[1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split, GridSearchCV
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import r2_score, mean_squared_error, mean_absolute_error
from sklearn.linear_model import LinearRegression
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import RandomForestRegressor, GradientBoostingRegressor
from sklearn.svm import SVR
```

[2]:

```
df = pd.read_csv("CarPrice_Assignment.csv")
df.head()
```

[2]:

	car_ID	symboling	CarName	fueltype	aspiration	doornumber	carbody	drivewheel	enginelocation	wheelbase	...	enginesize	fuelsystem	boreratio	stroke
0	1	3	alfa-romero giulia	gas	std	two	convertible	rwd	front	88.6	...	130	mpfi	3.47	2.68
1	2	3	alfa-romero stelvio	gas	std	two	convertible	rwd	front	88.6	...	130	mpfi	3.47	2.68
2	3	1	alfa-romero Quadrifoglio	gas	std	two	hatchback	rwd	front	94.5	...	152	mpfi	2.68	3.47
3	4	2	audi 100 ls	gas	std	four	sedan	fwd	front	99.8	...	109	mpfi	3.19	3.40
4	5	2	audi 100ls	gas	std	four	sedan	4wd	front	99.4	...	136	mpfi	3.19	3.40

5 rows × 26 columns

```
#Basic info and missing values
df.info()
df.isnull().sum()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 205 entries, 0 to 204
Data columns (total 26 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   car_ID            205 non-null    int64
 1   symboling         205 non-null    int64
 2   CarName           205 non-null    object
 3   fueltype          205 non-null    object
 4   aspiration        205 non-null    object
 5   doornumber        205 non-null    object
 6   carbody           205 non-null    object
 7   drivewheel        205 non-null    object
 8   enginelocation    205 non-null    object
 9   wheelbase         205 non-null    float64
 10  carlength         205 non-null    float64
 11  carwidth          205 non-null    float64
 12  carheight         205 non-null    float64
 13  curbweight        205 non-null    int64
 14  enginetype        205 non-null    object
 15  cylindernumber    205 non-null    object
 16  enginesize        205 non-null    int64
 17  fuelsystem        205 non-null    object
 18  boreratio         205 non-null    float64
 19  stroke            205 non-null    float64
 20  compressionratio  205 non-null    float64
 21  horsepower        205 non-null    int64
 22  peakrpm           205 non-null    int64
 23  citympg           205 non-null    int64
 24  highwaympg        205 non-null    int64
 25  price             205 non-null    float64
dtypes: float64(8), int64(8), object(10)
memory usage: 41.8+ KB
```

[3]:

```
car_ID            0
symboling         0
CarName           0
fueltype          0
aspiration        0
doornumber        0
```

```
fueltype          0
aspiration        0
doornumber        0
carbody           0
drivewheel        0
enginelocation    0
wheelbase         0
carlength         0
carwidth          0
carheight         0
curbweight        0
enginetype        0
cylindernumber    0
enginesize        0
fuelsystem        0
boreratio         0
stroke            0
compressionratio  0
horsepower        0
peakrpm           0
citympg           0
highwaympg        0
price             0
dtype: int64
```

[4]:

```
df.drop(columns=['car_ID'], inplace=True)
df['CarBrand'] = df['CarName'].apply(lambda x: x.split(' ')[0].lower())
df.drop(columns=['CarName'], inplace=True
df = pd.get_dummies(df, drop_first=True)
X = df.drop('price', axis=1)
y = df['price']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
```

[5]:

```
models = {
    'Linear Regression': LinearRegression(),
    'Decision Tree': DecisionTreeRegressor(random_state=42),
    'Random Forest': RandomForestRegressor(random_state=42),
```

```
models = {
    'Linear Regression': LinearRegression(),
    'Decision Tree': DecisionTreeRegressor(random_state=42),
    'Random Forest': RandomForestRegressor(random_state=42),
    'Gradient Boosting': GradientBoostingRegressor(random_state=42),
    'SVR': SVR()
}

results = {}
for name, model in models.items():
    model.fit(X_train, y_train)
    y_pred = model.predict(X_test)
    results[name] = {
        'R2': r2_score(y_test, y_pred),
        'MSE': mean_squared_error(y_test, y_pred),
        'MAE': mean_absolute_error(y_test, y_pred)
    }

