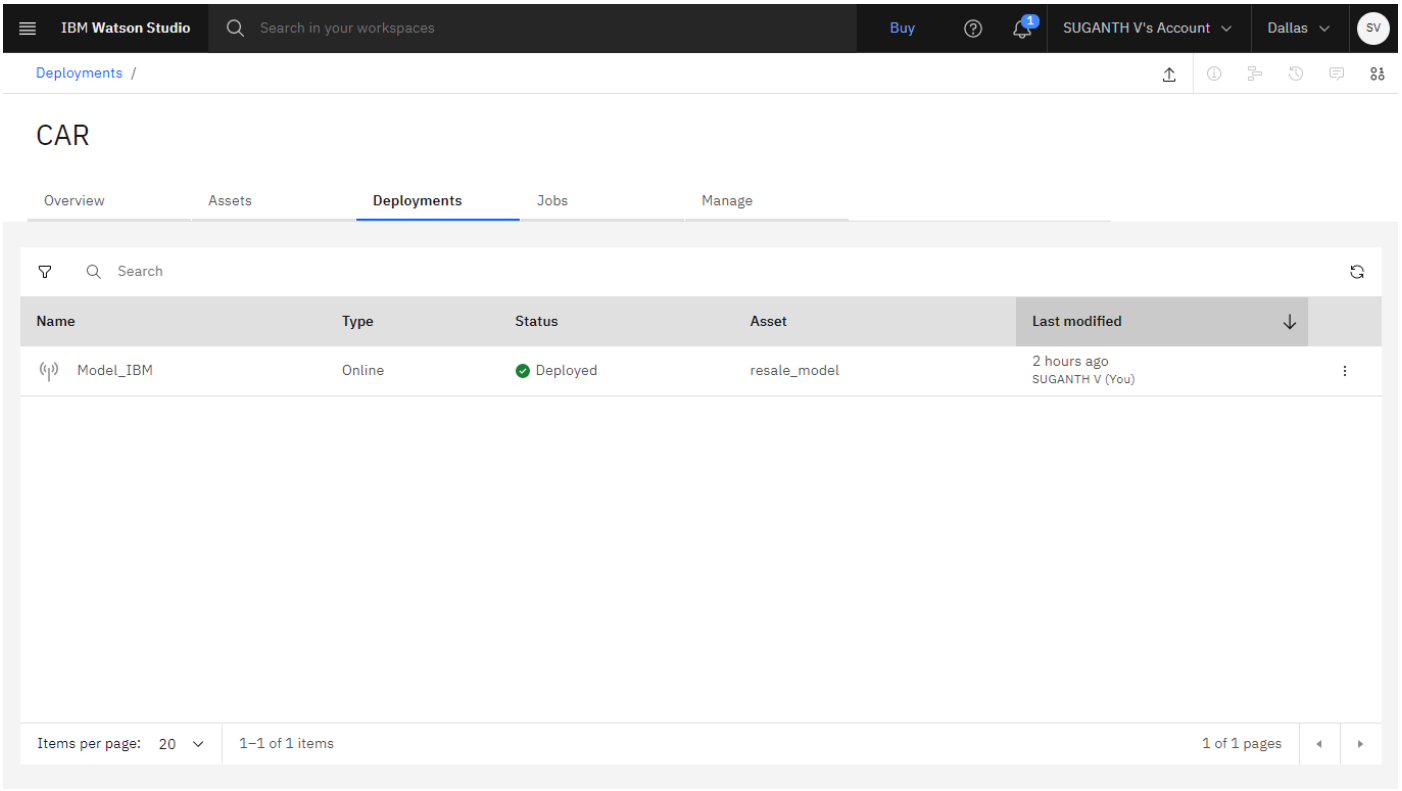
TRAIN THE ML MODEL ON IBM

Team ID	**PNT2022TMID07231**
Project Name	**Car Resale value Prediction**

TRAIN THE ML MODEL ON IBM




```
import pandas as pd
import numpy as np
import matplotlib as plt
from sklearn.preprocessing import LabelEncoder
import pickle
print("IMPORTED REQUIRED LIBRARIES")
# df = pd.read_csv("C:/Users/M.HEMNATH/Desktop/IBM/Data/autos.csv", header=0 , sep=','
,encoding='Latin1',low_memory=False)
# df.head()
import os, types
import pandas as pd
from botocore.client import Config
import ibm_boto3
import io
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='DT15l-lL0017uhnUGwXyhG_Eort5gohoW6XJTNoT3RKk',
    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 = 'carresalevalueprediction-donotdelete-pr-yuhtmzidi0ka1p'
object_key = 'autos.csv'

body = cos_client.get_object(Bucket=bucket,Key=object_key)
df = pd.read_csv((io.BytesIO(body['Body'].read())) , header=0 , sep=',' ,encoding='Latin1',low_memory=False)
df.head()
# df = pd.read_csv("C:/Users/M.HEMNATH/Desktop/IBM/Data/autos.csv", header=0 , sep=','
,encoding='Latin1',low_memory=False)
# df.head()
import os, types
import pandas as pd
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    config=Config(signature_version='oauth'),
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bucket = 'carresalevalueprediction-donotdelete-pr-yuhtmzidi0ka1p'
object_key = 'autos.csv'

body = cos_client.get_object(Bucket=bucket,Key=object_key)
df = pd.read_csv((io.BytesIO(body['Body'].read())) , header=0 , sep=',' ,encoding='Latin1',low_memory=False)
df.head()
print(df.seller.value_counts())
df[df.seller !='gewerblich']
