Project Report

Team ID : PNT2022TMID31242

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INTRODUCTION

1.1 Overview

This project is used to analyze vehicles based on several fields of data which are collected by various methods, these data are well analyzed by the model created in python and the result derived from it. By utilizing the results generated one can improve their performance.

1.2 Purpose

The main purpose of the project is to depict the current performance of the vehicle accurately so that the user may upgrade accordingly to achieve better performance.

1. LITERATURE SURVEY

2.1 Existing problem

Some of the existing solutions for solving this problem are:

1. **Modelling and performance analysis of a vehicle with kinetic dynamic suspension system:**

   The proposed KDS system consists of two hydraulic circuits acting on two pairs of torsional rods and levers, which can be treated as novel anti-roll bars. Hence, these anti-roll bars do not work independently, but are coupled to merely respond to particular motion modes. The results show that the KDS system considerably improves the vehicle's anti-roll ability.

2. **Improved vehicle performance using combined suspension and braking forces:**

   The specific focus of this research is the integration of active suspension components with anti-lock braking (ABS) mechanisms. Simulations of the integrated controller and an ABS system demonstrate a significant increase in performance.

2.2 References

1. **Environment Setup:** https://conda.io/projects/conda/en/latest/user-guide/tasks/manage-environments.html

2. **Handling missing values:** https://youtu.be/xkRz6R0FlQ4

3. **Splitting dataset into trainset:** https://youtu.be/-KYiefj2wuw

4. **Integrating Flask:** https://www.analyticsvidhya.com/blog/2020/04/how-to-deploy-machine-learning-model-flask/

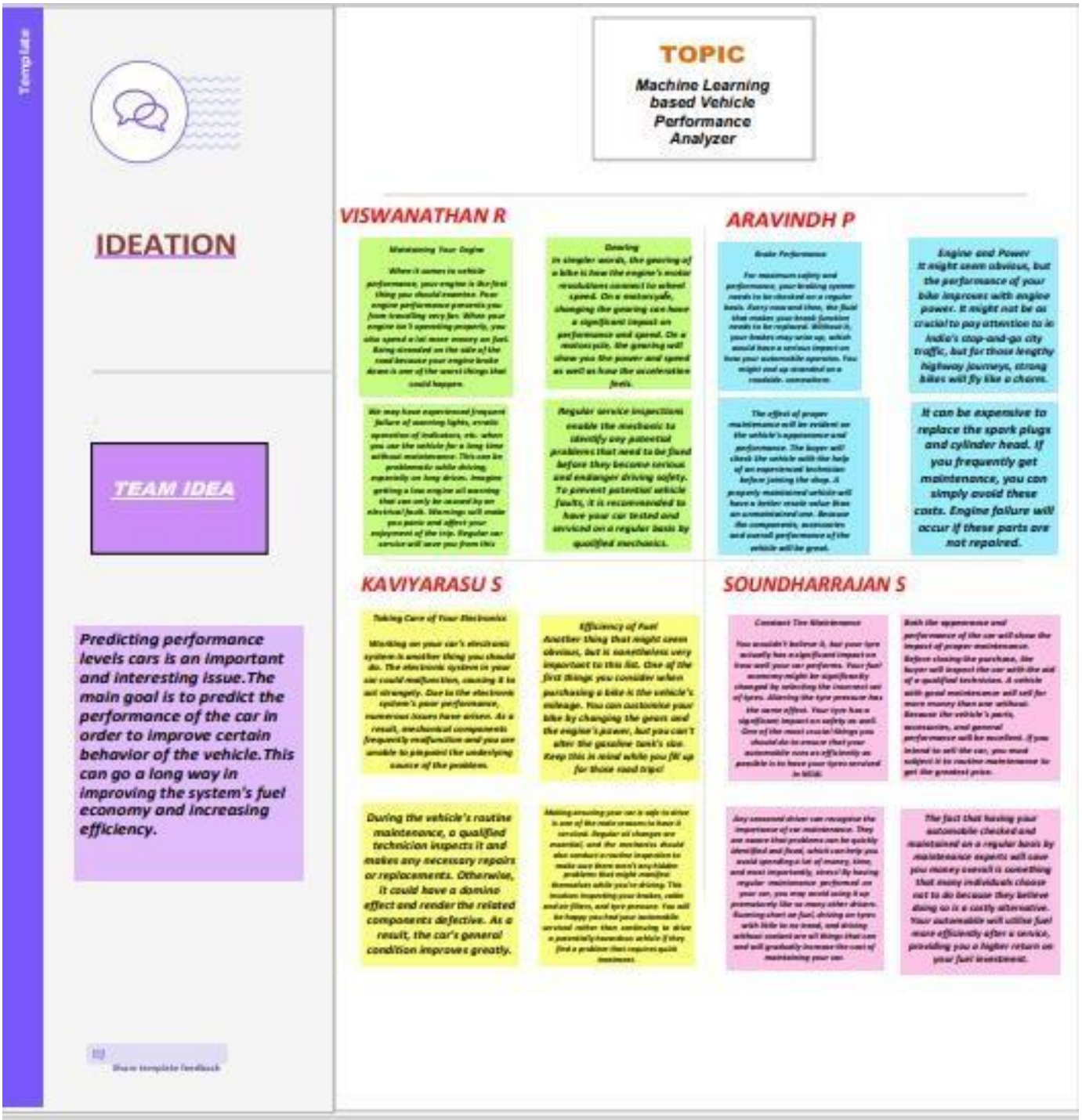
2.3 Problem Statement Definition

Predicting the performance level of cars is an important and interesting problem. The main goal is to predict the performance of thecar to improve certain behaviours of the vehicle. This can significantly help to improve the system's fuel consumption and increase efficiency.

The performance analysis of the car is based on the engine type, no of engine cylinders, fuel type, horsepower, etc. These are the factors on which the health of the car can be predicted. It is an ongoing process ofobtaining, researching, analysing, and recording health based on the above three factors. The performance objectives like mileage, dependability, flexibility and cost can be grouped together to play a vitalrole in the prediction engine and engine management system. This approach is a very important step towards understanding the vehicle's performance.

