Final Project Presentation

Optimal Spesification of Electric Vehicle

Anemon Team - Data Science Academy
Compfest 15

Team Member

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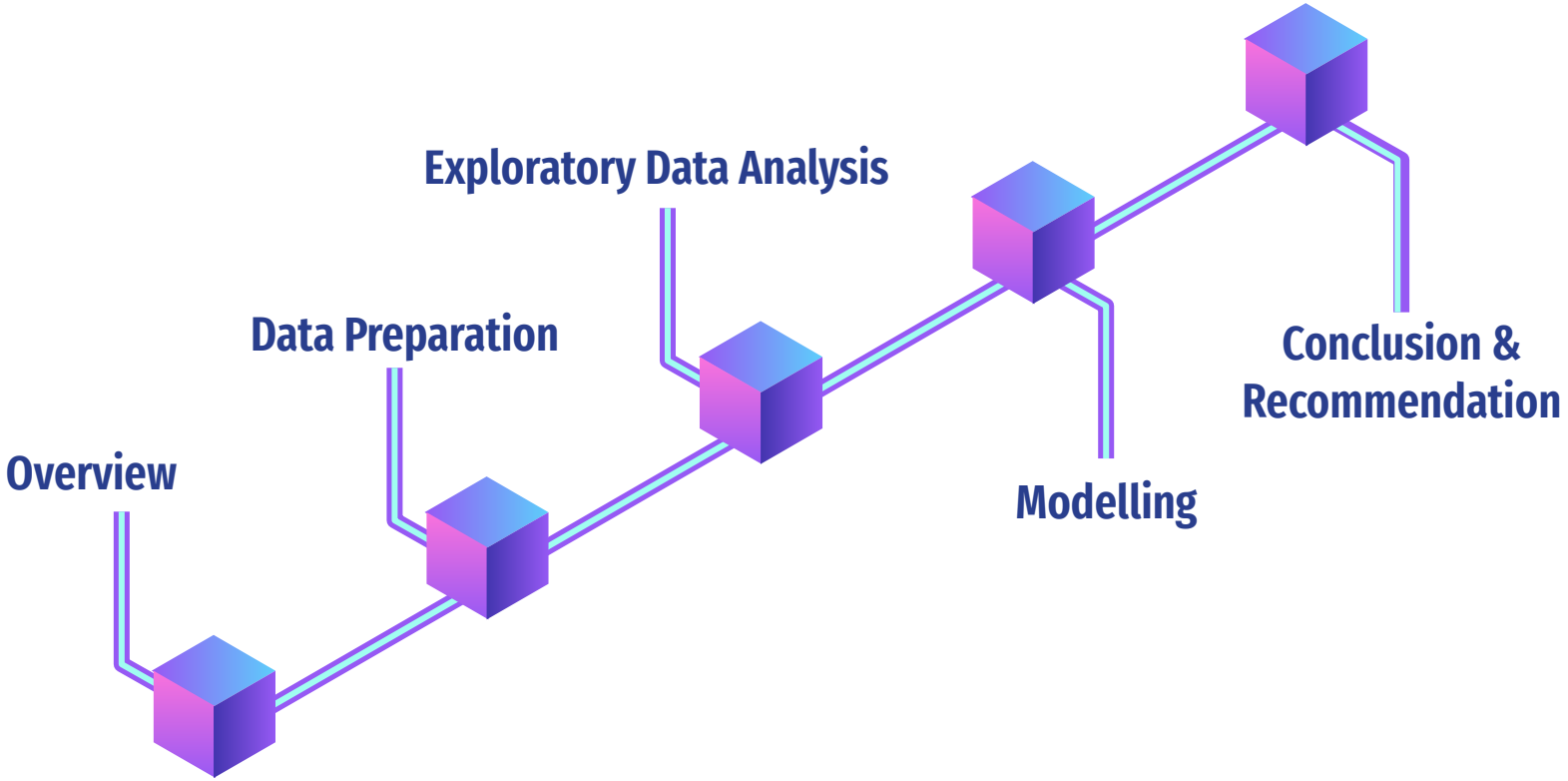
Session Outline