df=df.drop('seller',axis=1)

print(df.offerType.value_counts())
df[df.offerType !='Gesuch']
df=df.drop('offerType',axis=1)
print(df.shape)
df=df[(df.powerPS>50) & (df.powerPS<900)]
print(df.shape)
df=df[(df.yearOfRegistration>=1950)&(df.yearOfRegistration<2022)]
print(df.shape)
df.drop(['name','abtest','dateCrawled','nrOfPictures','lastSeen','postalCode','dateCreated'], axis='columns',inplace=True)
new_df=df.copy()
new_df=new_df.drop_duplicates(['price','vehicleType','yearOfRegistration','gearbox','powerPS','model','kilometer','mo
nthOfRegistration','fuelType','notRepairedDamage'])
new_df.gearbox.replace(('manuell','automatik'),('manual','automatic'),inplace=True)
new_df.fuelType.replace(('benzin','andere','elektro'),('petrol','others','electric'),inplace=True)
new_df.vehicleType.replace(('kleinwagen','cabrio','kombi','andere'),('samll
car','convertible','combination','others'),inplace=True)
```
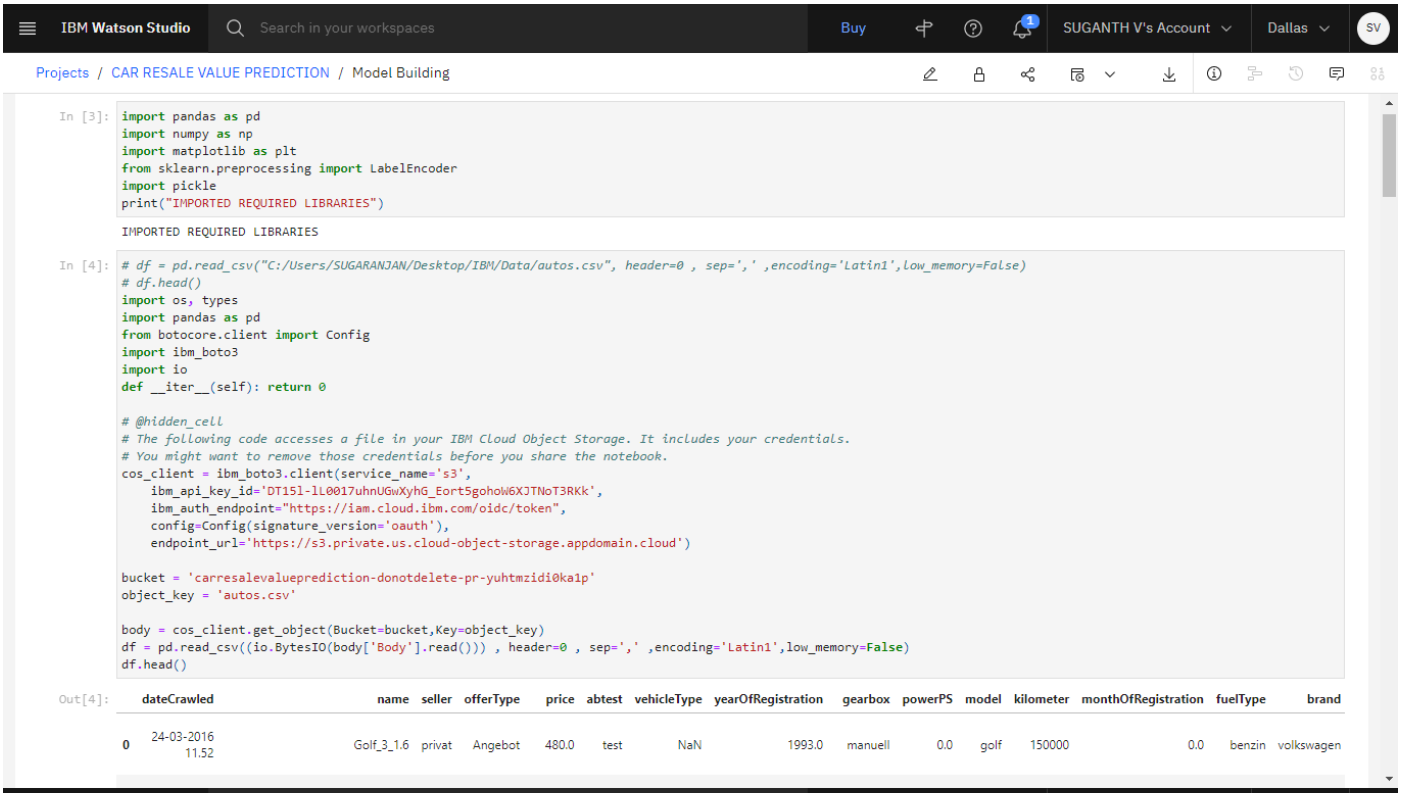

```
new_df.notRepairedDamage.replace(('ja','nein'),('Yes','No'),inplace=True)
new_df=new_df[(new_df.price>=100)&(new_df.price<=150000)]

new_df['notRepairedDamage'].fillna(value='not-declared',inplace=True)
new_df['fuelType'].fillna(value='not-declared',inplace=True)
new_df['gearbox'].fillna(value='not-declared',inplace=True)
new_df['vehicleType'].fillna(value='not-declared',inplace=True)
new_df['model'].fillna(value='not-declared',inplace=True)
from ibm_watson_machine_learning import APIClient
wml_credentials={
   "url":"https://us-south.ml.cloud.ibm.com",
   "apikey":"hEAn_mcoP3u_-ZjagjeqlxDayqUiETpYVYWdR1OLKAby"
}
client =APIClient(wml_credentials)
