END TO END FUEL PREDICTION USING DEEP LEARNING AND WEB DEVELOPMENT

Submitted in partial fulfilment of the requirements

for the award of degree of

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE & ENGINEERING

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GALGOTIAS UNIVERSITY,

GREATER NOIDA NOVEMBER 2020

DECLARATION

We hereby declare that the work which is being presented in the B.Tech.Project "**END TO END FUEL PREDICTION USING DEEP LEARNING AND WEB DEVELOPMENT**", in partial fulfilment of the requirements for the award of the B. Tech and submitted to the Department of Computer science and Engineering of Galgotias University, Greater Noida, is an authentic record of our work carried under the supervision of MR.SOUMALYA GHOSH**,** Assistant Professor, School ofComputing Science and Engineering, Galgotias University.

The contents of this project report, in full or in parts, have not been submitted to any other institute or university for the award of any degree.

AJITESH SHARMA

YATIN PANDEY

BONAFIDE CERTIFICATE

Certified that this project report **END TO END FUEL PREDICTION USING DEEP LEARNING AND WEB DEVELOPMENT**

"is the bonafide work of "AJITESH SHARMA **(19SCSE1010508), YATIN PANDEY(19SCSE1010216)"** who carried out the project work under my supervision.

SIGNATURE OF DEAN **SIGNATURE OF SUPERVISOR**

ACKNOWLEDGEMENT

We would really like to explicit our unique thank you of gratitude to our guide Mr. SOUMALYA GHOSH**,** Assistant Professor, School of Computing Science and Engineering, Galgotias University. as well as our reviewer MS. MONU SINGH, Assistant Professor, School of Computing Science and Engineering, Galgotias University who gave us the golden opportunity to do this first-rate assignment on the topic, which additionally helped us in doing lots of Research and that we came to recognize approximately such a lot of new things we in reality thankful to them. It changed into an incredible privilege and honour to work and guidance below their steering. Secondly, we would additionally want to thank our parents and friends who helped us loads in finalizing this challenge inside the restricted time frame. We are over helmed in all humbleness and gratefulness to well- known my depth to all the ones who have helped us to place those ideas, properly above the extent of simplicity and into something concrete. We are extraordinarily thankful to our mother and father for their love, prayers, being concerned and sacrifices for instructing and preparing us for our best

ABSTRACT

Ability to model and predict the fuel consumption is vital in enhancing fuel economy of vehicles and preventing fraudulent activities in fleet management. Fuel consumption of a vehicle depends on several internal factors such as distance, load, vehicle characteristics, and driver behavior, as well as external factors such as road conditions, traffic, and weather. However, not all these factors may be measured or available for the fuel consumption analysis. We consider a case where only a subset of the aforementioned factors is available as a multi-variate time series from a long distance, public bus. Hence, the challenge is to model and/or predict the fuel consumption only with the available data, while still indirectly capturing as much as influences from other internal and external factors. Machine Learning (ML) is suitable in such analysis, as the model can be developed by learning the patterns in data. In this paper, we compare the predictive ability of three ML techniques in predicting the fuel consumption of the bus, given all available parameters as a time series. Based on the analysis, it can be concluded that the random forest technique produces a more accurate prediction compared to both the gradient boosting and neural networks

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CHAPTER 1
INTRODUCTION TO THE PROJECT.

The automotive industry is extremely competitive. with increasing fuel prices and picky consumers, automobile makers are constantly optimizing their processes to increase fuel efficiency. but what if you could have a reliable estimator for a car's mpg given some known specifications about the vehicle? Then, you could beat a competitor to market by both having a more desirable vehicle that is also more efficient, reducingwastedR&Dcosts and gaining larger providing an alternate solution to simulation models that are used to predict the fuel consumption of vehicles chunks of the market Our proposed approach to evaluate the fuel consumption in automobile vehicles using the following predictors listed below:

● This paper is developed with the vehicle data that is acquired from the UCI repository.

● The dataset includes a number of cylinders, horsepower, displacement, acceleration and model year. The output variable obtained is fuel consumption in mpg. International Journal of Advanced Science and Technology Vol. 29, No. 5, (2020), pp. 6326 – 6335 ISSN: 2005-4238 IJAST 6327 Copyright ⓒ 2020 SERSC

● Displacement: It is the volume of the car's engine, usually expressed in litres or cubic centimetres.

● Origin: It is a discrete value from 1 to 3. This dataset is not clear about this so we can assume these numbers as countries.

● Model year: is given as a decimal number representing the last two digits of the

fourdigit year. (E.g.: 1970 is model year =70).

● Weight: The weight of the car is mentioned as total vehicle mass, including the passengers andluggage.

● Acceleration: Acceleration is the rate of change of velocity as a function of time. Here it is modified into a decimal value.

● Methods: LASSO Regression, Elastic Net Regression, Kernel Ridge Regression, Gradient Boosting Regression, XGBoost, LightGBM 6

● Our model dataset has been obtained from many different cars, and it should give us a good estimate for our unknown car's mpg. The study is evaluating machine learning approaches from a set of refined predictors to fuel consumption in gallons per litres.

● mongo DB :mongo client connect our server and store the value in database with data schema. export csv file of our data in our storage from mongo DB. we use node js in backend side, server express , database is mongo DB . we calculate mpg on hbs file. hbs means handlerbars. Hbs I template engine.this engine server static data on webpage that's help us to perform mpg calculation on webserver.

