```
!pip install pydantic
!pip install PyYAML
!pip install jinja2
!pip install visions
!pip install htmlmin
!pip install phik
!pip install requests
!pip install tqdm
!pip install seaborn
!pip install multimethod
!pip install statsmodels
!pip install typeguard
!pip install imagehash
!pip install wordcloud
!pip install dacite
!pip install numba
```

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
```

```
! python --version
```

```
Python 3.10.12
```

```
import sys
!{sys.executable} -m pip install -U ydata-profiling
!jupyter nbextension enable --py widgetsnbextension
```

```
from google.colab import files
uploaded = files.upload()
```

```
Choose Files used_cars.csv
• used_cars.csv(text/csv) - 611832 bytes, last modified: 9/25/2023 - 100% done
Saving used_cars.csv to used_cars.csv
```

```
data_file = "used_cars.csv"
df= pd.read_csv(data_file)
df
```

	brand	model	model_year	milage	fuel_type	engine	transmission	ext_

```
print(df.dtypes)
```

```
brand           object
model           object
model_year       int64
milage          object
fuel_type       object
engine          object
transmission    object
ext_col         object
int_col         object
accident        object
clean_title     object
price           object
dtype: object
```

3.5L V6

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4009 entries, 0 to 4008
Data columns (total 12 columns):
 #   Column        Non-Null Count  Dtype 
---  ------        --------------  ----- 
 0   brand         4009 non-null   object
 1   model         4009 non-null   object
 2   model_year    4009 non-null   int64 
 3   milage        4009 non-null   object
 4   fuel_type     3839 non-null   object
 5   engine        4009 non-null   object
 6   transmission  4009 non-null   object
 7   ext_col       4009 non-null   object
 8   int_col       4009 non-null   object
 9   accident      3896 non-null   object
 10  clean_title   3413 non-null   object
 11  price         4009 non-null   object
dtypes: int64(1), object(11)
memory usage: 376.0+ KB
```

```
df['milage'] = df['milage'].str.replace(r'\D', '', regex=True)
df['milage'] = df['milage'].astype(float)
df['price'] = df['price'].str.replace(r'\D', '', regex=True)
df['price'] = df['price'].astype(float)
df
```

	brand	model	model_year	milage	fuel_type	engine	transmission	ext_
0	Ford	Utility Police Interceptor Base	2013	51000.0	E85 Flex Fuel	300.0HP 3.7L V6 Cylinder Engine Flex Fuel Capa...	6-Speed A/T	B
1	Hyundai	Palisade SEL	2021	34742.0	Gasoline	3.8L V6 24V GDI DOHC	8-Speed Automatic	Moon C
2	Lexus	RX 350 RX 350	2022	22372.0	Gasoline	3.5 Liter DOHC	Automatic	I
3	INFINITI	Q50 Hybrid Sport	2015	88900.0	Hybrid	354.0HP 3.5L V6 Cylinder Engine Gas/Electric H...	7-Speed A/T	B
4	Audi	Q3 45 S line Premium	2021	9835.0	Gasoline	2.0L I4 16V GDI DOHC Turbo	8-Speed Automatic	Gla W

```
df.isna().sum()
#df.dtypes
```

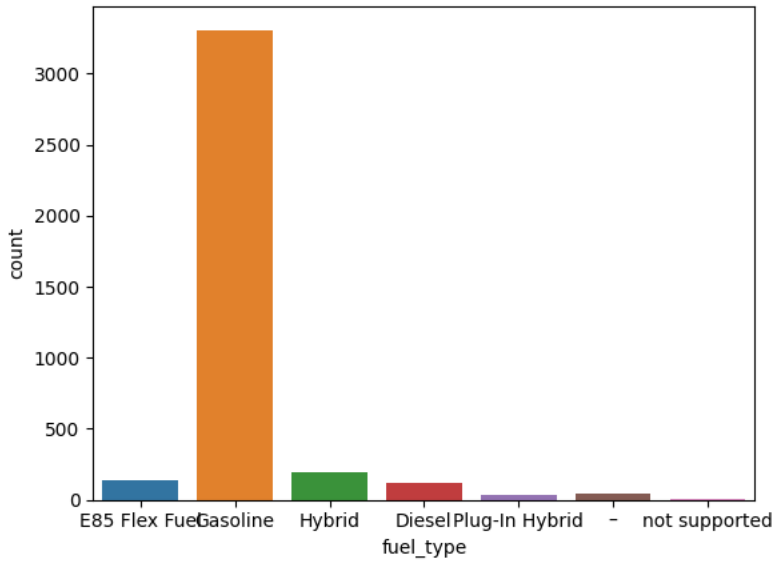
```
brand             0
model             0
model_year        0
milage            0
fuel_type       170
engine            0
transmission      0
ext_col           0
int_col           0
accident        113
clean_title     596
price             0
dtype: int64
```

```
df['accident'] = df['accident'].replace({'At least 1 accident or damage reported' : 'Yes',
'None reported': 'No'})
df['clean_title'] = df['clean_title'].fillna('No')
#this last part is done by me
df['accident'] = df['accident'].fillna('No')
df
```