def guide_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=guide_from_space_name(client,'CAR')
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
print(new_df)
labels=['gearbox','notRepairedDamage','model','brand','fuelType','vehicleType']

mapper={}
for i in labels:
   mapper[i]=LabelEncoder()
   mapper[i].fit(new_df[i])
   tr=mapper[i].transform(new_df[i])
   np.save(str('classes'+i+'.npy'),mapper[i].classes_)
   print(i,":",mapper[i])
   new_df.loc[:, i+ '_labels']=pd.Series(tr,index=new_df.index)

labeled = new_df[['price','yearOfRegistration','powerPS','kilometer','monthOfRegistration']+[x+"_labels" for x in
labels]]
print(labeled.columns)
Y=labeled.iloc[:,0].values
X=labeled.iloc[:,1:].values

Y=Y.reshape(-1,1)
from sklearn.model_selection import cross_val_score,train_test_split
X_train , X_test, Y_train , Y_test = train_test_split(X,Y,test_size=0.3,random_state=3)
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import r2_score
regressor = RandomForestRegressor(n_estimators = 1000,max_depth = 10,random_state = 34)

regressor.fit(X_train, np.ravel(Y_train,order='C'))
y_pred = regressor.predict(X_test)
print(r2_score(Y_test,y_pred))
filename='resale_model.sav'
pickle.dump(regressor,open(filename,'wb'))
```

```
model_details = client.repository.store_model(model=regressor,meta_props={
    client.repository.ModelMetaNames.NAME: "resale_model",
    client.repository.ModelMetaNames.SOFTWARE_SPEC_UID: software_spec_uid,
    client.repository.ModelMetaNames.TYPE: "scikit-learn_1.0"
})
model_id = client.repository.get_model_id(model_details)
model_id
X_train[0]
regressor.predict([[2012.0, 179.0, '1500000', 12.0, 0, 0, 30, 1, 1, 4]])
```