Initial thoughts

According to others using this dataset, some of the mpg values for the cars are incorrect, meaning that some of our predictions will be off by a large amount, but we shouldn't always trust the listed mpg value.

There are also unknown mpg values in the dataset, marked with a '?'. We will need to manually replace these with the correct mpg value.While our model is the end result of this notebook, the data analysis section will be incredibly important in visualizing trends without having to use any machine learning techniques.

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Consumer information system on fuel economy can help car buyers go green

Fuel efficiency is rarely a consumer's primary concern, and vehicle manufacturers have little incentive to innovate technology

India is the fifth-largest market for passenger vehicles. With its deep-rooted socialism and a high middle-class population, it has one of the most conservative markets where pricing of vehicles and after-sales economics drive purchases.

Social class, prestige, vehicle robustness and mileage: These are some of the other parameters on which people purchase cars.

It is, therefore, surprising that the current portfolio of information does not lay enough emphasis on fuel efficiency. In fact, an average car owner does not have information on the synergistic links between fuel economy standards and emission control systems within a vehicle.

Robust fuel efficiency norms in vehicles closer to the global standards help achieve cleaner air and have a direct economic benefit as well. The costs of petrol and diesel in major cities has risen steadily since 2018: They have been well above the Rs 60-mark, even as prices of crude oil fell sharply in global markets.

Even then, a conservative Indian customer does not delve enough into fuel efficiency and regulatory standards for potential vehicle purchases. It does not help that the information available is, at times, sparse.

.

WHAT IS FUEL SAVING?

Lets assume that you are referring to ways to reduce the amount of fuel used when driving a car or other motor vehicle. There are many ways which, cumulatively, can save a lot of fuel.

- Accelerate gently with small throttle openings. Do not mash the accelerator pedal to the floor at every opportunity.
- When slowing for a corner, or in preparation to stopping, release the accelerator early, and slow the car by means of its natural deceleration.
- Leave several car lengths between you and the car ahead. If the car ahead slows, you can slow by coming off the accelerator.
- Find the optimum speed for your vehicle. At 60 mph, you will use far less fuel than at 70 mph.
- Keep your tyres at the correct pressure. A soft tyre has much more rolling resistance.
- Try to use roads where you are not continually having to slow for corners or traffic, and then accelerate to your cruising speed.
- Every time you use your brakes, they generate heat. This heat has come from burning fuel. Try to keep at a constant cruising speed.

In general, a more relaxed style of driving will save fuel. Now you know that energy cannot be created or destroyed, All energy can only be transferred. Fuel also do not create energy. They only convert the chemical energy of the fuel to the kinetic energy with the help of the thermal energy supplied to them. The efficiency with which the fuel does this conversion of energy is known as fuel efficiency.

Now let us take a look at how we measure this fuel efficiency. Fuel efficiency is measured as the amount of heat that 1 kg of fuel (any fuel) produces on combustion. This is known as the calorific value of the fuel. The unit of measurement of fuel efficiency is kilojoules per kg, i.e. kJ/kg.

CHAPTER 2

REQUIREMENTS, FEASIBILITY AND SCOPE/OBJECTIVE

- PYTHON
- KAGGLE
- WEB DEVELOPMENT
- TENSERFLOW
- NUMPY
- OPENCV
- PANDAS
- MONGODB

PYTHON:

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages..

KAGGLE:

Figure2.1

Kaggle is a subsidiary of Google that functions as a community for data scientists and developers. Those interested in machine learning or other kinds of modern development can join the community of over 1 million registered users and talk about development models, explore data sets, or network across 194 separate countries around the world

WEB DEVELOPMENT

Web development refers to the building, creating, and maintaining of websites. It includes aspects such as web design, web publishing, web programming, and database management . It is the creation of an application that works over the internet i.e. websites.

TENSERFOLOW:

TensorFlow is an end-to-end open source platform for machine learning. It has a comprehensive, flexible ecosystem of tools, libraries and community resources that lets researchers push the state-of-the-art in ML and developers easily build and deploy ML powered applications.

NUMPY:

NumPy is a Python library used for working with arrays.

It also has functions for working in domain of linear algebra, fourier transform, and matrices.

NumPy was created in 2005 by Travis Oliphant. It is an open source project and you can use it Freely.NumPy stands for Numerical Python.

OPENCV:

OpenCV is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then Itseez. The library is cross-platform and free for use under the open-source Apache 2 License

PANDAS:

pandas is a fast, powerful, flexible and easy to use open source data analysis and manipulation tool,

built on top of the Python programming language**.**

MONGODB

MongoDB’s document model is simple for developers to learn and use, while still providing all the capabilities needed to meet the most complex requirements at any scale. We provide drivers for 10+ languages, and the community has built dozens more.