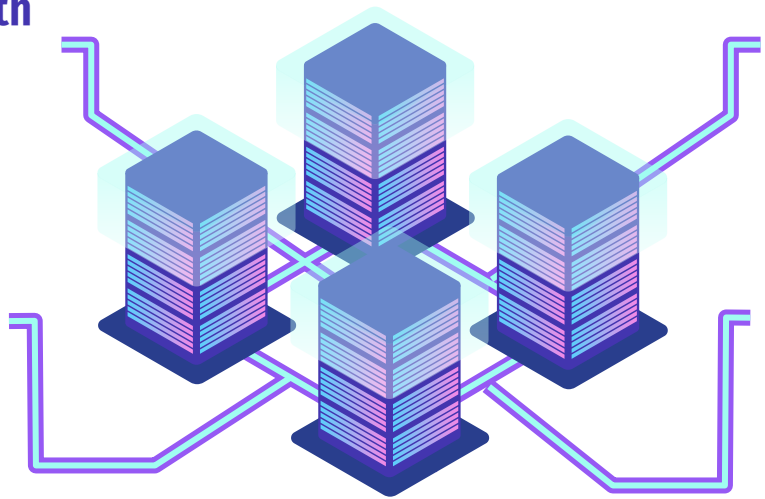
What happen with Electric Vehicles?

Massive Demand Growth

Electric vehicle is one of the alternative vehicle option which will not contribute in emission number rise

One of the Ways to Reduce Emissions

One of the biggest contributor in current earth condition is vehicle gas emission. Hence, people are looking for an alternative vehicle which are more environmentally friendly.



Worsening Earth Conditions

In each year, the number of pollution, deforestation, and biodiversity loss are keep increasing as a result of human's deed.

The Increases of Awareness

With the increases of this condition, people have gradually felt the negative effect. Due to this condition, environmental movement are gradually increasing.

Business Problem

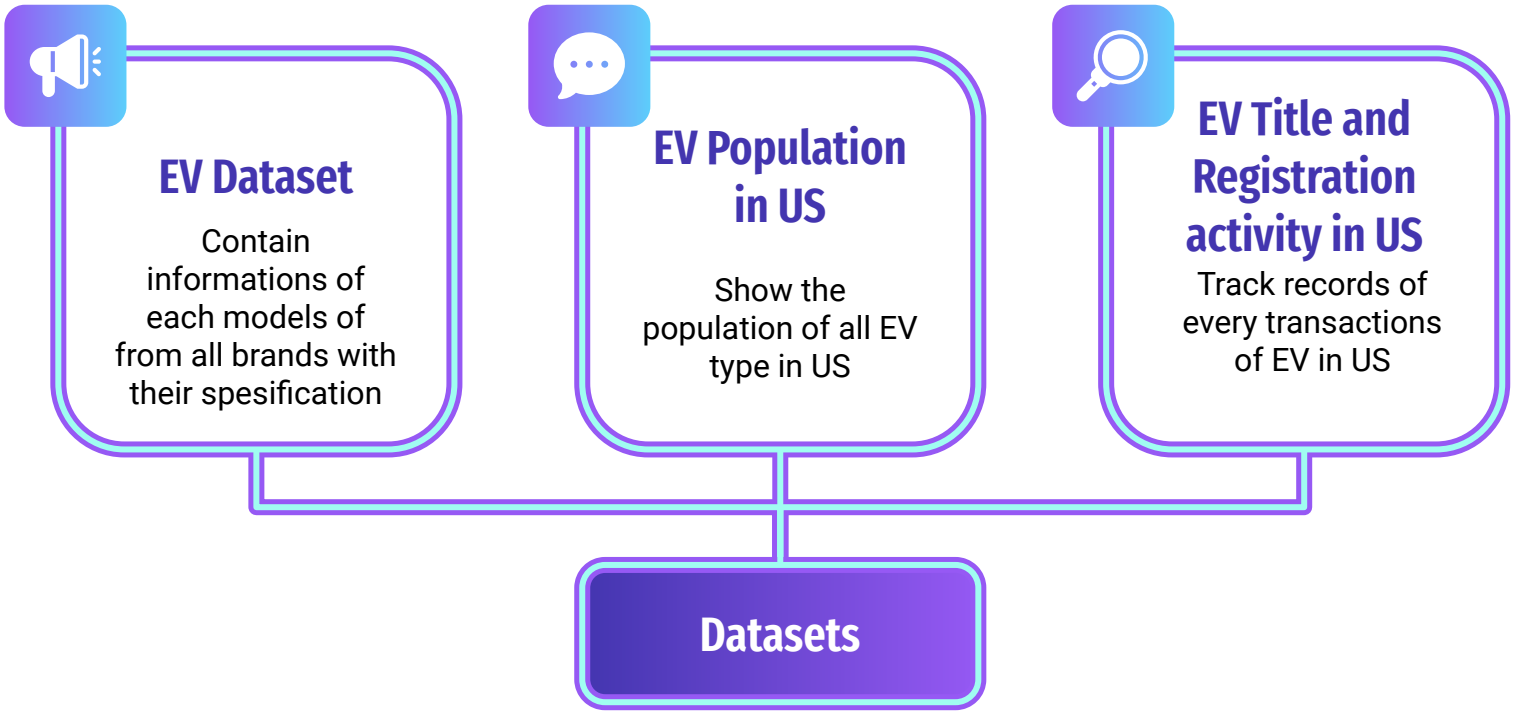
Continous developments in technology leading to improvement of electric vehicle characteristics. There is many brand such as Tesla release various types of model. They offers models with unique characteristics, fast charging capabilities, acceleration, electric range, etc. Every brands competes to create a models that can bring what costumer by improving every aspects and feature of electric vehicle including the efficiency. **But, with releasing new models with improved characteristics can bring it to high demand in market?**