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In [3]:
```
import pandas as pd
import numpy as np
import matplotlib as plt
from sklearn.preprocessing import LabelEncoder
import pickle
print("IMPORTED REQUIRED LIBRARIES")
```

```
IMPORTED REQUIRED LIBRARIES
```

In [4]:
```
# df = pd.read_csv("C:/Users/SUGARANJAN/Desktop/IBM/Data/autos.csv", header=0 , sep=',' ,encoding='Latin1',low_memory=False)
# df.head()
import os, types
import pandas as pd
from botocore.client import Config
import ibm_boto3
import io
def __iter__(self): return 0

# @hidden_cell
# The following code accesses a file in your IBM Cloud Object Storage. It includes your credentials.
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    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 = 'carresalevalueprediction-donotdelete-pr-yuhtmzidi0ka1p'
object_key = 'autos.csv'

body = cos_client.get_object(Bucket=bucket,Key=object_key)
df = pd.read_csv((io.BytesIO(body['Body'].read())) , header=0 , sep=',' ,encoding='Latin1',low_memory=False)
df.head()
```
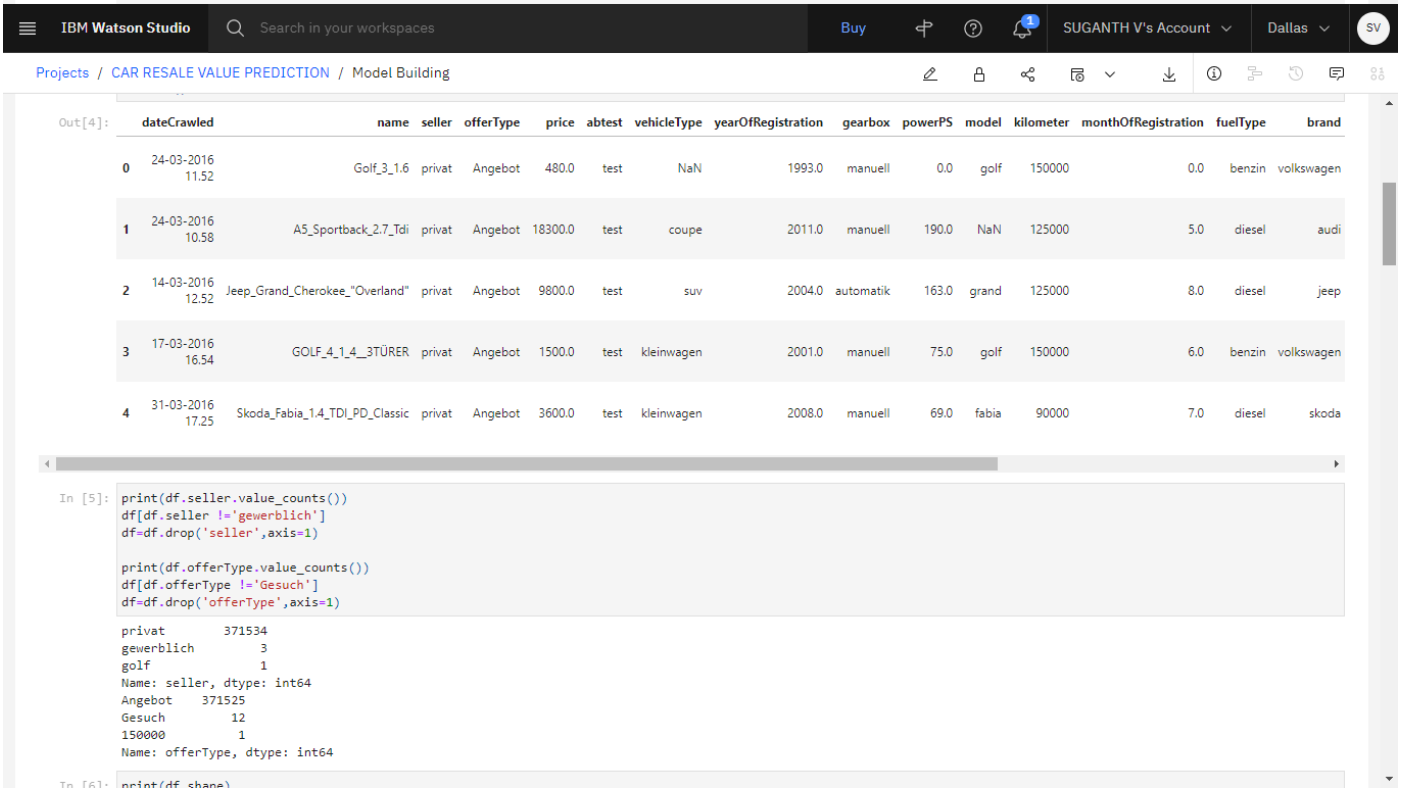

Out[4]:

	dateCrawled	name	seller	offerType	price	abtest	vehicleType	yearOfRegistration	gearbox	powerPS	model	kilometer	monthOfRegistration	fuelType	brand
0	24-03-2016 11.52	Golf_3_1.6	privat	Angebot	480.0	test	NaN	1993.0	manuell	0.0	golf	150000	0.0	benzin	volkswagen



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Out[4]:

	dateCrawled	name	seller	offerType	price	abtest	vehicleType	yearOfRegistration	gearbox	powerPS	model	kilometer	monthOfRegistration	fuelType	brand
0	24-03-2016 11.52	Golf_3_1.6	privat	Angebot	480.0	test	NaN	1993.0	manuell	0.0	golf	150000	0.0	benzin	volkswagen
1	24-03-2016 10.58	A5_Sportback_2.7_Tdi	privat	Angebot	18300.0	test	coupe	2011.0	manuell	190.0	NaN	125000	5.0	diesel	audi
2	14-03-2016 12.52	Jeep_Grand_Cherokee_"Overland"	privat	Angebot	9800.0	test	suv	2004.0	automatik	163.0	grand	125000	8.0	diesel	jeep
3	17-03-2016 16.54	GOLF_4_1_4__3TÜRER	privat	Angebot	1500.0	test	kleinwagen	2001.0	manuell	75.0	golf	150000	6.0	benzin	volkswagen
4	31-03-2016 17.25	Skoda_Fabia_1.4_TDI_PD_Classic	privat	Angebot	3600.0	test	kleinwagen	2008.0	manuell	69.0	fabia	90000	7.0	diesel	skoda