Comparative Study

A. Cappiello, in his paper developed a model,which is instantaneous statistical emission of gases such as CO, HC, NOx and the fuel consumption in the automobiles based on physical weight of the car. They collected data in three different ways as Regional based, Facility based Transportation and Microscopic Traffic which in term called as CMEM Model. The CMEM Model has three levels where the driving cycle data are collected as macro level, meso level and micro level whereas in macro levelthey will collect data for every hour and in meso level the data is collected for every minute and in micro the data is collected for every second. They performed the model on aggressive data cycle and tested on another driving cycle to estimate its capabilities. Their model helps in the Intelligent Transportation System where traffic conditions, vehicle emissions can be controlled.[6] Geoffrey I. Webb and Zijian Zheng, in their paper proposed that, ensemble learning strategies have improved the accuracy of base learning algorithms. They followed the basic principles of boosting and bagging to improve the efficiency. They have stated that the diversity of algorithms using in the ensemble model may increase the test error of the individual members in the ensemble, and it is hard to measure those. However, the success of this ensemble depends on the how the ensemble techniques is equally distributed. So they have succeed in reducing the error in the internal models in ensemble by working with Wag algorithm, Sasc algorithm, MB algorithm 7 and adaboost algorithms. They have demonstrated the hierarchy between internal errors, bias and variance of the different algorithms chosen.[4] Sandareka Wickramanayake, H.M.N. Dilum Bandara, in their paper, developed a comparative study, on the fuel consumption of fleet vehicles using three different machine learning algorithms namely Random Forest, Neural Networks and Gradient Boosting. They state the analysis of fuel consumption in fleet vehicles will reduce the fraudulences. In this study, they have chosen the public bus data in time series. The challenge they face is that the dataset available is so less and yet they need to provide a comprehensive result on their paper. They say that the fuel consumption may be affected by both the internal and external factors. So, they studied

the pattern in the data and performed an analysis and proved that the random forest algorithm predicted more accurately rather than the two others.[2] S. Sailaja, in her paper, suggested an ensemble stacking model by combining the unsupervised model and supervised model. They have used the diabetes dataset. Before developing the model, they pre-processed their dataset by clearing the null values and outliers. They have studied the inter-relationship between the data. K-means as the unsupervised model performed the elbow method to find the number of clusters in their data. KNN as the supervised model stacked along with logistic regression acted as the meta classifiers and K-means as the base classifier performed the ensemble stacking and found the result that the stacked prediction's accuracy is higher than the individual models. [7] Rahul Goel, Dinesh Mohan, Sarath K. Guttikunda, Geetam Tiwari, in their paper proposed a new reliable method to collect the data to estimate the emission and fuel consumption in the fleet vehicles. In their method, they followed two ways namely primary surveys where they collect data directly from the customers in the petrol bunk and secondary data resources available from already developed data. Their method provides fleet size, annual mpg and fuel efficiency of cars and bike in their three chosen city Delhi, Vishakhapatnam and Rajkot. They have distinguished and the studied the factors affecting the fuel consumption in the new vehicles and vehicles in-fleet. They have explained that the number of vehicles owned in India is numerously higher than the individual fleets in the country. They 8 included that more number of fleets should be developed and proper fuel-efficiency methods are introduced, so that the fuel consumption rate of the vehicles can be minimized

Chapter 3:- Feasibility Analysis,Workplan,Architecture diagram

Depending on the results of the initial investigation, the survey is expanded to a more detailed feasibility study. Feasibility study is a test of system proposal according to its workability, impact on the organization, ability to meet user needs, and effective use of resources. The objective of the feasibility study is not to solve the problem but to acquire a sense of its scope . During the study, the problem definition is crystallized and aspects of the problem to be included in the system are determined. Consequently, costs and benefits are described with greater accuracy at this stage.

It consists of the following:

1. Statement of the problem:

A carefully worded statement of the problem that led to analysis.

2. Summary of finding and recommendations:

A list of the major findings and recommendations of the study. It is ideal for the user who requires quick access to the results of the analysis of the system under study. Conclusion are stated , followed by a list of the recommendation and a justification for them .

3. Details of findings :

An outline of the methods and procedures under-taken by the existing system, followed by coverage of the objectives and procedures of the candidate system. Included are also discussions of output reports, file structures, and costs and benefits of the candidate system.

4. Recommendations and conclusions:

Specific recommendations regarding the candidate system, including personnel assignments, costs, project schedules, and target dates.

- **Technical Feasibility**

Technical feasibility centers around the existing computer system (Hardware and Software etc) and to what extend it support the proposed addition. For example, if the current computer is operating at 80 percent capacity - an arbitrary ceiling - then running another application could overload the system or require additional Hardware. This involves

financial considerations to accommodate technical enhancements. If the budgets is a serious constraint ,then the project is judged not feasible. In this project, all the necessary cautions have been taken care to make it technically feasible. Using a key, the display of text/object is very fast. Also, the tools, operating system and programming language used in this localization process is compatible with the existing one.

Economic analysis is the most frequently used method for evaluating the effectiveness of the candidate system. More commonly known as cost/benefit analysis, the procedure is to be determining the benefits and savings that are expected from a candidate and compare them with costs. If benefits outweigh costs, then the decision is made to design and implement the system.

A systems financial benefit must exceed the cost of developing that system. i.e. a new system being developed should be a good investment for the organization. Economic feasibility considers the following:

i. The cost to conduct a full system investigation.

ii. The cost of hardware and software for the class of application.

iii. The benefits in the form of reduced cost or fewer costly errors.

iv. The cost if nothing changes (i.e. The proposed system is not developed).

The proposed SYSTEM is economically feasible because

i. The system requires very less time factors.

ii. The system will provide fast and efficient automated environment instead of slow and error prone manual system, thus reducing both time and man power spent in running the system.

iii. The system will have GUI interface and very less user training is required to learn it.

iv. The system will provide service to view various information if required for some decision making.