Solution for Business Problem

Here are some of the solution to our Business Problem:

- Identify which specification are high on demand in the current market.
- Classify the efficiency to classes based on their range.
- Create a model prediction that would able to predict the efficiency of the EV.

Data Description



Data Wrangling & Preprocessing

1. Importing Data
2. Check data types from every variable
3. Remove dimension from every variable
4. Change data types from object to float because we want to make `.describe()`
5. Drop missing values and duplicates using `.drop_duplicates()` `.isnull().sum()`

Dataset 1 (Electric Vehicle Database)

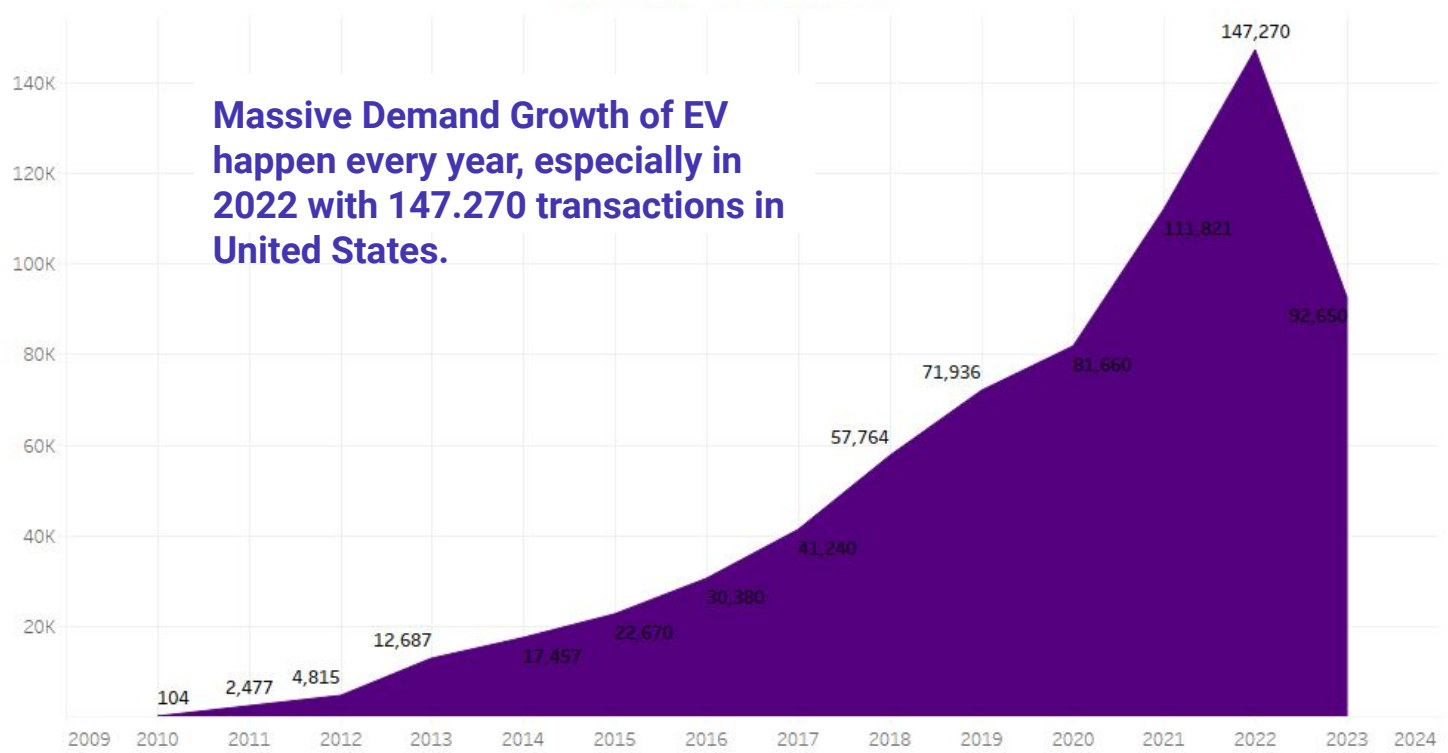
```
4  df_car.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 350 entries, 0 to 349
Data columns (total 9 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   Model               350 non-null    object
 1   Usable Battery      350 non-null    float64
 2   Year                350 non-null    object
 3   Acceleration        350 non-null    object
 4   Top Speed           350 non-null    object
 5   Range               350 non-null    object
 6   Efficiency          350 non-null    object
 7   Price (€)           309 non-null    object
 8   Charging capacity   350 non-null    object
dtypes: float64(1), object(8)
memory usage: 24.7+ KB
```

```
1  df_car_model.info()
```