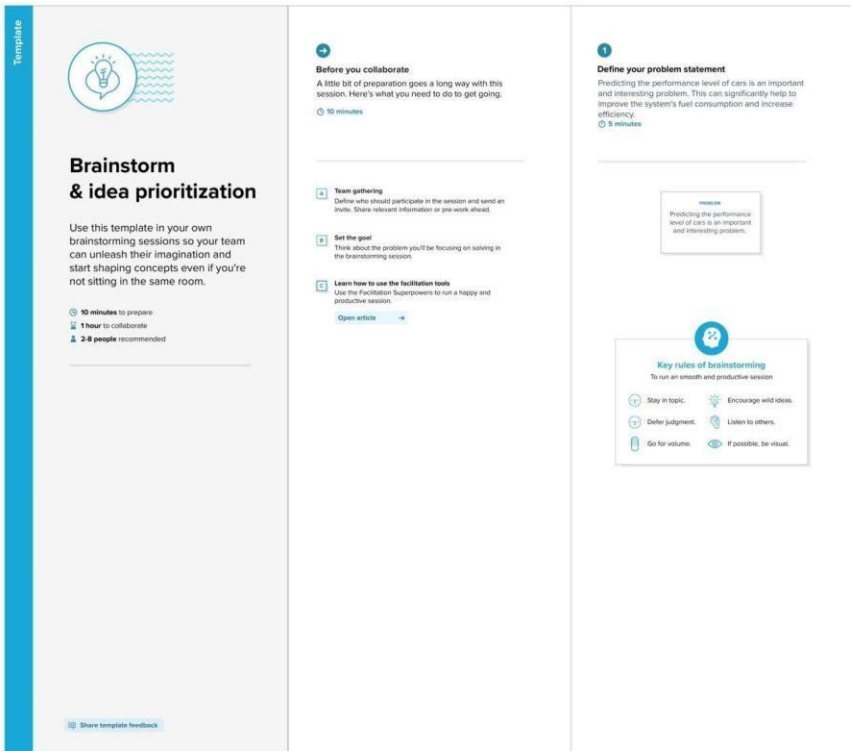
3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