- **Operational Feasibility**

This Application is very easy to operate as it is made user friendly with the help of very effective GUI tools . Main consideration is user's easy access to all the functionality of the Application. Another main consideration is here is

that whether user organization is trained enough to use the newer application. Here every functionality is as per previous operational strategy which is not expected to be cumbersome to the potential clients.

- **Behavioral Feasibility**

People are inherently resistant to change, and computers have been known to facilitate change. An estimate should be made of how strong a reaction the user staff is likely to have toward the development of a computerized system. Therefore, it is understandable that the introduction of a candidate system requires special efforts to educate and train the staff. The software that is being developed is user friendly and easy to learn. In this way, the developed software is truly efficient and can work on any circumstances ,tradition , locales.

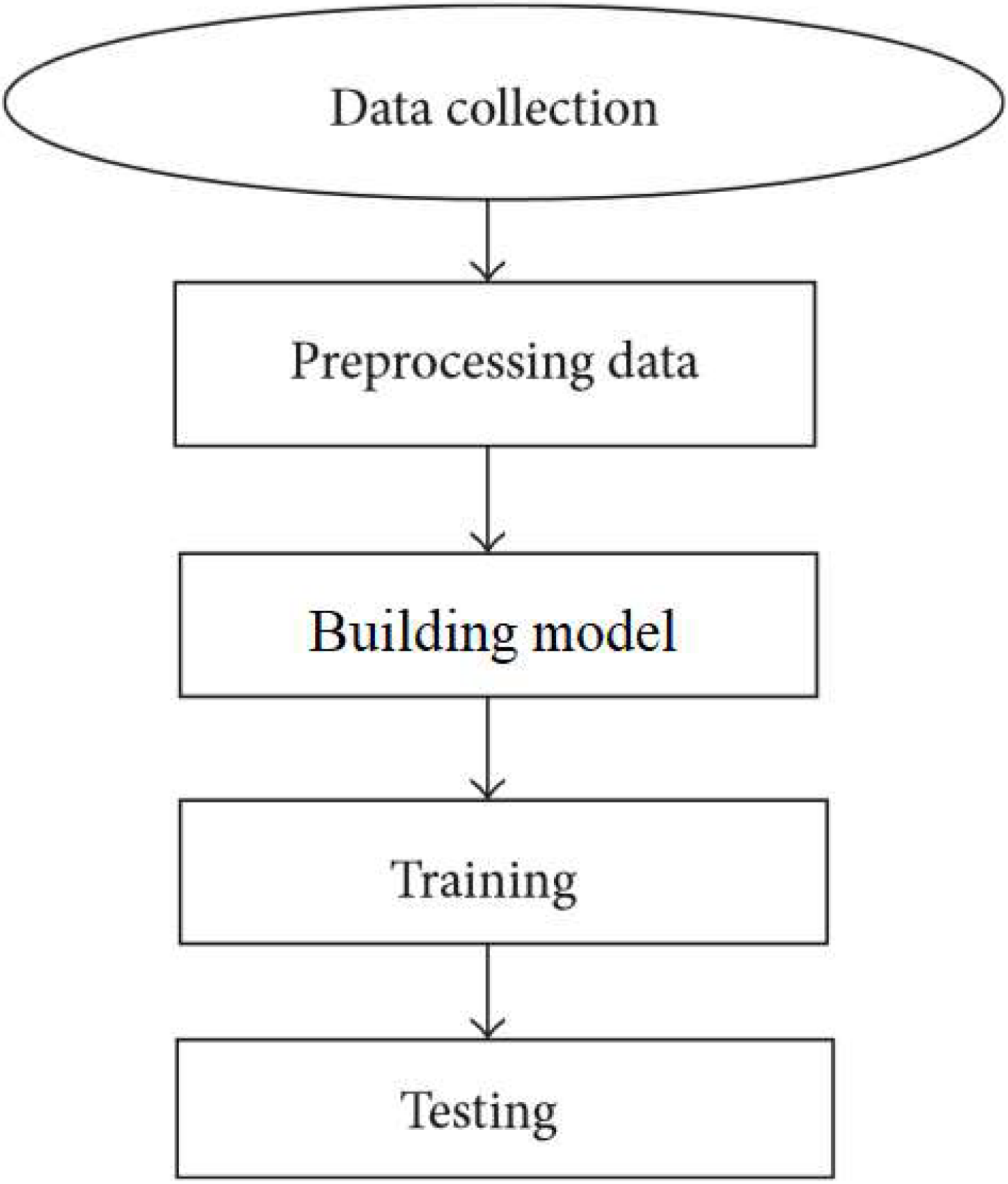
Behavioral study strives on ensuring that the equilibrium of the organization and status quo in the organization are nor disturbed and changes are readily accepted by the users.

WORK PLAN

To build a model that could reliably predict a car's MPG

 Providing an alternate solution to simulations models that are used to predict the fuel efficiency of cars
 It can also be useful in detection of anomalous cars by identifying irregular fuel efficiency.
 Minimize model size and increase accuracy.