	brand	model	model_year	milage	fuel_type	engine	transmission	ext_
0	Ford	Utility Police Interceptor Base	2013	51000.0	E85 Flex Fuel	300.0HP 3.7L V6 Cylinder Engine Flex Fuel Capa...	6-Speed A/T	B
1	Hyundai	Palisade SEL	2021	34742.0	Gasoline	3.8L V6 24V GDI DOHC	8-Speed Automatic	Moon C
2	Lexus	RX 350 RX 350	2022	22372.0	Gasoline	3.5 Liter DOHC	Automatic	I
3	INFINITI	Q50 Hybrid Sport	2015	88900.0	Hybrid	354.0HP 3.5L V6 Cylinder Engine Gas/Electric H...	7-Speed A/T	B

```
sns.countplot(x = 'fuel_type', data = df)
```

```
<Axes: xlabel='fuel_type', ylabel='count'>
```




```
df['fuel_type'] = df['fuel_type'].fillna('Gasoline')
df
```

```
df.isna().sum()
#df.dtypes
```

```
brand           0
model           0
model_year      0
milage          0
fuel_type       0
engine          0
transmission    0
ext_col         0
int_col         0
accident        0
clean_title     0
price           0
dtype: int64
```

```
df.dtypes
```

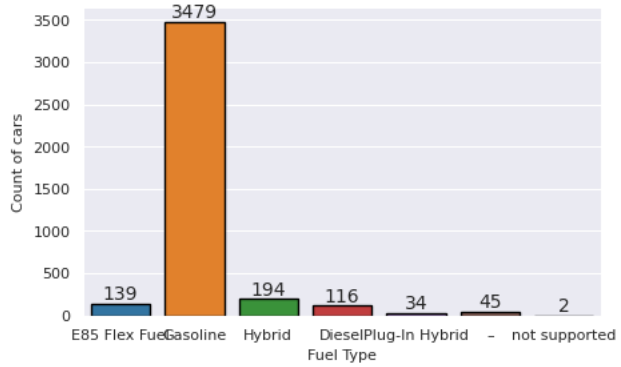
```
brand            object
model            object
model_year        int64
milage          float64
fuel_type        object
engine           object
transmission     object
ext_col          object
int_col          object
accident         object
clean_title      object
price           float64
dtype: object
```

```
Current_Year = 2023
df['age'] = Current_Year - df['model_year']
df['age'] = df['age'].astype(np.int64)
df
```

```
df_new = df.drop(['model_year'], axis=1)
df_new
```