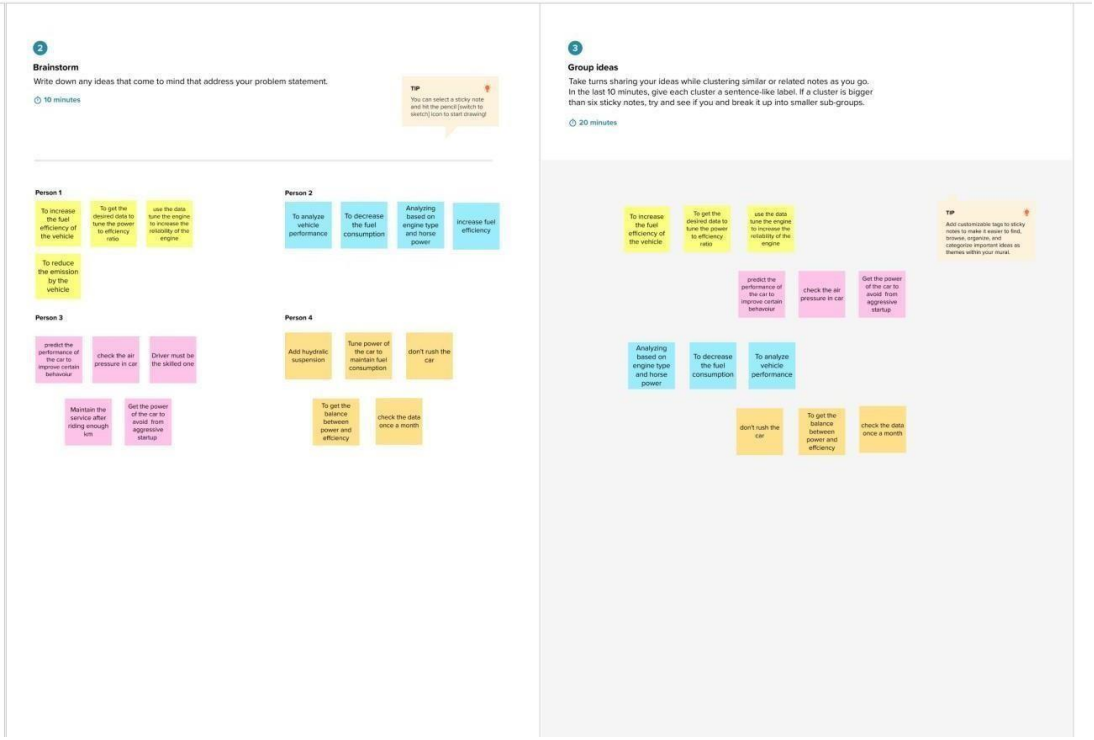


3.2. Ideation & Brainstorming

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



Step-2: Brainstorm, Idea Listing and Grouping



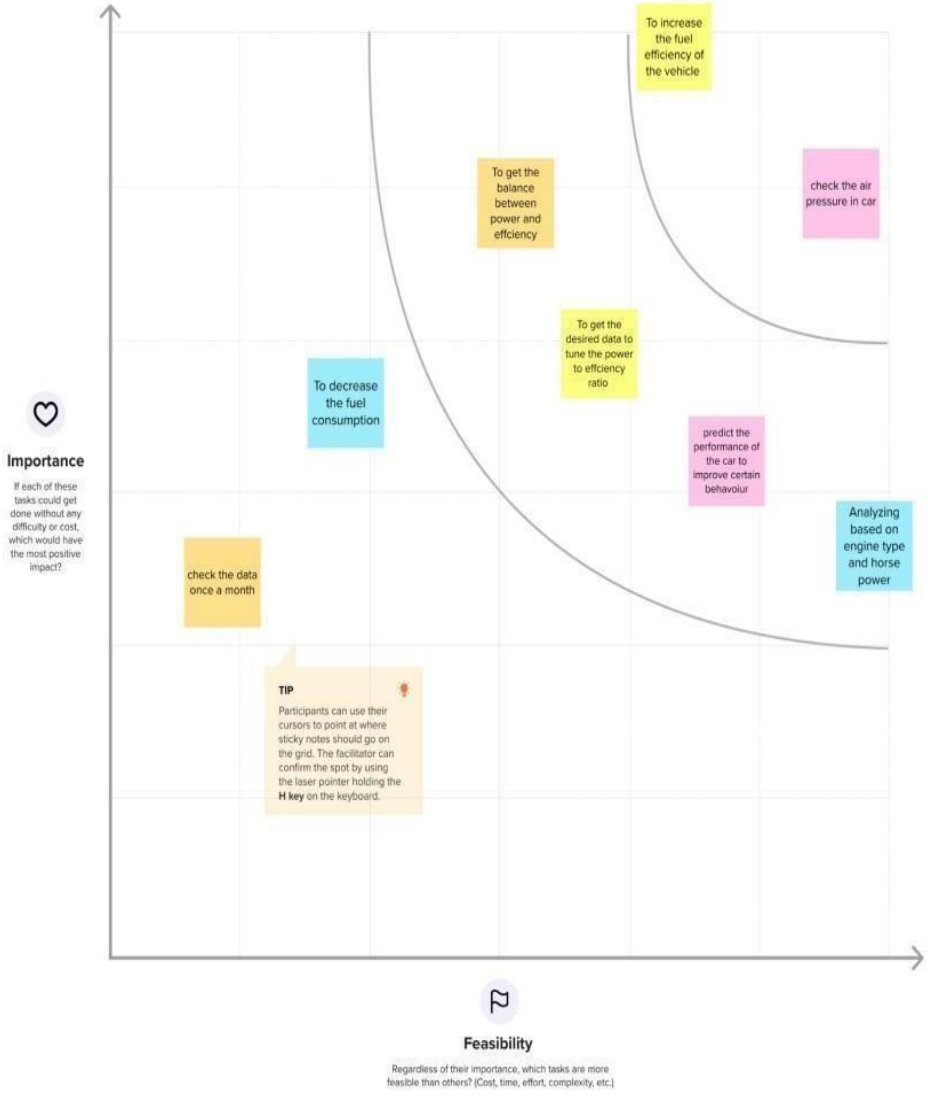
Step-3: Idea Prioritization

4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes



After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

Quick add-ons

A **Share the mural**
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.

B **Export the mural**
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

Keep moving forward

Strategy blueprint
Define the components of a new idea or strategy.
Open the template →

Customer experience journey map
Understand customer needs, motivations, and obstacles for an experience.
Open the template →

Strengths, weaknesses, opportunities & threats
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
Open the template →

Share template feedback

3.3. Proposed Solution

Proposed Solution Template

Date	18 October 2022
Team ID	PNT2022TMID31242
Project Name	Machine Learning based Vehicle Performance Analyzer
Maximum Marks	2 Marks

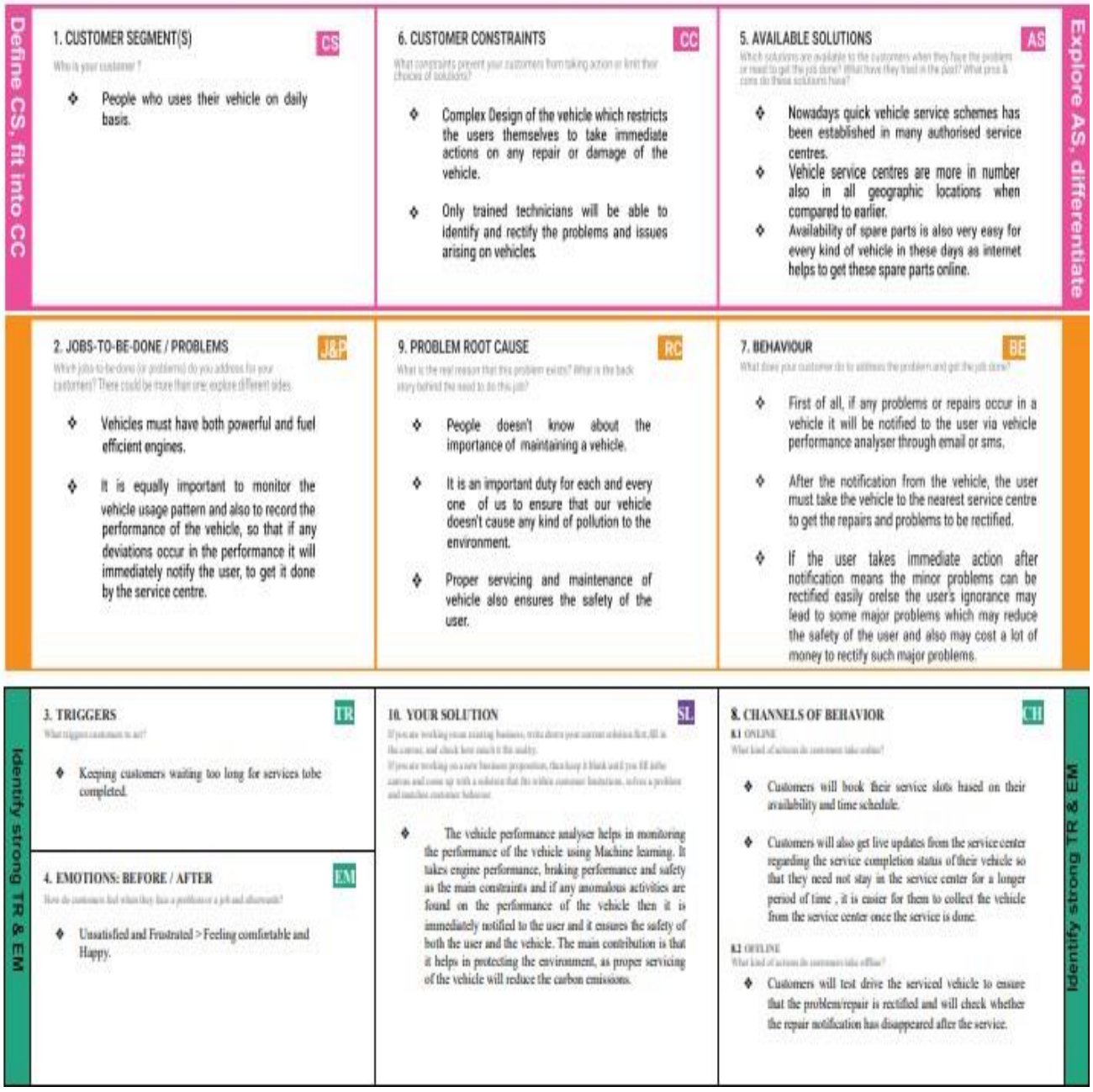
Proposed Solution Template:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	In our day-to-day life vehicles play an integral part in all our lives. We are lagging in servicing it because we are preoccupied with our daily tasks which have a direct impact on the environment. To improve the performance and efficiency of our vehicle, it must be properly serviced and maintained. So, to remind the owner about vehicle maintenance, we have created Vehicle Performance Analyzer using machine learning.
2.	Idea / Solution description	To improve the vehicle's performance efficiency, it is critical to analyse the factors using a variety of well-known machine learning algorithms such as linear regression, decision tree, and random forest. Automotive traction batteries' range, durability, and longevity are "hot topics" in automotive engineering. And now we'll look at mileage performance. We will create models using various algorithms and neural networks to solve this problem. We'll then see which algorithm accurately predicts car performance and its efficiency. This can significantly reduce system fuel consumption and increase efficiency.
3.	Novelty / Uniqueness	There are a few works that analyse vehicle performance using very few vehicle parameters, whereas, in our idea, we use the number of cylinders, displacement, horsepower, weight, model's year and country of origin to determine vehicle performance. We anticipate that as more data is added to fit the model, the sensitivity of our measure will increase. Because our model will be exposed to more possible scenarios, it will be able to find more data that is similar to the previously unseen ones.