ARCHITECTURE DIAGRAM FOR PROPOSED METHOD


Data collection
Preprocessing data
Building model
Training
Testing

Chapter 4: DESIGN

- **Proposed System**:

This paper explains the fuel efficiency of car's using linear regressions with gradient descent algorithm and adding UI server and mongo DB database. the proposed structure of the fuel efficiency system perform following task:A)server: start express server in terminal in our code file B)webpage: write localhost:3000 on address bar then load our page . we see the form for calculate mpg of car's
C)hbs : this is a template engine support the node js and it serve the our html tag, CSS , values from node js .
d)mongo DB :mongo client connect our server and store the value in database with data schema. export csv file of our data in our storage from mongo DB. we use node js in backend side, server express , database is mongo DB . we calculate mpg on hbs file. hbs means handlerbars. Hbs I template engine.this engine server static data on webpage that's help us to perform mpg calculation on webserver.
We use algorithm to calculate car MPG values using linear regression with gradient descent. this make solve machine learning problem. gradient descent is an optimization algorithm used to find the values of parameter(coeffients) of a function (f) that minimizes a cost function (cost).gradient descent is best used when the parameters cannot be calculated analytically(eg. Using linear algebra) and must be searched for by an optimization algorithm.

- Taking data of car from internet and make csv file. car displacement, car name,

  horsepower, weight , their actual mpg value. We use displacement, weight, horsepower

for predict mpg value. take displacement in cubic inch and weight in tons, horsepower in hp.

IN THE NEXT CHAPTER WE WILL BE SHOWING THEIMPLEMENTATION OF EACH PROJECT

PART .

CHAPTER -5

IMPLEMENTATION AND TESTING

In this chapter we will be discussing more on implementations ...like in previous chapter we already discussed how we are going to do it .

```
1 Data = pd.read_csv('Mileage.csv')
2 Data.columns=['mpg','cylinders','displacement','horsepower','weight','acceleration','model y
3 Data.head()
```

	mpg	cylinders	displacement	horsepower	weight	acceleration	model year	origin	car name
0	18.0	8	307.0	130.0	3504	12.0	70	1	chevrolet chevelle malibu
1	15.0	8	350.0	165.0	3693	11.5	70	1	buick skylark 320
2	18.0	8	318.0	150.0	3436	11.0	70	1	plymouth satellite
3	16.0	8	304.0	150.0	3433	12.0	70	1	amc rebel sst
4	17.0	8	302.0	140.0	3449	10.5	70	1	ford torino