	brand	model	milage	fuel_type	engine	transmission	ext_col	int_col
0	Ford	Utility Police Interceptor Base	51000.0	E85 Flex Fuel	300.0HP 3.7L V6 Cylinder Engine Flex Fuel Capa...	6-Speed A/T	Black	Black
1	Hyundai	Palisade SEL	34742.0	Gasoline	3.8L V6 24V GDI DOHC	8-Speed Automatic	Moonlight Cloud	Gray
2	Lexus	RX 350 RX 350	22372.0	Gasoline	3.5 Liter DOHC	Automatic	Blue	Black
3	INFINITI	Q50 Hybrid Sport	88900.0	Hybrid	354.0HP 3.5L V6 Cylinder Engine Gas/Electric H...	7-Speed A/T	Black	Black

```
plt.figure(figsize=(20,8))
plt.subplot(1,2,1)
plt.title('Car Selling price Distribution Plot')
sns.distplot(df_new['price'])
sns.set_style('darkgrid')

plt.subplot(1,2,2)
plt.title('Car Selling price Spread')
sns.boxplot(y=df_new['price'])
sns.set_style('darkgrid')

plt.show()


# plotting the target-age scatter graph
sns.scatterplot(data=df_new, x="age", y="price")
sns.set_style('darkgrid')
plt.title("Selling price by age", size=12)
plt.ylabel("Selling price (Thousand bucks)", size=10)
plt.xlabel("Age", size=10)
plt.show()


#Distribution
plt.figure(figsize=(20,8))
plt.subplot(1,2,1)
plt.title('Car Milage Plot')
sns.distplot(df_new.milage, color='green')

#Spread
plt.subplot(1,2,2)
plt.title('Car milage Spread')
sns.boxplot(y=df_new.milage)

plt.show()


df_sym = pd.DataFrame(df_new['accident'].value_counts())
df_sym.plot.pie(subplots=True, labels = df_sym.index.values, autopct='%1.1f%%', fontsize=8)
# Unsquish the pie.
plt.gca().set_aspect('equal')
plt.show()


# Count of cars by fuel_type
plt.figure(figsize = (5, 3))
ax=sns.countplot(data=df_new, x=df.fuel_type, ec='black')
sns.set_style('darkgrid')
for cont in ax.containers:
    ax.bar_label(cont)
plt.ylabel('Count of cars', size=8)
plt.yticks(size=8)
plt.xlabel('Fuel Type', size=8)
plt.xticks(size=8)
plt.show()
```



```
# plotting the target-Fuel type scatter graph
sns.scatterplot(data=df_new, x="fuel_type", y="price")
sns.set_style('darkgrid')
plt.title("Fuel type vs. Selling price", size=10)
plt.ylabel("Selling price (Thousand bucks)", size=8)
plt.xlabel("Fuel type", size=8)
plt.show()


obj_cols = [col for col in df_new.columns if df_new[col].dtypes == 'O']
print('Number of Qualitative Variable: ', len(obj_cols))

def bar_charts(data, obj_cols):
    col_counter = 0
    data = df_new.copy()
    for col in obj_cols:
      data[col].value_counts().plot(kind = "bar",figsize=(10,2),fontsize=10)
      plt.xlabel(col)
      plt.title(col)
      plt.show()
      col_counter += 1
    print(col_counter, "variables have been plotted")

bar_charts(df_new, obj_cols)


num_cols = [col for col in df_new.columns if df_new[col].dtypes != 'O']
print('Number of Numerical Variable: ', len(num_cols))


def hist_for_nums(data, numeric_cols):
    col_counter = 0
    data = data.copy()
    for col in numeric_cols:
        data[col].plot.hist(alpha=0.5, color='y')
        plt.xlabel(col)
        plt.title(col)
        plt.show()
        col_counter += 1
    print(col_counter, "variables have been plotted")
hist_for_nums(df_new, num_cols)


import ydata_profiling
from ydata_profiling import ProfileReport
profile = ProfileReport(df)


profile


from sklearn import preprocessing
le = preprocessing.LabelEncoder()
for x in df_new.columns:
    if df_new[x].dtypes=='object':
       df_new[x]=le.fit_transform(df_new[x].astype(str))
corr = df_new.corr()
corr



df_new
```

	brand	model	milage	fuel_type	engine	transmission	ext_col	int_col	accident	clean_title	price	age
0	14	1743	51000.0	1	581	16	29	14	1	1	10300.0	10
1	19	1182	34742.0	2	566	32	185	71	1	1	38005.0	2
2	27	1325	22372.0	2	541	40	38	14	0	0	54598.0	1
4	3	1225	9835.0	2	200	32	120	14	0	0	34999.0	2
4007	14	666	33000.0	2	917	38	38	14	0	1	62999.0	3

```
X = df_new.iloc[:, list(range(10)) + [-1]]
y = df_new.iloc[:, -2]
```

```
X
#y
```

```
import statsmodels as sm
from statsmodels.api import OLS
from statsmodels.api import add_constant
```

```
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= 1)
X_train = add_constant(X_train)
X_test = add_constant(X_test)
```

```
#fit linear regression model

OLS_model = OLS(y_train, X_train).fit()

#view model summary
print(OLS_model.summary())
```

```
print(X_train.shape)
print(X_test.shape)
print(y_train.shape)
print(y_test.shape)
```

```
(3207, 12)
(802, 12)
(3207,)
(802,)
```

```
from sklearn.linear_model import LinearRegression
# Create an instance of the LinearRegression class
reg = LinearRegression()

# Fit the model to the data
reg.fit(X_train, y_train)
score_LR = reg.score(X_test, y_test)

print(score_LR)
```

```
0.3191546734509779
```

```
# Print the coefficients and intercept of the model
print(reg.coef_)
print('Intercept: ', reg.intercept_)
```

```
[ 0.00000000e+00  2.11754287e+02 -1.51749000e+00 -3.82413150e-01
 -4.68630937e+03  6.12280708e+01  1.86939042e+02  5.33937334e+00
  6.73130085e+01 -2.26895985e+03 -3.41477166e+03  1.45479648e+02]
Intercept:  31951.61963787728
```