4.	Social Impact / Customer Satisfaction	The main objective of this Vehicle performance analyser is that it helps in major reduction of emissions from the vehicles. The reduced amount of poisonous gas emission will definitely improve the quality of air in our environment. By using this Vehicle Performance Analyser customers can know the technical status of their own vehicle. It provides the customer to maintain good quality of the vehicle by enhancing the engine performance, taking care of the interior, regular tire maintenance and also improves the driver safety whereas vehicle gives service alerts which provides better driving experience.
5.	Business Model (Revenue Model)	This System will provide detailed information about the vehicle performance and very user-friendly interface to use. By being informative and unique, it attracts more customers leading to higher revenue. As it plays a vital role in maintaining the efficiency of the vehicle and also in saving the environment from global warming it has a greater impact on the competitive business world.
6.	Scalability of the Solution	Irrespective of the vehicle type or the count of vehicles, this system will analyse the performance of the vehicle and also gives periodic service alerts, when performance of the vehicle degrades. Multiple users can also access the system at same time, it processes the results without any delay.

3.4. Problem Solution fit

Project Title: Machine Learning based Vehicle Performance Analyzer **Project Design Phase-I - Solution Fit** **Team ID: PNT2022TMID31242**



4. REQUIREMENT ANALYSIS

4.1. Functional requirement

Date	18.October.2022
Team ID	PNT2022TMID31242
Project Name	Machine Learning-Based VehiclePerformance Analyzer
Maximum Marks	2 Marks

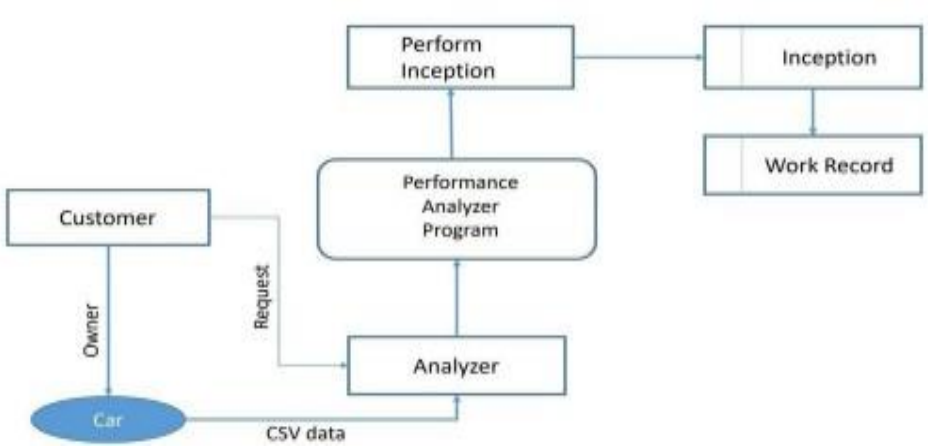
FR.No	FUNCTIONAL REQUIREMENTS (Epic)	NON- FUNCTIONAL REQUIREMENTS
FR-1	Enter the Inputs	Get Inputs through a form
FR-2	User Essential	Predict the performance of the vehicle
FR-3	Data Prepossessing	Sample Dataset for training purpose
FR-4	User input Evaluation	Evaluating the given user values
FR-5	Prediction	Fuel consumption and efficiency of the vehicle

5.PROJECT DESIGN

5.1.Data Flow Diagrams

Data Flow Diagrams:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the rightamount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