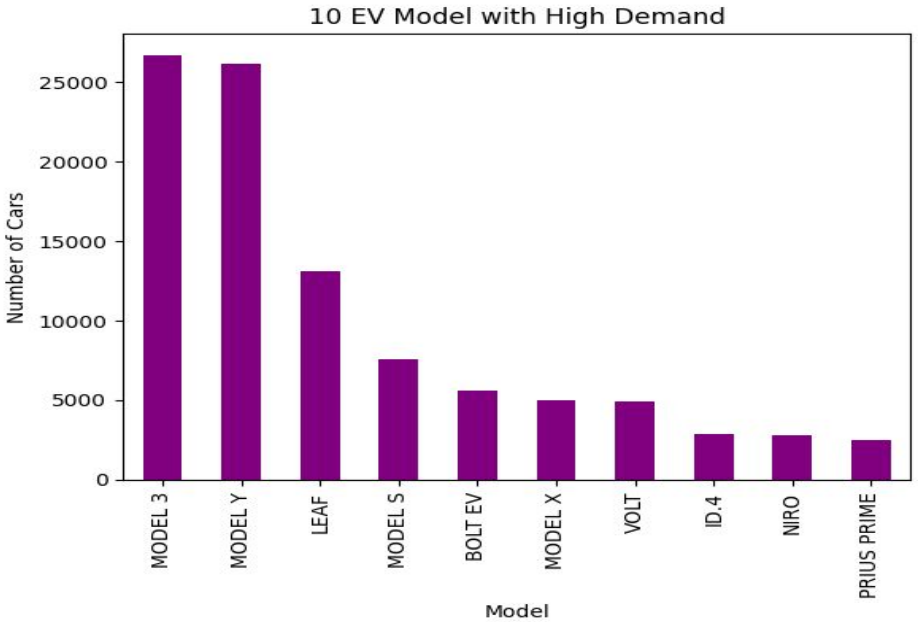
```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 348 entries, 0 to 349
Data columns (total 9 columns):
 #   Column                Non-Null Count  Dtype
---  ------                --------------  -----
 0   Model                 348 non-null    object
 1   Usable Battery        348 non-null    float64
 2   Year                  348 non-null    object
 3   Acceleration          348 non-null    float64
 4   Top Speed             348 non-null    float64
 5   Range                 348 non-null    float64
 6   Efficiency            348 non-null    float64
 7   Charging capacity     348 non-null    float64
 8   Charging Speed (hour) 348 non-null    float64
dtypes: float64(7), object(2)
memory usage: 27.2+ KB
```

The Rise of Electric Vehicle in US



Trend of Electric Vehicles

The data show the 3 Model as the most popular model from Tesla, with 26684 already sold followed by the Y model, Leaf, S Model, Bolt EV, and so on.



Tesla Model 3

Usable Battery	Year	Acceleration	Top Speed	Range	Efficiency	Charging capacity	Price
57.5 kWh	2021	6.1 sec	225 km/h	405 km	142 Wh/km	680 km/h	$32,740†

Tesla Model Y

Usable Battery	Year	Acceleration	Top Speed	Range	Efficiency	Charging capacity	Price
57.5 kWh	2023	6.9 sec	217 km/h	350 km	164 Wh/km	580 km/h	$40,240†

Nissan Leaf

Usable Battery	Year	Acceleration	Top Speed	Range	Efficiency	Charging capacity	Price
39 kWh	2022	7.9 sec	144 km/h	235 km	166 Wh/km	230 km/h	$28,140