pd.DataFrame(results).T.sort_values('R2', ascending=False)
```

[5]:

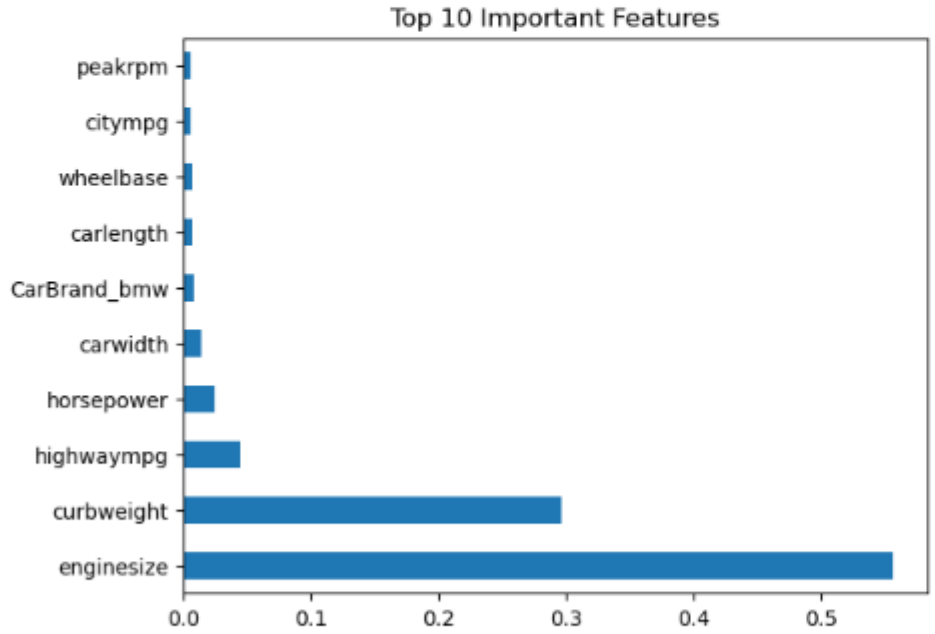
	R2	MSE	MAE
Random Forest	0.957509	3.354425e+06	1297.758813
Gradient Boosting	0.928584	5.637845e+06	1686.942854
Linear Regression	0.909597	7.136800e+06	1820.619487
Decision Tree	0.883730	9.178813e+06	2070.187000
SVR	-0.100686	8.689256e+07	5701.502460

[6]:

```
#Random_forest_model
rf = RandomForestRegressor(random_state=42)
rf.fit(X_train, y_train)
importances = pd.Series(rf.feature_importances_, index=df.drop('price', axis=1).columns)
importances.nlargest(10).plot(kind='barh')
plt.title("Top 10 Important Features")
plt.show()
```

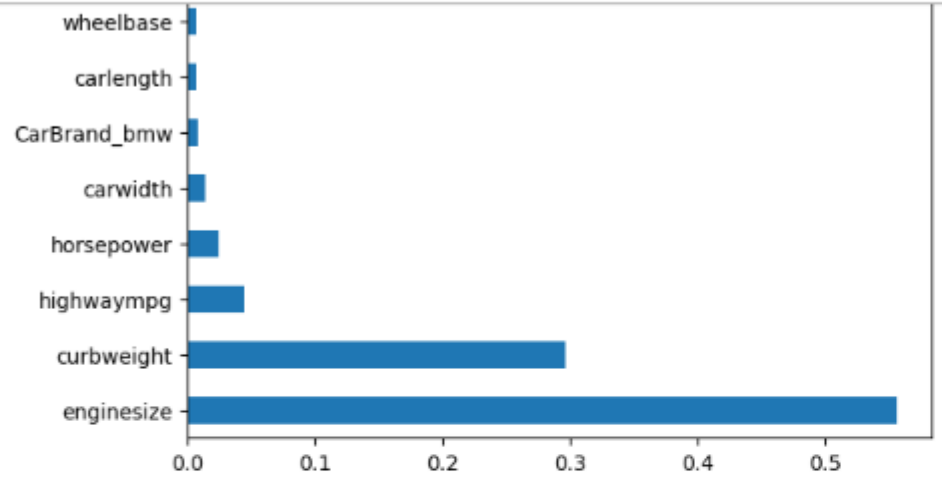
[6]:

```
#Random_forest_model
rf = RandomForestRegressor(random_state=42)
rf.fit(X_train, y_train)
importances = pd.Series(rf.feature_importances_, index=df.drop('price', axis=1).columns)
importances.nlargest(10).plot(kind='barh')
plt.title("Top 10 Important Features")
plt.show()
```



[7]:

```
##Hyperparameter tuning for Random Forest
param_grid = {
    'n_estimators': [100, 200],
    'max_depth': [None, 10, 20]
}
```



[7]:

```
##Hyperparameter tuning for Random Forest
param_grid = {
    'n_estimators': [100, 200],
    'max_depth': [None, 10, 20]
}

grid = GridSearchCV(RandomForestRegressor(random_state=42), param_grid, cv=3, scoring='r2')
grid.fit(X_train, y_train)
print("Best Parameters:", grid.best_params_)
print("Best Score:", grid.best_score_)
```

```
Best Parameters: {'max_depth': 10, 'n_estimators': 100}
Best Score: 0.8802844531123291
```