5.2 Solution & Technical Architecture:

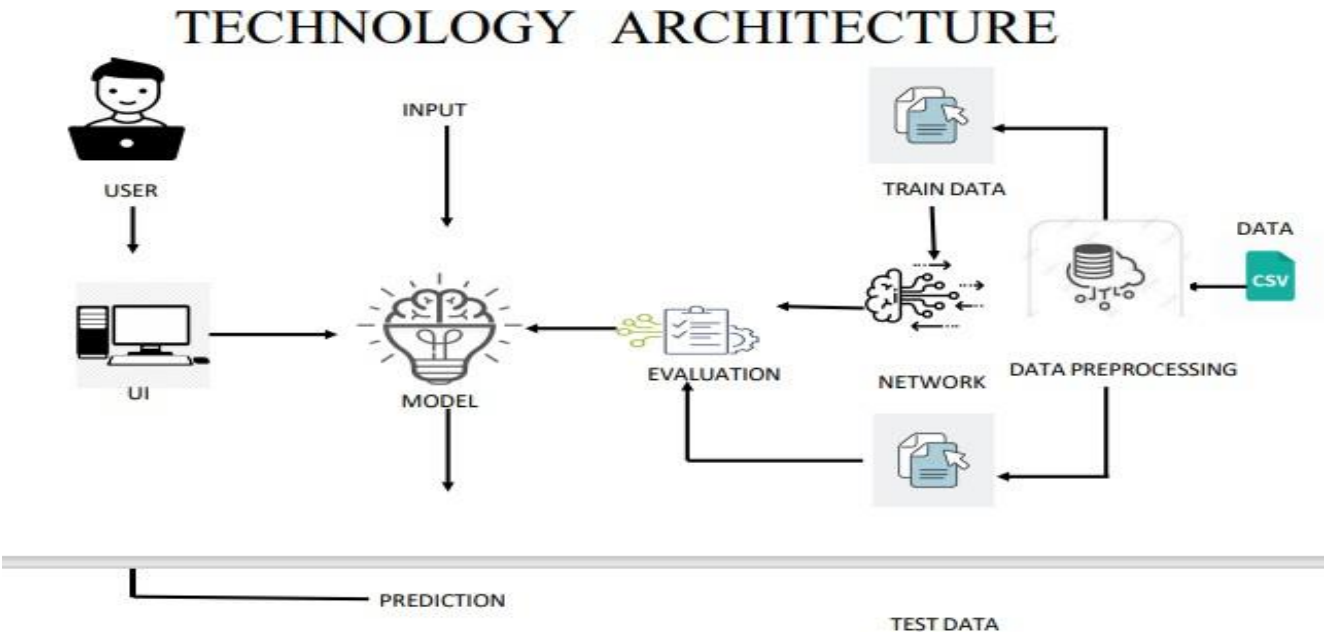


Table-5.2.1: Components & Technologies:

S. No	Component	Description	Technology
1.	User Interface	With the help of web UI, user has better experience And can access the website user-friendly.	HTML, CSS, JavaScript, React JS.
2.	Application Logic-1	Customer can login with username and password.	Java / Python
3.	Application Logic-2	Customer can give their vehicle faults.	IBM Watson STT service
4.	Application Logic-3	Customer can check their vehicle performance and can check the vehicle after the service.	IBM Watson Assistant
5.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.
6.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
7.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
8.	External API-1	Purpose of External API used in the application	IBM Weather API, etc.
9.	External API-2	Purpose of External API used in the application	Aadhar API, etc.
10	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model, etc.
11	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration:	Local, Cloud Foundry, Kubernetes, etc.

Table-5.2.2: Application Characteristics:

S. No	Characteristics	Description	Technology
1	Open-Source Frameworks	List the open-source frameworks used	Technology of Opensource framework
2	Security Implementations	List all the security / access controls implemented, use of firewalls etc.	e.g. SHA-256, Encryptions, IAM Controls, OWASP etc.
3	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services)	Technology used
4	Availability	Justify the availability of application (e.g. use of load balancers, distributed servers etc.)	Technology used
5	Performance	Design consideration for the performance of the application (number of requests per sec, use of Cache, use of CDN's) etc.	Technology used

5.3.User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer	Access the webpage	USN-1	As a user, anyone can access the webpageto check the specifications of the vehicle.	I can access my webpage online at any time.	High	Sprint-1
Customer	Performance of the vehicle	USN-2	As per the usage of the user, the performanceof the vehicle should be predicted easily.	Prediction can be done in an easy way.	High	Sprint-2
Customer	Accuracy to check the performance and health of the car	USN-3	By using our prediction, it helps to check the health of the car.	The efficiency of the carcan be predicted	High	Sprint-1

6. Product Backlog, Sprint Schedule, and Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Preprocessing	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	30	High	Viswanathan.R Aravindh.P Soundharrajan.S Kaviyarasu.S
Sprint-3	Web Page Design	USN-3	As a user, I can register for the application through Facebook	30	High	Viswanathan.R Aravindh.P Soundharrajan.S Kaviyarasu.S
Sprint-4	Result	USN-4	As a user, I can register for the application through Gmail	20	High	Viswanathan.R Aravindh.P Soundharrajan.S Kaviyarasu.S

6.1.Project Tracker, Velocity & Burndown Chart:

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	30	1 Days	01 Nov 2022	03 Nov 2022	30	12 Nov 2022
Sprint -2	20	2 Days	03 Nov 2022	05 Nov 2022	20	12 Nov 2022
Sprint -3	20	5 Days	06 Nov 2022	11 Nov 2022	20	12 Nov 2022
Sprint-4	20	4 Days	12 Nov 2022	16 Nov 2022	20	16 Nov 2022