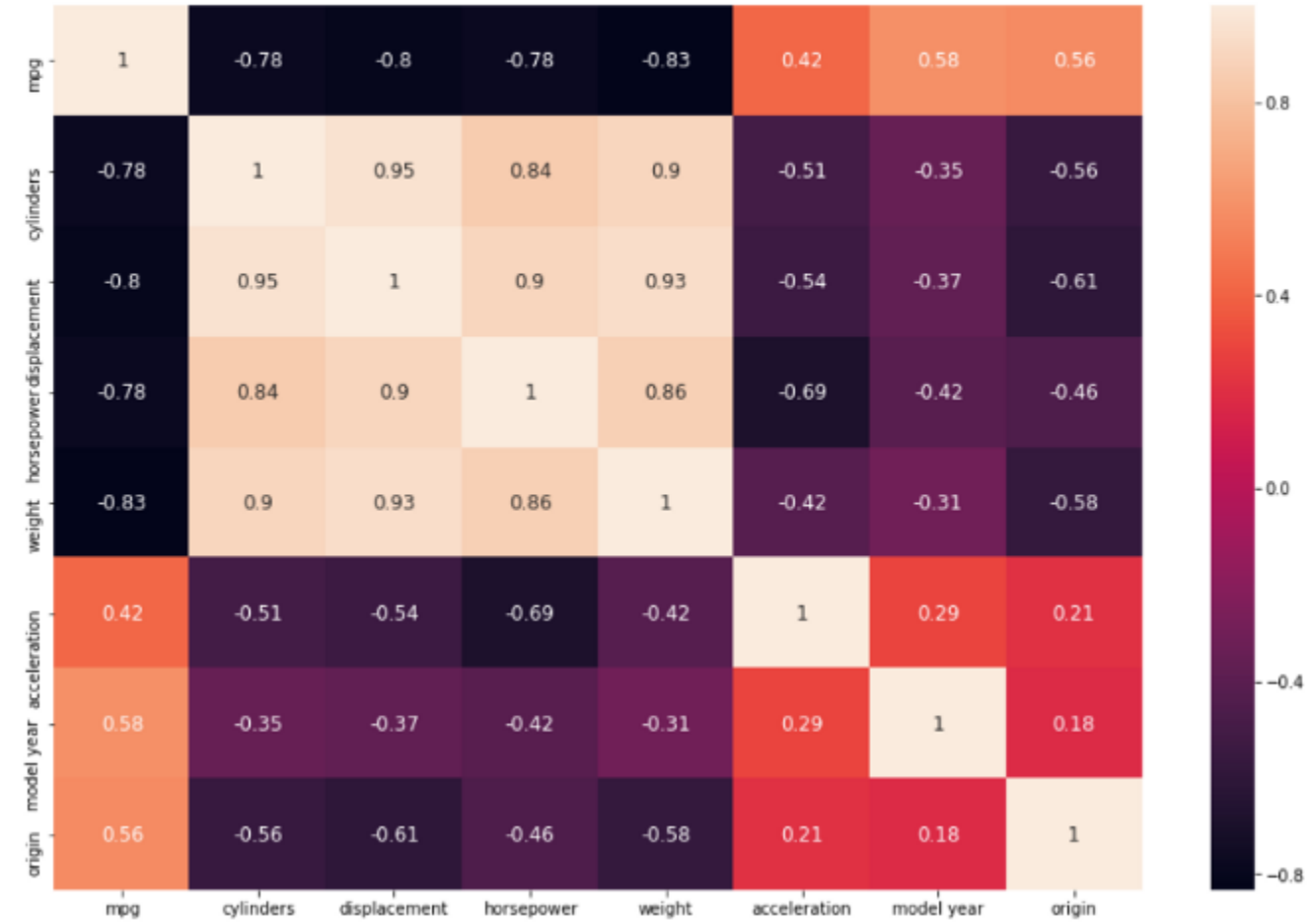
```
1 Data.describe()
```

	mpg	cylinders	displacement	weight	acceleration	model year	origin
count	398.000000	398.000000	398.000000	398.000000	398.000000	398.000000	398.000000
mean	23.514573	5.454774	193.425879	2970.424623	15.568090	76.010050	1.572864
std	7.815984	1.701004	104.269838	846.841774	2.757689	3.697627	0.802055
min	9.000000	3.000000	68.000000	1613.000000	8.000000	70.000000	1.000000
25%	17.500000	4.000000	104.250000	2223.750000	13.825000	73.000000	1.000000
50%	23.000000	4.000000	148.500000	2803.500000	15.500000	76.000000	1.000000
75%	29.000000	8.000000	262.000000	3608.000000	17.175000	79.000000	2.000000
max	46.600000	8.000000	455.000000	5140.000000	24.800000	82.000000	3.000000

Figure 1: first look at data, with some high level insights

```
plt.figure(figsize=(15,10))
sns.heatmap(Data.corr(),annot=True,annot_kws={"size":12})
```

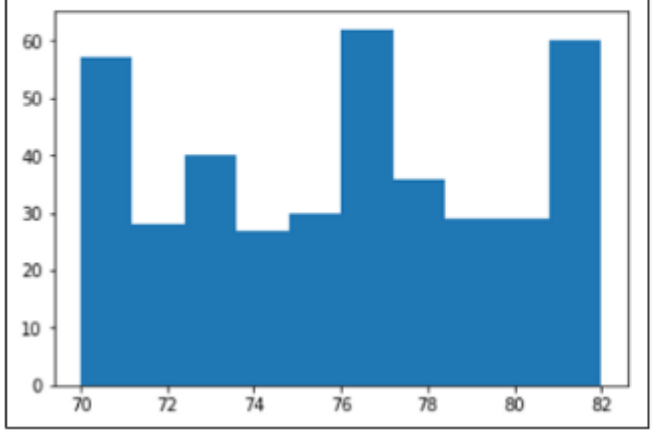
```
<matplotlib.axes._subplots.AxesSubplot at 0x29914b75c18>
```



plotting correlations as a Seaborn heatmap

```
1 plt.hist(Data['model year'])
```

```
(array([57., 28., 40., 27., 30., 62., 36., 29., 
 array([70. , 71.2, 72.4, 73.6, 74.8, 76. , 77.2,
 <a list of 10 Patch objects>)
```




```
1 plt.hist(Data['origin'])
```

```
(array([249.,   0.,   0.,   0.,   0.,  70.,   0.,
 array([1. , 1.2, 1.4, 1.6, 1.8, 2. , 2.2, 2.4, 2.6
 <a list of 10 Patch objects>)
```

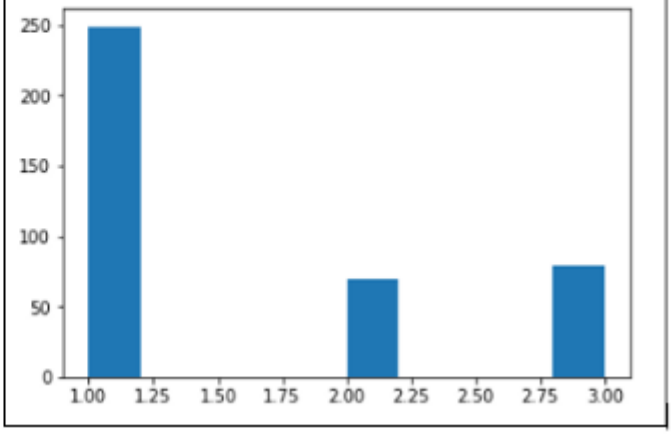
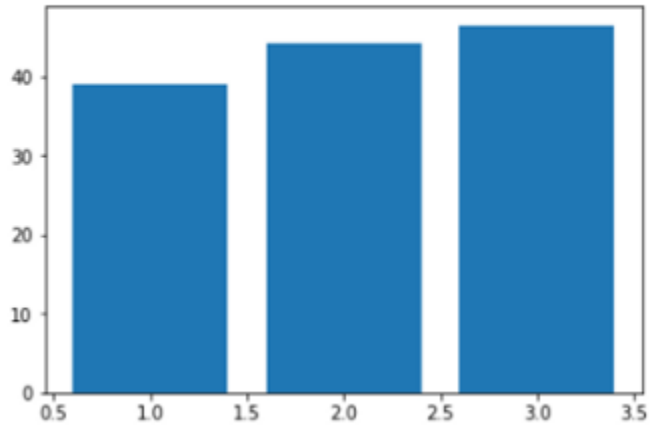


Figure 3: histograms of car origin and car model year

```
1 plt.bar(x=Data['origin'],height=Data['mpg'])
```

```
<BarContainer object of 398 artists>
```




```
1 plt.bar(x=Data['model year'],height=Data['mpg'])
```

```
<BarContainer object of 398 artists>
```