In [5]:
```
print(df.seller.value_counts())
df[df.seller !='gewerblich']
df=df.drop('seller',axis=1)

print(df.offerType.value_counts())
df[df.offerType !='Gesuch']
df=df.drop('offerType',axis=1)
```

```
privat        371534
gewerblich         3
golf               1
Name: seller, dtype: int64
Angebot    371525
Gesuch         12
150000          1
Name: offerType, dtype: int64
```

In [6]:
```
print(df.shape)
```

In [5]:
```
print(df.seller.value_counts())
df[df.seller !='gewerblich']
df=df.drop('seller',axis=1)

print(df.offerType.value_counts())
df[df.offerType !='Gesuch']
df=df.drop('offerType',axis=1)
```

```
privat        371534
gewerblich         3
golf               1
Name: seller, dtype: int64
Angebot    371525
Gesuch         12
150000          1
Name: offerType, dtype: int64
```

In [6]:
```
print(df.shape)
df=df[(df.powerPS>50) & (df.powerPS<900)]
print(df.shape)
df=df[(df.yearOfRegistration>=1950)&(df.yearOfRegistration<2022)]
print(df.shape)
```

```
(371539, 18)
(319717, 18)
(319649, 18)
```

In [7]:
```
df.drop(['name','abtest','dateCrawled','nrOfPictures','lastSeen','postalCode','dateCreated'], axis='columns',inplace=True)
```

In [8]:
```
new_df=df.copy()
new_df=new_df.drop_duplicates(['price','vehicleType','yearOfRegistration','gearbox','powerPS','model','kilometer','monthOfRegistration','fuelType','notRepairedDamage'])
```

In [9]:
```
new_df.gearbox.replace(('manuell','automatik'),('manual','automatic'),inplace=True)
new_df.fuelType.replace(('benzin','andere','elektro'),('petrol','others','electric'),inplace=True)
new_df.vehicleType.replace(('kleinwagen','cabrio','kombi','andere'),('samll car','convertible','combination','others'),inplace=True)
new_df.notRepairedDamage.replace(('ja','nein'),('Yes','No'),inplace=True)
```

In [10]:
```
new_df=new_df[(new_df.price>=100)&(new_df.price<=150000)]

new_df['notRepairedDamage'].fillna(value='not-declared',inplace=True)
new_df['fuelType'].fillna(value='not-declared',inplace=True)
new_df['gearbox'].fillna(value='not-declared',inplace=True)
new_df['vehicleType'].fillna(value='not-declared',inplace=True)
new_df['model'].fillna(value='not-declared',inplace=True)
```

In [11]:
```
from ibm_watson_machine_learning import APIClient
wml_credentials={
    "url":"https://us-south.ml.cloud.ibm.com",
    "apikey":"hEAn_mcoP3u_-ZjagjeqlxDayqUiETpYVYWdR1OLKAby"
}
client =APIClient(wml_credentials)
```

In [12]:
```
def guide_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'])
```

In [13]:
```
space_uid=guide_from_space_name(client,'CAR')
print("Space UID"+ space_uid)
```

```
Space UIDbe467bbb-03a2-40e7-bf5a-91836e346951
```