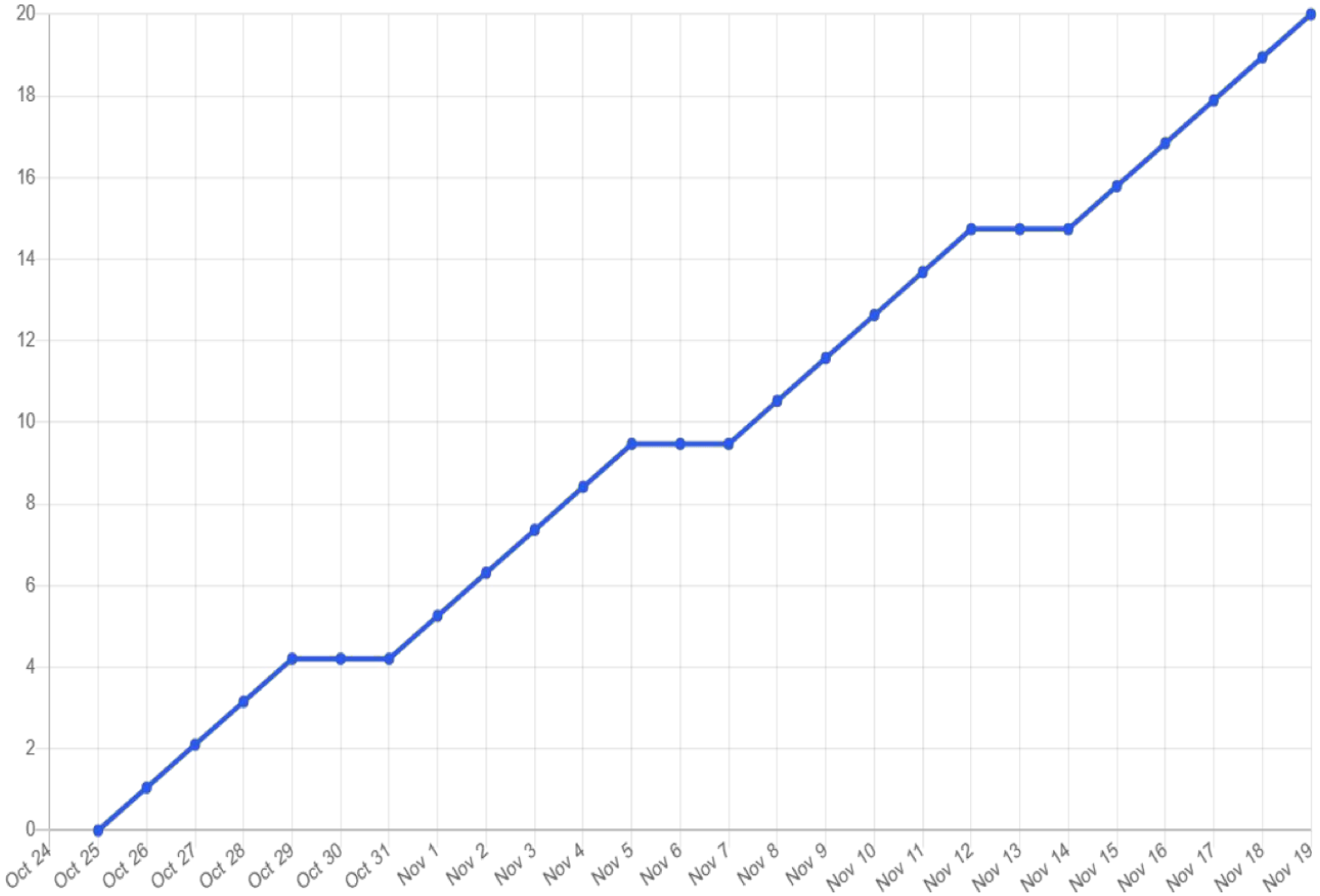
Velocity:

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)

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

Burndown Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies suchas Scrum. However, burn down charts can be applied to any project containing measurable progress over time.



7. CODING & SOLUTIONING:

7.1. **Features:**

FR No.	Feature	Description
FR-1	Enter the input	Get input through the form
FR-2	User Essential	Predict the performance of the vehicle
FR-3	Data preprocessing	Sample dataset for training purpose
FR-4	User input Evaluation	Evaluating the given user values
FR-5	Prediction	Fuel consumption and efficiency of the vehicle

8. Testing:

TEST CASES:

Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Comments	TC for Automation(Y/N)	BUG ID	Executed By
HomePage_TC_OO 1	Functional	Home Page	Verify if the user is able to enter the data into the text field in the webpage and click the button		1. Enter the URL 2. Enter the values	[8,307.130,3504.70,1]	Page refresh	Working as expected	Pass				Sandeep
HomePage_TC_OO 2	Functional	Home page	Verify is the user is able to view the output after the submit button has been clicked		1. Click the submit button		Low performance with mileage 17.1	Working as expected	Pass				Sandeep

User Acceptance Testing:

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [ProductName] project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	1	1	0	0	2
Duplicate	1	0	0	0	1
External	1	0	0	0	1
Fixed	1	1	1	1	4
Not Reproduced	0	0	0	0	0
Skipped	0	0	0	0	0
Won't Fix	0	0	0	0	0
Totals	4	2	1	1	13

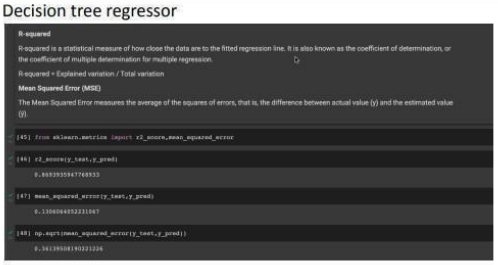
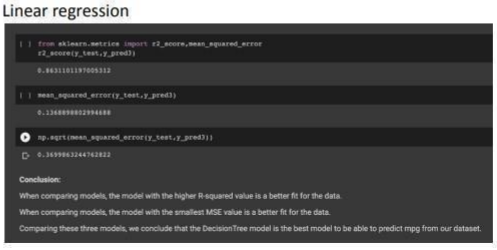
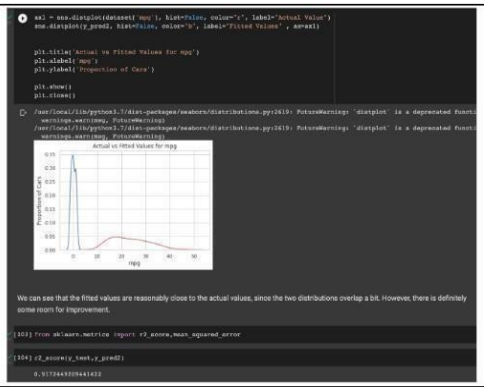
3. Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	4	0	0	4
Client Application	4	0	0	4
Security	1	0	0	1
Outsource Shipping	0	0	0	0
Exception Reporting	1	0	0	1
Final Report Output	4	0	0	4
Version Control	1	0	0	1