Tesla Model 3

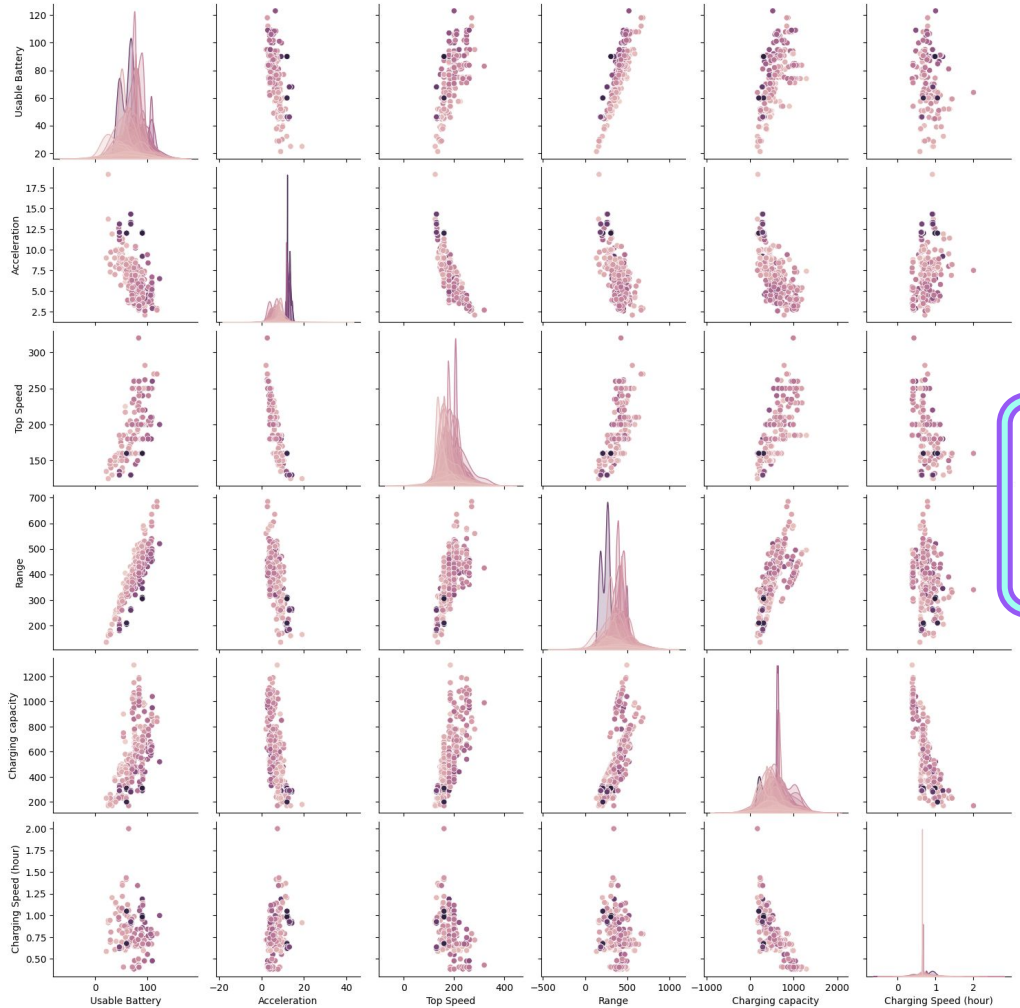
Compared to the other top selling EV, Tesla Model 3 have a moderate selling price. Despite that, this model have the highest number of Top Speed, Range, battery capacity, and Efficiency

Tesla Model Y

This EV model have the highest selling price among the other top selling EV. Despite the insignificant difference of the machine performance compared to the Tesla Model 3, Tesla Model Y offers more interior space which up to 7 person, panoramic sunroof, a power liftgate, and heated front seats.

Nissan Leaf

With the lowest price compared to the other top selling model, Nissan Leaf also offers the lowest machine performance out of the other model. This EV could be considered as enough for city usage.