In [14]:
```
client.set.default_space(space_uid)
```

Out[14]:
```
'SUCCESS'
```

In [15]:
```
client.software_specifications.list()
```

```
------------------------------  ------------------------------------  ----
NAME                            ASSET_ID                              TYPE
default_py3.6                   0062b8c9-8b7d-44a0-a9b9-46c416adcbd9  base
kernel-spark3.2-scala2.12       020d69ce-7ac1-5e68-ac1a-31189867356a  base
pytorch-onnx_1.3-py3.7-edt      069ea134-3346-5748-b513-49120e15d288  base
scikit-learn_0.20-py3.6         09c5a1d0-9c1e-4473-a344-eb7b665ff687  base
spark-mllib_3.0-scala_2.12      09f4cff0-90a7-5899-b9ed-1ef348aebdee  base
pytorch-onnx_rt22.1-py3.9       0b848dd4-e681-5599-be41-b5f6fccc6471  base
ai-function_0.1-py3.6           0cdb0f1e-5376-4f4d-92dd-da3b69aa9bda  base
shiny-r3.6                      0e6e79df-875e-4f24-8ae9-62dcc2148306  base
tensorflow_2.4-py3.7-horovod    1092590a-307d-563d-9b62-4eb7d64b3f22  base
pytorch_1.1-py3.6               10ac12d6-6b30-4ccd-8392-3e922c096a92  base
tensorflow_1.15-py3.6-ddl       111e41b3-de2d-5422-a4d6-bf776828c4b7  base
autoai-kb_rt22.2-py3.10         125b6d9a-5b1f-5e8d-972a-b251688ccf40  base
runtime-22.1-py3.9              12b83a17-24d8-5082-900f-0ab31fbfd3cb  base
scikit-learn_0.22-py3.6         154010fa-5b3b-4ac1-82af-4d5ee5abbc85  base
default_r3.6                    1b70aec3-ab34-4b87-8aa0-a4a3c8296a36  base
pytorch-onnx_1.3-py3.6          1bc6029a-cc97-56da-b8e0-39c3880dbbe7  base
kernel-spark3.3-r3.6            1c9e5454-f216-59dd-a20e-474a5cdf5988  base
pytorch-onnx_rt22.1-py3.9-edt   1d362186-7ad5-5b59-8b6c-9d0880bde37f  base
tensorflow_2.1-py3.6            1eb25b84-d6ed-5dde-b6a5-3fbdf1665666  base
spark-mllib_3.2                 20047f72-0a98-58c7-9ff5-a77b012eb8f5  base
tensorflow_2.4-py3.8-horovod    217c16f6-178f-56bf-824a-b19f20564c49  base
runtime-22.1-py3.9-cuda         26215f05-08c3-5a41-a1b0-da66306ce658  base
do_py3.8                        295addb5-9ef9-547e-9bf4-92ae3563e720  base
autoai-ts_3.8-py3.8             2aa0c932-798f-5ae9-abd6-15e0c2402fb5  base
tensorflow_1.15-py3.6           2b73a275-7cbf-420b-a912-eae7f436e0bc  base
kernel-spark3.3-py3.9           2b7961e2-e3b1-5a8c-a491-482c8368839a  base
pytorch_1.2-py3.6               2c8ef57d-2687-4b7d-acce-01f94976dac1  base
spark-mllib_2.3                 2e51f700-bca0-4b0d-88dc-5c6791338875  base
pytorch-onnx_1.1-py3.6-edt      32983cea-3f32-4400-8965-dde874a8d67e  base
spark-mllib_3.0-py37            36507ebe-8770-55ba-ab2a-eafe787600e9  base
spark-mllib_2.4                 390d21f8-e58b-4fac-9c55-d7ceda621326  base
autoai-ts_rt22.2-py3.10         396b2e83-0953-5b86-9a55-7ce1628a406f  base
xgboost_0.82-py3.6              39e31acd-5f30-41dc-ae44-60233c80306e  base
pytorch-onnx_1.2-py3.6-edt      40589d0e-7019-4e28-8daa-fb03b6f4fe12  base
pytorch-onnx_rt22.2-py3.10      40e73f55-783a-5535-b3fa-0c8b94291431  base
default_r36py38                 41c247d3-45f8-5a71-b065-8580229facf0  base
```

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In [16]:
```
software_spec_uid  = client.software_specifications.get_uid_by_name("runtime-22.1-py3.9")
software_spec_uid
```