9. RESULTS:

PERFORMANCE METRICS:

S.No.	Parameter	Values	Screenshot
1.	Metrics	**Regression Model:** MAE - , MSE - , RMSE - , R2 score - **Classification Model:** Confusion Matrix - , Accuray Score- & Classification Report -	Decision tree regressor 
			Random forest regressor  Linear regression 
Accuracy	Training Accuracy - 0.91724492094	

10. PROS AND CONS:

PROS:

- Using the Random Forest Algorithm in the model helps to perform both classification aswell as regression tasks.
- A random forest produces good predictions that can be easily understood
- It can handle large datasets easily Random Forest Algorithm provides a higher-level accuracy in predicting outcomes.

CONS:

- The main limitation of using random forest algorithm in the model is that a large numberof trees can make the algorithm too slow and ineffective for real-time predictions.
- The random forest algorithm is quite slow to create predictions once it is trained.

11. CONCLUSION:

The ability to estimate a car's performance level presents a big and fascinating challenge. Forecasting vehicle performance in order to improve particular vehicle behavior was our main goal. performance evaluation of the car considering its horsepower, cylinder count, fuel type, and engine type, among other things. Based on the factors, like horsepower, cylinder count, fueltype, and engine type, the health of the car is forecasted. We analyzed the components using a number of well-known machine learning approaches, like linear regression, decision trees, and random forests, in order to optimize the performance efficiency of the vehicle. The power, longevity, and range of automobile traction batteries are now the "hot topics" in automotive engineering. In this case, we additionally consider mileage performance. To answer this problem, we have built the models using a variety of methods and neural networks. We've then

compared which algorithm is most accurate in forecasting car performance (Mileage). A front- end webpage was designed to help give the user an attractive front while they input the values required by the developed machine learning model. The IBM cloud platform was used to develop the model.

12. FUTURE WORKS:

The dataset used for this model is an old vehicle dataset, thus the model's accuracy would dropwhen the details of vehicles released in recent times are given as input. Thus, in the future we propose to use the latest dataset set containing vehicle information to help train the model. We also plan to use other classification algorithms such as SVM and Decision Tress instead of Random Forest and measure if any accuracy gain occurs. Finally, we propose to scale the machine learning model to also analyze the performance of a larger range of vehicles.

13. APPENDIX:

Car Performance Prediction.ipbyn:

```
import numpy as np
import pandas as pd
import os, types
import pandas as pd
  from botocore.client import Config
import ibm_boto3

def _iter_(self): return 0

# @hidden_cell
# The following code accesses a file in your IBM Cloud Object Storage. It
    includes your credentials.
# You might want to remove those credentials before you share the
    notebook.
cos_client = ibm_boto3.client(service_name='s3',

    ibm_api_key_id='wdPOG7CvYRZxYt4sjm8d_Qv7Fzslp7NDy9yWfHWE
    xaSG',
    ibm_auth_endpoint="https://iam.cloud.ibm.com/oidc/token",
    config=Config(signature_version='oauth'),
    endpoint_url='https://s3.private.us.cloud-object-
    storage.appdomain.cloud')

bucket = 'machinelearningbasedvehicleperfor-donotdelete-pr-
    eqbab3sfwyugyu'
object_key = 'car performance (1).csv'

body = cos_client.get_object(Bucket=bucket,Key=object_key)['Body']
# add missing _iter_ method, so pandas accepts body as file-like object
if not hasattr(body, "_iter"): body.iter_ = types.MethodType( _iter_, body )

datas = pd.read_csv(body)
    datas.head()
```

```
    x=datas.iloc[:,1:8]
        x
    y=datas.iloc[:,0]
        y
from sklearn.model_selection import train_test_split
        x_train,x_test,y_train,y_test =
train_test_split(x,y,test_size=0.2,random_state=0
from sklearn.preprocessing import StandardScaler
        sd=StandardScaler()
        x_train=sd.fit_transform(x_train)
        x_test=sd.fit_transform(x_test)
from sklearn.ensemble import RandomForestRegressor
     d=RandomForestRegressor(n_estimators=30,random_state=0)
     d.fit(x_train,y_train)
!pip install ibm_watson_machine_learning

from ibm_watson_machine_learning import APIClient
     wml_credentials={
                "url":"https://us-south.ml.cloud.ibm.com",

         "apikey":"zDg62IPh9bpRQ06F0TDmtiqqDoQfoiv4z4tcu2RUY9fF"
                }
client=APIClient(wml_credentials)
def guid_from_space_name(client,space_name):
         space=client.spaces.get_details()
         #print(space)
   return(next(item for item in space['resources'] if
item['entity']["name"]==space_name)['metadata']['id'])
space_uid=guid_from_space_name(client,'models')
print("Space UID = "+ space_uid)
client.set.default_space(space_uid)
client.software_specifications.list()
     software_spec_uid =
     client.software_specifications.get_uid_by_name("runtime-22.1-py3.9")
software_spec_uid

     model_details = client.repository.store_model(model=d,meta_props={
        client.repository.ModelMetaNames.NAME : "Model Building",
```

```
        client.repository.ModelMetaNames.TYPE : "scikit-learn_1.0",

        client.repository.ModelMetaNames.SOFTWARE_SPEC_UID:software
        _spec_uid }
                                    )

model_id = client.repository.get_model_uid(model_details)
model_id
     #Prediction
     y_pred=d.predict(x_test)
y_pred
from sklearn.metrics import r2_score
     accuracy=r2_score(y_pred,y_test)
accuracy
    import pickle
        pickle.dump(d,open('regression.pkl','wb'))
x2=[[4,7,58,89,1000,568,70]]
     y=d.predict(x2)
y
```