Pair Plot of Efficiency

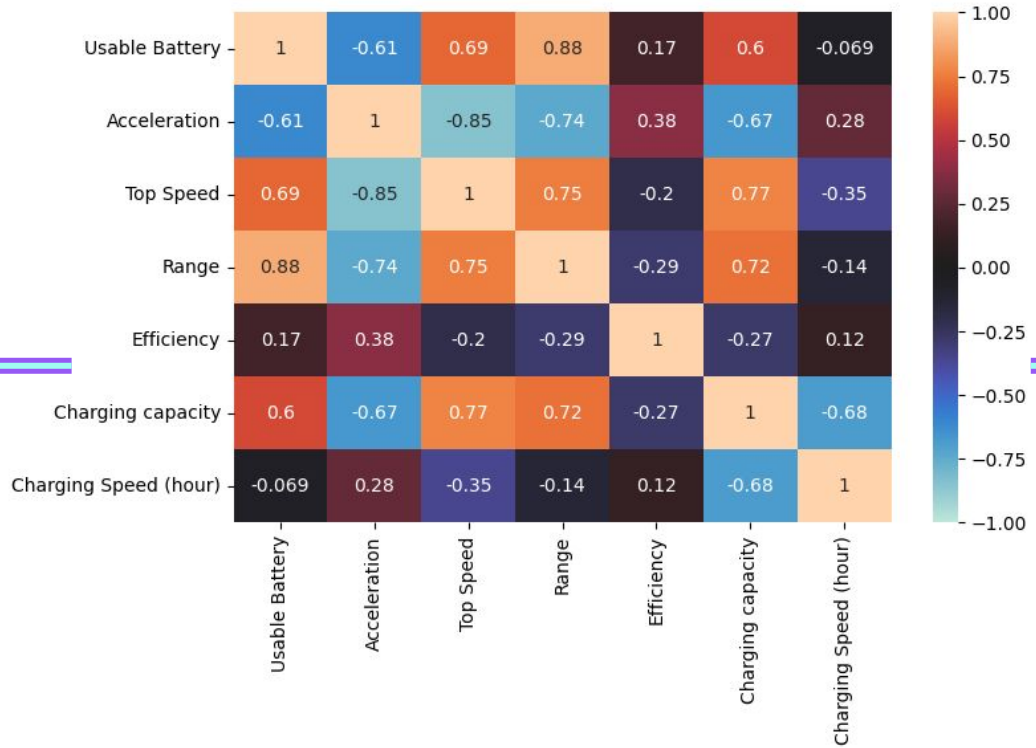
At present, models with low efficiency values have come to dominate, thus making the creation of new models with low efficiency values a suitable choice.

