ADVANTAGES:

- The application helps to reduce human efforts.
- Helps to know the accurate price for used cars.
- Scale up business for business persons.
- Protects the privacy of the user.
- Helps to prevent fraudulent practises.
- Saves your valuable time.
- Predict the prices based on user input.
- Increased efficiency.

DISADVANTAGES:

- Customer is unable to know the exact details of car's damage.
- No prediction application is 100% reliable for every current use case

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11. CONCLUSION:

From this project we are able to predict the resale value of the car with minimum human effort effectively.While making this project, we gained a lot ofexperience of working as a team. We discovered various predicted andunpredicted problems and we enjoyed a lot solving them as a team. We adopted things like video tutorials, text tutorials, internet and learningmaterials to make our project complete.

12. FUTURE:

- In future this machine learning model may bind with various website which can provide real time data for price prediction.
- Also we may add large historical data of car price which can help to improve accuracy of the machine learning model.
- We can build an android app as user interface for interacting with user.
- For better performance, we plan to judiciously design deep learning network structures, use adaptive learning rates and train on clusters of data rather than the whole dataset.

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13. APPENDIX

Source Code Github Link:

https://github.com/IBM-EPBL/IBM-Project-30512-1660147853.git

Project Demo Link:

https://drive.google.com/file/d/1Q0Ew1NvD-XZOwbi4Qxu-Wluqi9Th8stl/view?usp=share_link