Sourcing end point.py:

```
import requests

# NOTE: you must manually set API_KEY below using information
    retrieved from your IBM Cloud account.
API_KEY = " 6Um4mZdaiEEL5HIQcUtfZPUwMjauxm0vA_sigkM1ZMrF"
token_response = requests.post('https://iam.cloud.ibm.com/identity/token',
    data={"apikey":
 API_KEY, "grant_type": 'urn:ibm:params:oauth:grant-type:apikey'})
mltoken = token_response.json()["access_token"]

header = {'Content-Type': 'application/json', 'Authorization': 'Bearer ' +
    mltoken}

# NOTE: manually define and pass the array(s) of values to be scored in
    the next line
payload_scoring = {"input_data": [{"fields":
    [["Cylinders","Displacement","Horsepower","Weight","Acceleration","Mo
```

```
delYear","Origin"]], "values": [4,7,58,89,1000,568,70]}]}

response_scoring = requests.post(https://us-
    south.ml.cloud.ibm.com/ml/v4/deployments/17588351-5478-4848-
    9747-cee50f78b2e1/predictions?version=2022-11-19,
    json=payload_scoring,
 headers={'Authorization': 'Bearer ' + mltoken})
print("Scoring response")
    print(response_scoring.json())
```

Index.html:

```
<html>
<head>
<meta charset="ISO-8859-1">

<style>
    body{
        background-size: cover;
    }
</style>
</head>
<body background="cars.jpg">

<div align="center">
        <h1>VEHICLE PERFORMANCE PREDICTION</h1>

        <br><br><br>
        <form action="output.html" method="get">
            <table>
                <tr>
                    <td><b>No of Cylinders:</b></td>
                    <td><input type="text" name="Cylinders" /></td>
                </tr>
                <tr>
                    <td><b>Enter Displacement:</b></td>
                    <td><input type="text" name="Displacement" /></td>
                </tr>
                <tr>
                    <td><b>Enter Horsepower:</b></td>
                    <td><input type="text" name="HorsePower" /></td>
                </tr>
                <tr>
                    <td><b>Weight:</b></td>
                    <td><input type="text" name="Weight" /></td>
                </tr>
                <tr>
```

```
                <td><b>Model Year:</b></td>
                <td><input type="text" name="Model" /></td>
            </tr>
            <tr>
                <td><b>Enter Origin:</b></td>
                <td><input type="text" name="Origin" /></td>
            </tr>

            </table><br>

        <input type="submit" value="PREDICT"/>


    </form>
</div>
```

app.py:

```
from flask import Flask, request, Response, send_from_directory
import requests
import json
from flask_cors import CORS
import ibm_db

# NOTE: you must manually set API_KEY below using information
    retrieved from your IBM Cloud account.
API_KEY = " 6Um4mZdaiEEL5HIQcUtfZPUwMjauxm0vA_sigkM1ZMrF"
token_response = requests.post('https://iam.cloud.ibm.com/identity/token',
    data={"apikey":
 API_KEY, "grant_type": 'urn:ibm:params:oauth:grant-type:apikey'})
mltoken = token_response.json()["access_token"]

header = {'Content-Type': 'application/json', 'Authorization': 'Bearer ' +
    mltoken}

# NOTE: manually define and pass the array(s) of values to be scored in
    the next line
#payload_scoring = {"input_data": [{"fields":
    [["Cylinders","Displacement","Horsepower","Weight","Acceleration","Mo
    delYear","Origin"]], "values": [4,7,58,89,1000,568,70]}]}
```

```
#API_KEY_NEW = 'https://us-
    south.ml.cloud.ibm.com/ml/v4/deployments/6ed70a51-2d98-4119-
    a5bf-eda733928a88/predictions?version=2022-11-17'

app=Flask(_name_)

@app.route('/health-check', methods=['GET'])
def health_check_for_user():
    return Response("Running")


@app.route('/get-key', methods=['GET'])
def get_key():
    API_KEY = "6Um4mZdaiEEL5HIQcUtfZPUwMjauxm0vA_sigkM1ZMrF"
    token_response =
    requests.post('https://iam.cloud.ibm.com/identity/token',
    data={"apikey":
     API_KEY, "grant_type": 'urn:ibm:params:oauth:grant-type:apikey'})
    mltoken = token_response.json()["access_token"]
    return Response(mltoken)


@app.route('/get-users', methods=['GET'])
def get_users():
    return get_user()


@app.route('/get-performance', methods=['POST'])
def get_performance_for_user():
    print(request.args)
    query = request.get_json()
    print(query)
    inp = query.get('inp')
    payload_scoring = {"input_data": [{"field": [["cylinders", "displacement",
     "horsepower", "weight", "acceleration", "model year", "origin"]],
     "values": [
        inp]}]}
```

```
    API_KEY = "6Um4mZdaiEEL5HIQcUtfZPUwMjauxm0vA_sigkM1ZMrF"
    token_response =
    requests.post('https://iam.cloud.ibm.com/identity/token',
    data={"apikey":
                                                        API_KEY,
     "grant_type": 'urn:ibm:params:oauth:grant-type:apikey'})
    mltoken = token_response.json()["access_token"]

    header = {'Content-Type': 'application/json',
              'Authorization': 'Bearer ' + mltoken}
    url = API_KEY_NEW
    api_response = requests.post(url=url, json=payload_scoring,
     headers=header)
    return Response(api_response)

if _name_ == '_main_':
        app.run(debug=True)
```

GitHub & Project Demo Link:

https://github.com/IBM-EPBL/IBM-Project-4655-1658737118/blob/main/DEMO%20VIDEO/Demo%20Video%20(IBM).webm