Correlation-Heatmap

Usable Battery
Have low correlation to efficiency

Top Speed
Have low correlation to efficiency

Charging speed
Have low correlation to efficiency

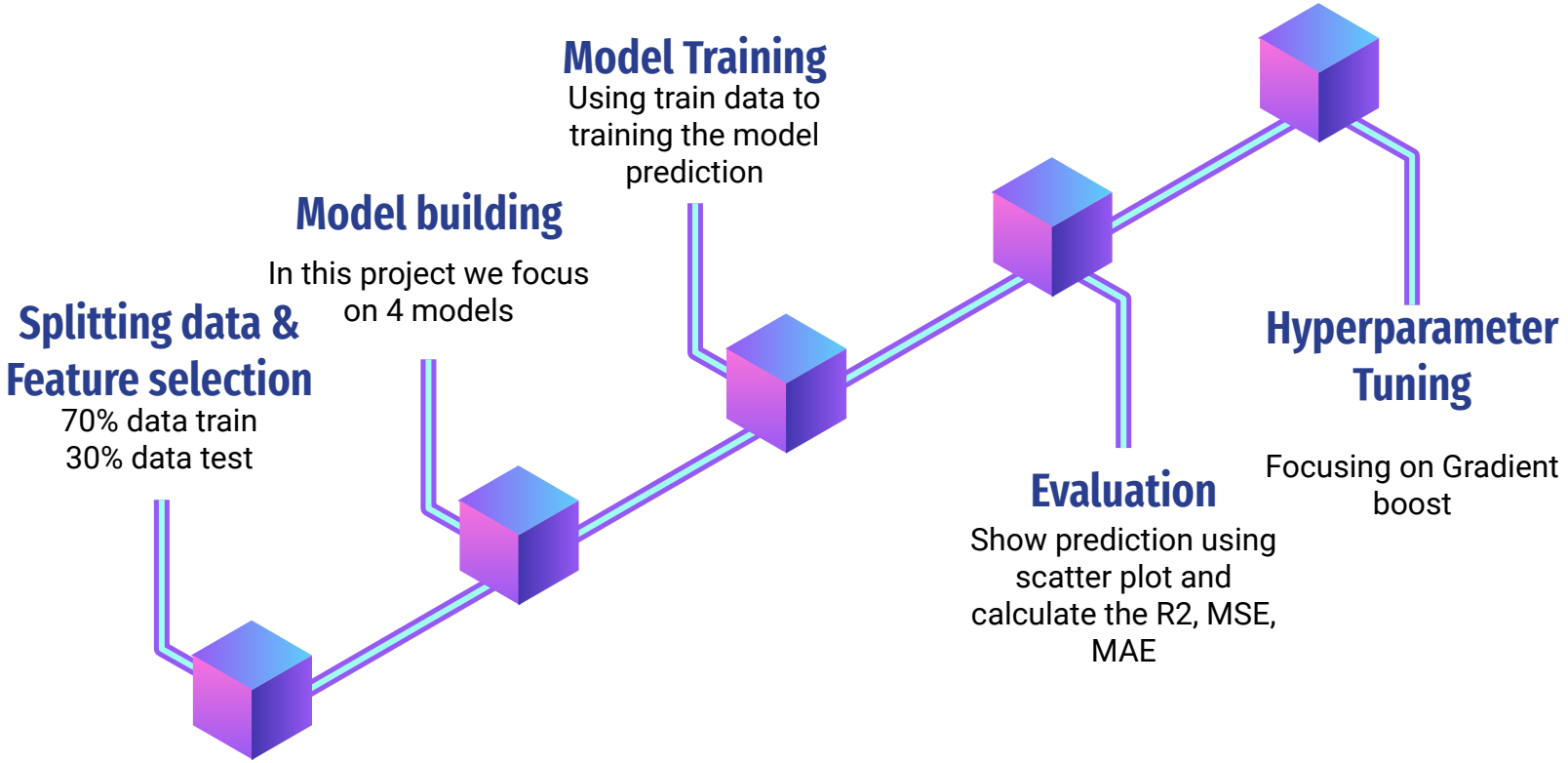


Acceleration
Have the highest correlation to efficiency

Electric Range
Have the highest correlation to efficiency after acceleration

Charging capacity
Have high correlation to efficiency after electric range

Modelling



Splitting data & Feature selection

70% data train
30% data test

Model building

In this project we focus on 4 models

Model Training

Using train data to training the model prediction

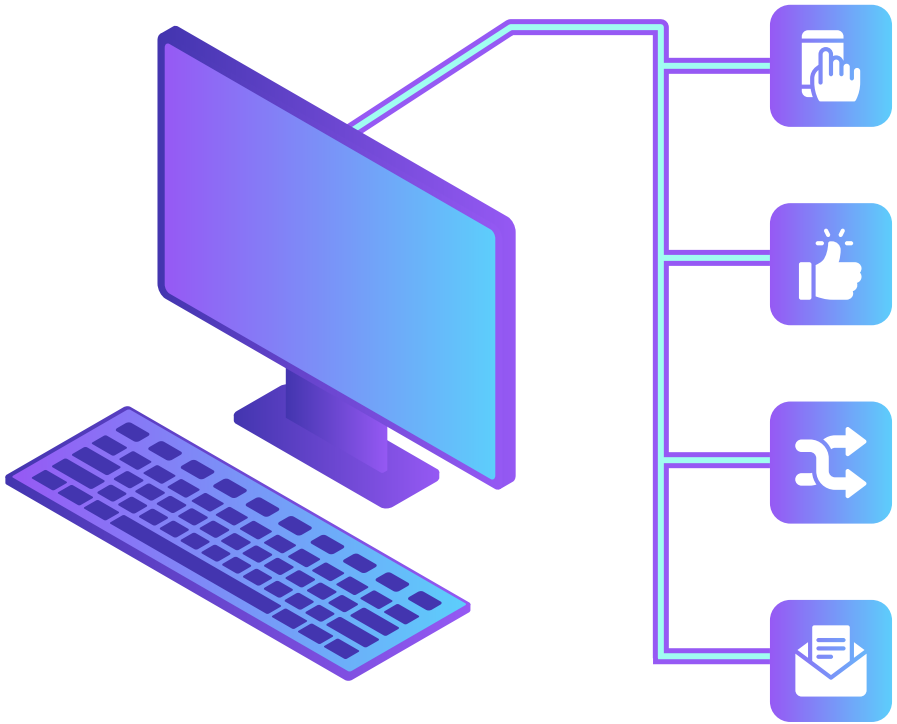
Evaluation

Show prediction using scatter plot and calculate the R2, MSE, MAE

Hyperparameter Tuning

Focusing on Gradient boost

Modelling and Evaluation



Linear Regression

r2 score: 0.9134237322519088
mse score: 81.93588973491133
mae score: 6.05704389217962

Decision Tree

r2 score: 0.8790606622111363
mse score: 114.45714285714286
mae score: 7.0095238095238095