Double-click (or enter) to edit

```
y_pred = reg.predict(X_test)
#First five preditions
#y_pred = reg.predict(X_test)[0:5]
#y_pred
```

```
import math
from sklearn.metrics import mean_absolute_error,mean_squared_error, r2_score

mae = mean_absolute_error(y_true=y_test,y_pred=y_pred)
#squared True returns MSE value, False returns RMSE value.
mse = mean_squared_error(y_true=y_test,y_pred=y_pred) #default=True
rmse = mean_squared_error(y_true=y_test,y_pred=y_pred,squared=False)
#rmse = math.sqrt(mse)

print("MAE:",mae)
print("MSE:",mse)
print("RMSE:",rmse)
```

```
MAE: 22922.871783004957
MSE: 1825516368.7970448
RMSE: 42726.061938786785
```

```
#Cross avlidation for Linear Regression

from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
from numpy import mean
from numpy import absolute
from numpy import sqrt


#Cross avlidation for Linear Regression on training set
#define cross-validation method to use
cv = KFold(n_splits=10, random_state=1, shuffle=True)

#use k-fold CV to evaluate linear Regression model
scores = cross_val_score(reg, X_train, y_train, scoring='neg_mean_absolute_error',
                         cv=cv, n_jobs=-1)
score = cross_val_score(reg, X_train, y_train, scoring='r2',
                         cv=cv, n_jobs=-1)

print(mean(score))

#view mean absolute error
print(mean(absolute(scores)))
#view RMSE
print(sqrt(mean(absolute(scores))))
```

```
0.24649214463535812
23903.8261184643
154.60862239365662
```

```
#Cross avlidation for Linear Regression (On test set)
cv = KFold(n_splits=10, random_state=1, shuffle=True)

#use k-fold CV to evaluate linear Regression model
scores = cross_val_score(reg, X_test, y_test, scoring='neg_mean_absolute_error',
                         cv=cv, n_jobs=-1)
score = cross_val_score(reg, X_test, y_test, scoring='r2',
                         cv=cv, n_jobs=-1)

print(mean(score))

#view mean absolute error
print(mean(absolute(scores)))
#view RMSE
print(sqrt(mean(absolute(scores))))
```

```
0.3304022253035129
22190.884699786868
148.96605217225456
```

```
#Random Forest Regression
from sklearn.ensemble import RandomForestRegressor
RF_regressor = RandomForestRegressor(n_estimators= 10, random_state= 0)
RF_regressor.fit(X_train, y_train)
```

```
RandomForestRegressor
RandomForestRegressor(n_estimators=10, random_state=0)
```

```
#Predicting the target values of the test set
y_pred_RF = RF_regressor.predict(X_test)
score_RF = RF_regressor.score(X_test, y_test)
print(score_RF)
#MSE
mse = float(mean_squared_error(y_test, y_pred_RF))
rmse = float(mean_squared_error(y_test, y_pred_RF, squared = False))
print("MSE: ", mse)
# RMSE (Root Mean Square Error)
#rmse = float(format(np.sqrt(mean_squared_error(y_test, y_pred_RF)), '.3f'))
print("\nRMSE: ", rmse)
```

```
0.440490377885139
MSE:  1500185040.3339524

RMSE:  38732.22224884537
```

```
# Random forets with Cross Validation (On training set)
scores_RF = cross_val_score(RF_regressor, X_train, y_train, scoring='neg_mean_absolute_error',
                            cv=10)
score_RF = cross_val_score(RF_regressor, X_train, y_train, scoring='r2',
                            cv=cv, n_jobs=-1)
print(mean(score_RF))
#view mean absolute error
print(mean(absolute(scores_RF)))
#view RMSE
print(sqrt(mean(absolute(scores_RF))))
```

```
0.032566581058069956
16790.1474208528
129.576801244871
```

```
# Random forets with Cross Validation (On testing set)
scores_RF = cross_val_score(RF_regressor, X_test, y_test, scoring='neg_mean_absolute_error',
                            cv=10)
score_RF = cross_val_score(RF_regressor, X_test, y_test, scoring='r2',
                            cv=cv, n_jobs=-1)
print(mean(score_RF))
#view mean absolute error
print(mean(absolute(scores_RF)))
#view RMSE
print(sqrt(mean(absolute(scores_RF))))
```

```
0.5569469417488535
15305.532827160496
123.71553187518734
```

```
#KNN Regression
from sklearn.neighbors import KNeighborsRegressor

# Instance and fit
knn_model = KNeighborsRegressor(n_neighbors=5)