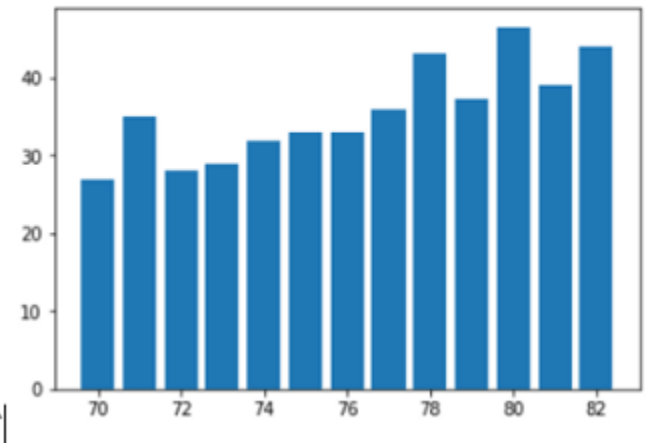


Figure 4: barplots of car origin and model year vs. mpg

```
1  plt.hist(Data['mpg'],histtype='bar')
```

```
(array([13., 78., 73., 61., 54., 48., 38., 22.,
 array([ 9.  , 12.76, 16.52, 20.28, 24.04, 27.8
        42.84, 46.6 ]),
 <a list of 10 Patch objects>)
```

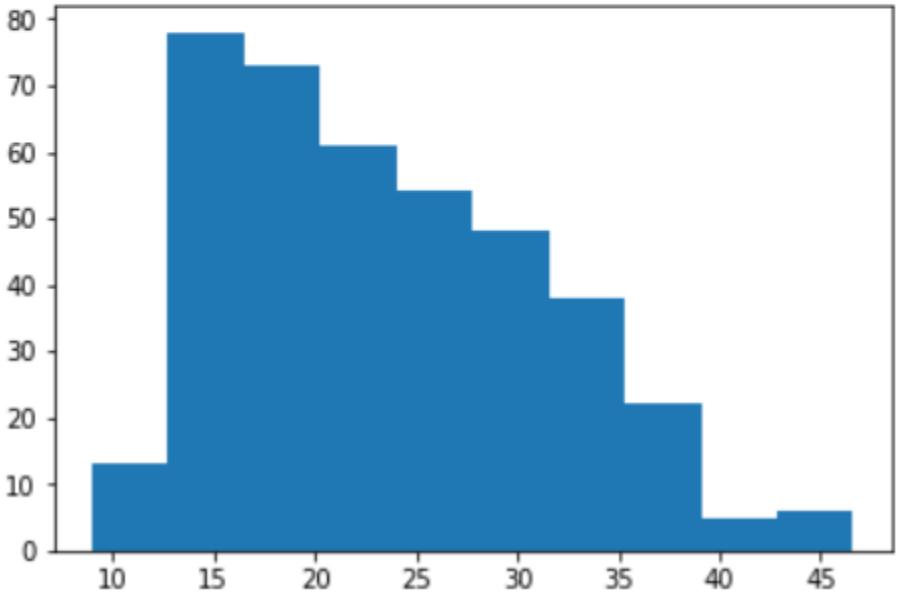


Figure 5: histogram of mpg

```
# The code below one-hot encodes car make and drops car model.Data['car make'] =
Data['car name']
Data['car make'] = Data['car name'].apply(lambda x:
x.split()[0])Data.drop(columns=['car name'],inplace=True)Data =
pd.get_dummies(Data,columns=['car make'])# Next: creating x and y belowx_no_log =
Data.drop(columns=['mpg'])
y_no_log = Data['mpg']# Imputing missing car horsepower values.imp =
SimpleImputer(missing_values=np.nan,strategy='median')
x_no_log['horsepower'] = imp.fit(x_no_log['horsepower'].values.reshape(-1,
1)).transform(x_no_log['horsepower'].values.reshape(-1, 1))
```

```
import torch
from torch import nn
```

```
# Define network dimensions
n_input_dim = xtrain.shape[1]
# Layer size
n_hidden = 4 # Number of hidden nodes
n_output = 1 # Number of output nodes for predicted mpg

# Build mdel
torch_model = torch.nn.Sequential(
    torch.nn.Linear(n_input_dim, n_hidden),
    torch.nn.ELU(),
    torch.nn.Linear(n_hidden, n_output)
)

print(torch_model)
```