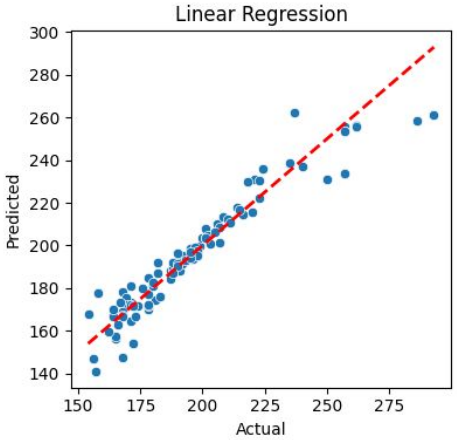
Random Forest

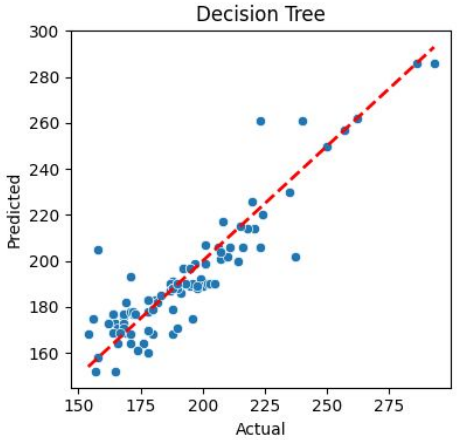
r2 score: 0.9085863441259857
mse score: 86.514
mae score: 6.162857142857142

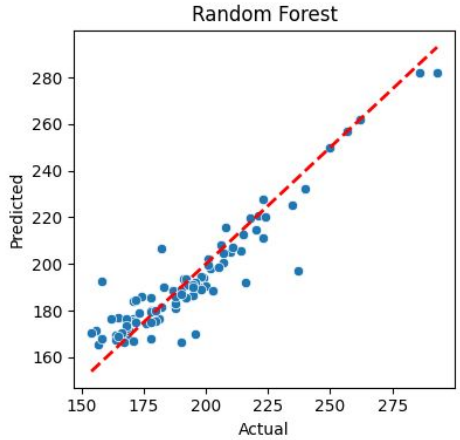
Gradient Boost

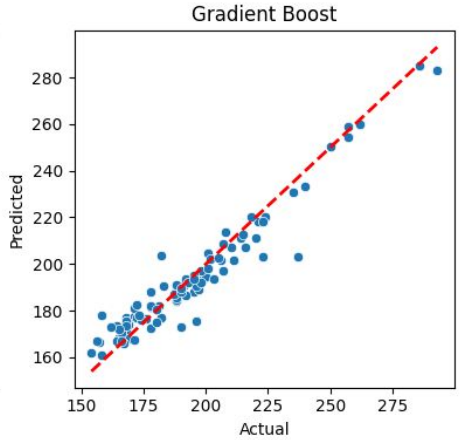
r2 score: 0.941507915553387
mse score: 55.356982995937386
mae score: 5.264922107270218

Model evaluation using scatter plot









The Model that show best performance

1

Gradient Boosting

Show the lowest number of R squared error, MSE, MAE

2

Random Forest

Have low number & balance of MSE, MAE

3

Linear Regression

Show good result in R squared error

Hyperparameter tuning

```
from sklearn.model_selection import GridSearchCV

parameter_grid = {
    'n_estimators': [150, 200, 300],
    'learning_rate': [0.01, 0.1, 0.2],
    'max_depth': [3, 4, 5]
}

gb_reg = GradientBoostingRegressor()
grid_search = GridSearchCV(gb_reg, parameter_grid, cv=5, scoring='neg_mean_squared_error')

grid_search.fit(X_train, Y_train)
```

```
[66] best_parameter = grid_search.best_params_
     print("Best Parameters:", best_parameter)

     Best Parameters: {'learning_rate': 0.1, 'max_depth': 4, 'n_estimators': 200}
```

```
[67] gb_bestmodel = grid_search.best_estimator_
```

```
[68] gb_predictions = gb_bestmodel.predict(X_test)
```

```
[69] gb2_pred_r2 = r2_score(Y_test, gb_predictions)
     gb2_pred_mse = mean_squared_error(Y_test, gb_predictions)
     gb2_pred_mae = mean_absolute_error(Y_test, gb_predictions)

     print('Gradient Boost')
     print('r2 score:', gb2_pred_r2)
     print('mse score:', gb2_pred_mse)
     print('mae score:', gb2_pred_mae)

     Gradient Boost
     r2 score: 0.9365532128180125
     mse score: 60.04611995638178
     mae score: 4.5589708399584925
```

Conclusion & Recommendation

The demand of EV is massively growing and will continuously grow in the future

Improving features in EV can lead to good demand in market

the market demonstrates a strong preference for EV that excel in attributes such as top speed, range, battery capacity, and efficiency.

Improving the efficiency will be a good choice to make new models

customers tend to choose moderate price over lower specifications at an equally low price.

in order to optimize sales pricing, it is unnecessary to manufacture vehicles of larger dimensions.