knn_model.fit(X_train, y_train)

# Score
score_knn = knn_model.score(X_test, y_test)
print(score_knn)
```

```
-0.10260211256746499
```

```
preds = knn_model.predict(X_test)

# Performance
performance = pd.DataFrame({ 'True Value': y_test,
                             'Prediction': preds,
                             'Error': y_test - preds})
# View
performance
```

```
MSE = mean_squared_error(y_test, preds)
RMSE = mean_squared_error(y_test, preds, squared=False)
print('MSE:', MSE)
print('RMSE:', RMSE)
```

```
MSE: 2956351650.329177
RMSE: 54372.34269671647
```

```
#Cross validation on training set
from sklearn.model_selection import cross_val_score
#create a new KNN model
knn_scores = cross_val_score(knn_model, X_train, y_train, scoring='neg_mean_absolute_error',
                         cv=10)
knn_score = cross_val_score(knn_model, X_train, y_train, scoring='r2',
                         cv=10)

print(mean(knn_score))
#print('knn_scores mean:{}'.format(np.mean(cv_scores)))
#view mean absolute error
print(mean(absolute(knn_scores)))
#view RMSE
print(sqrt(mean(absolute(knn_scores))))
```

```
0.08251636475621885
22904.264565031153
151.34154936775013
```

```
#Cross validation on testing set

knn_scores = cross_val_score(knn_model, X_test, y_test, scoring='neg_mean_absolute_error',
                         cv=10)
knn_score = cross_val_score(knn_model, X_test, y_test, scoring='r2',
                         cv=10)

print(mean(knn_score))
#print('knn_scores mean:{}'.format(np.mean(cv_scores)))
#view mean absolute error
print(mean(absolute(knn_scores)))
#view RMSE
print(sqrt(mean(absolute(knn_scores))))
```

```
0.29580015419224237
21771.140990740743
147.55046930030667
```

```
#model Comparison
"""pd.DataFrame({'Linear Regression':[score_LR],
              'Random forest Regression': [score_RF],
              'KNN Regression': [score_knn]})



features = ['milage','age', 'accident']
X = df_new.loc[:, features]
y = df_new.loc[:, ['price']]



X_train, X_test, y_train, y_test = train_test_split(X, y, test_size= 0.2, random_state= 1)



# Create an instance of the LinearRegression class
L_reg = LinearRegression()

# Fit the model to the data
L_reg.fit(X_train, y_train)
L_score = L_reg.score(X_test, y_test)
print(L_score)
```

```
0.18699535268341005
```

```
y_pred = L_reg.predict(X_test)
```

```
L_mae = mean_absolute_error(y_true=y_test,y_pred=y_pred)
#squared True returns MSE value, False returns RMSE value.
L_mse = mean_squared_error(y_true=y_test,y_pred=y_pred) #default=True
L_rmse = mean_squared_error(y_true=y_test,y_pred=y_pred,squared=False)
print(L_mse)
print(L_rmse)
```

```
2179868515.9626217
46689.062059144235
```

```
#Random Forest Regressor
R_regressor = RandomForestRegressor(n_estimators= 10, random_state= 0)
R_regressor.fit(X_train, y_train)
```

```
<ipython-input-38-0e370bea7b76>:3: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the s
  R_regressor.fit(X_train, y_train)
```

```
RandomForestRegressor
RandomForestRegressor(n_estimators=10, random_state=0)
```

```
#Predicting the target values of the test set
y_pred_R = R_regressor.predict(X_test)
score_R = R_regressor.score(X_test, y_test)
print(score_R)
#MSE
R_mse = float(mean_squared_error(y_test, y_pred_R))
R_rmse = float(mean_squared_error(y_test, y_pred_R, squared = False))
print("MSE: ", R_mse)
# RMSE (Root Mean Square Error)
#rmse = float(format(np.sqrt(mean_squared_error(y_test, y_pred_RF)), '.3f'))
print("\nRMSE: ", R_rmse)
```

```
-0.011120052129570457
MSE:  2711065397.6833167

RMSE:  52067.89219551063
```

```
#KNN regression
knn_reg = KNeighborsRegressor(n_neighbors=5)
knn_reg.fit(X_train, y_train)

# Score
knn_score = knn_reg.score(X_test, y_test)
print(knn_score)
```

```
0.04948506488675841
```

```
predicted_value = knn_reg.predict(X_test)


KNN_MSE = mean_squared_error(y_test, predicted_value)
KNN_RMSE = mean_squared_error(y_test, predicted_value, squared=False)
```