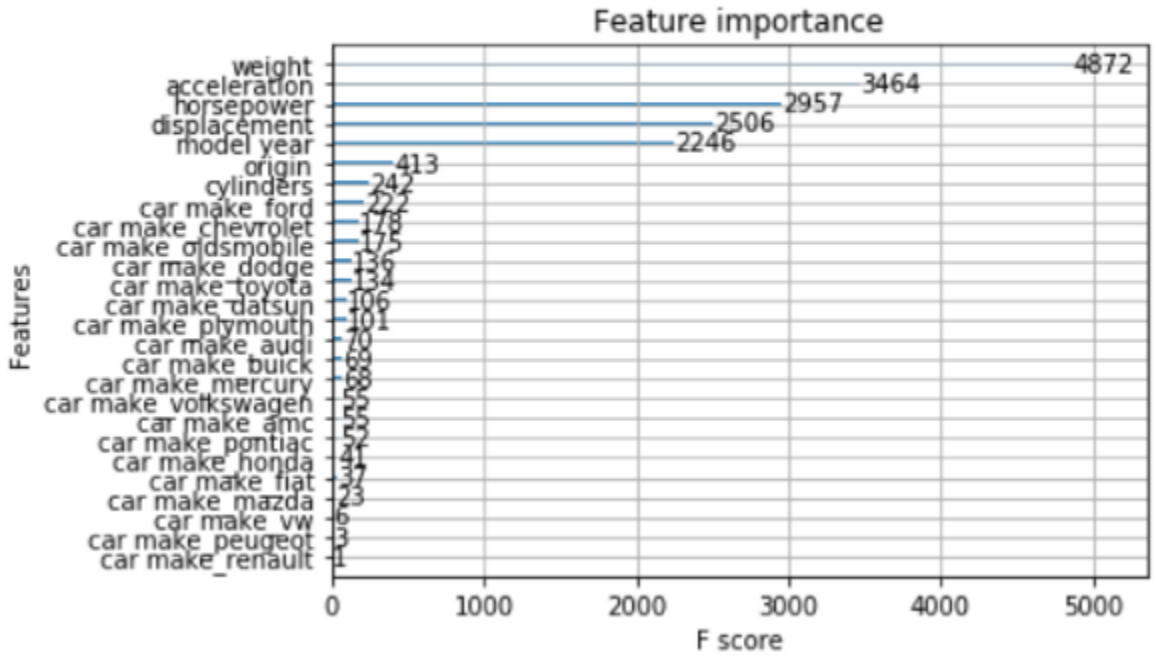
```
Sequential(
  (0): Linear(in_features=62, out_features=4, bias=True)
  (1): ELU(alpha=1.0)
  (2): Linear(in_features=4, out_features=1, bias=True)
)
```

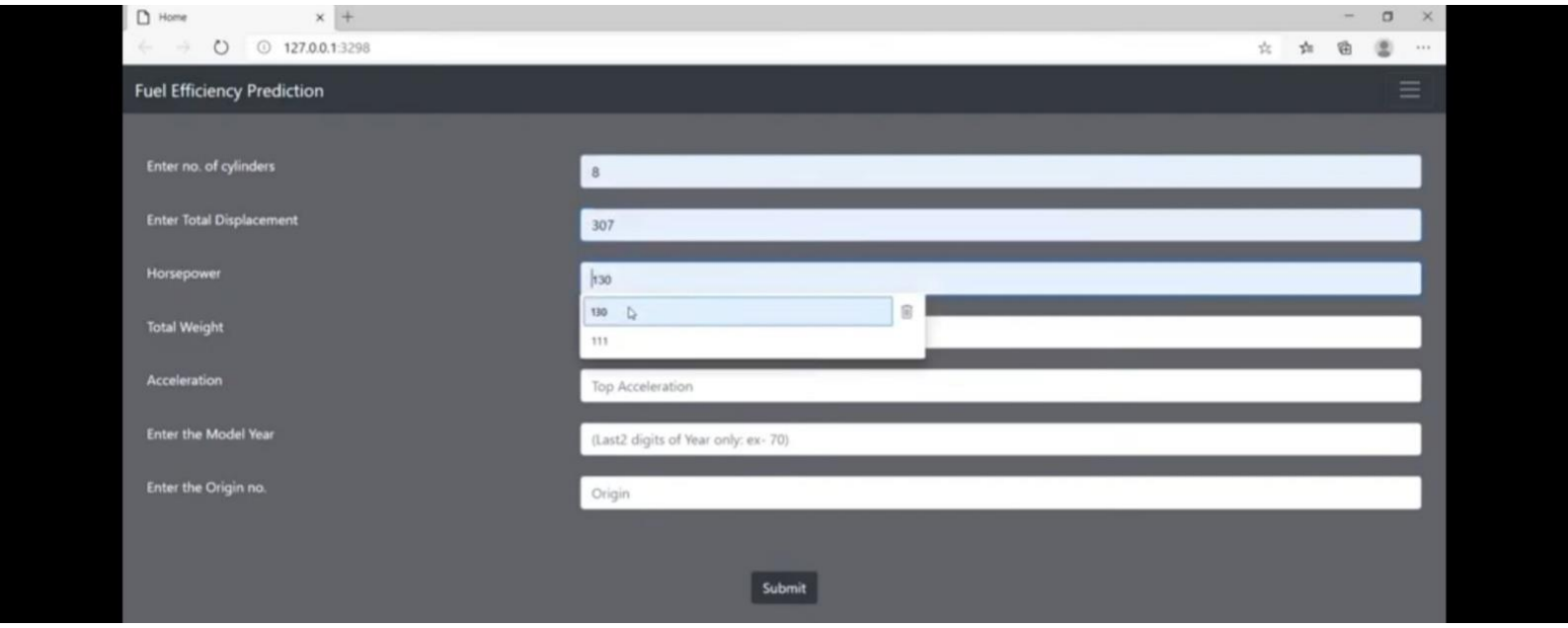
```
loss_func = torch.nn.MSELoss() #Choosing mean square error as loss metric
learning_rate = 0.01
optimizer = torch.optim.Adam(torch_model.parameters(), lr=learning_rate)
```

Figure 6: excerpt of code with PyTorch

```
1 plot_importance(XGB_best)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x14fb441e198>
```





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