Out[16]:
```
'12b83a17-24d8-5082-900f-0ab31fbfd3cb'
```

In [17]:
```
print(new_df)
```

```
          price  vehicleType  yearOfRegistration    gearbox  powerPS  \
1       18300.0        coupe              2011.0     manual    190.0
2        9800.0          suv              2004.0  automatic    163.0
3        1500.0    samll car              2001.0     manual     75.0
4        3600.0    samll car              2008.0     manual     69.0
5         650.0    limousine              1995.0     manual    102.0
...         ...          ...                 ...        ...      ...
371531   3200.0    limousine              2004.0     manual    225.0
371535   1199.0  convertible              2000.0  automatic    101.0
371536   9200.0          bus              1996.0     manual    102.0
371537   3400.0  combination              2002.0     manual    100.0
371538  28990.0    limousine              2013.0     manual    320.0

               model kilometer  monthOfRegistration fuelType       brand  \
1       not-declared    125000                  5.0   diesel        audi
2              grand    125000                  8.0   diesel        jeep
3               golf    150000                  6.0   petrol  volkswagen
4              fabia     90000                  7.0   diesel       skoda
5                3er    150000                 10.0   petrol         bmw
...              ...       ...                  ...      ...         ...
371531          leon    150000                  5.0   petrol        seat
371535        fortwo    125000                  3.0   petrol       smart
371536   transporter    150000                  3.0   diesel  volkswagen
371537          golf    150000                  6.0   diesel  volkswagen
371538      m_reihe     50000                  8.0   petrol         bmw

       notRepairedDamage
1                    Yes
2          not-declared
3                     No
4                     No
5                    Yes
```

[288053 rows x 11 columns]

In [18]:
```
labels=['gearbox','notRepairedDamage','model','brand','fuelType','vehicleType']

mapper={}
for i in labels:
    mapper[i]=LabelEncoder()
    mapper[i].fit(new_df[i])
    tr=mapper[i].transform(new_df[i])
    np.save(str('classes'+i+'.npy'),mapper[i].classes_)
    print(i,":",mapper[i])
    new_df.loc[:, i+ '_labels']=pd.Series(tr,index=new_df.index)

labeled = new_df[['price','yearOfRegistration','powerPS','kilometer','monthOfRegistration']+[x+"_labels" for x in labels]]
print(labeled.columns)
```

```
gearbox : LabelEncoder()
notRepairedDamage : LabelEncoder()
model : LabelEncoder()
brand : LabelEncoder()
fuelType : LabelEncoder()
vehicleType : LabelEncoder()
Index(['price', 'yearOfRegistration', 'powerPS', 'kilometer',
       'monthOfRegistration', 'gearbox_labels', 'notRepairedDamage_labels',
       'model_labels', 'brand_labels', 'fuelType_labels',
       'vehicleType_labels'],
      dtype='object')
```

In [19]:
```
Y=labeled.iloc[:,0].values
X=labeled.iloc[:,1:].values

Y=Y.reshape(-1,1)
```

In [20]:
```
from sklearn.model_selection import cross_val_score,train_test_split
X_train , X_test, Y_train , Y_test = train_test_split(X,Y,test_size=0.3,random_state=3)
```

In [21]:
```
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import r2_score
regressor = RandomForestRegressor(n_estimators = 1000,max_depth = 10,random_state = 34)
```

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In [21]:
```
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import r2_score
regressor = RandomForestRegressor(n_estimators = 1000,max_depth = 10,random_state = 34)

regressor.fit(X_train, np.ravel(Y_train,order='C'))
```

Out[21]:
```
RandomForestRegressor(max_depth=10, n_estimators=1000, random_state=34)
```

In [22]:
```
y_pred = regressor.predict(X_test)
print(r2_score(Y_test,y_pred))
```

```
0.8310350387286918
```

In [23]:
```
filename='resale_model.sav'
pickle.dump(regressor,open(filename,'wb'))
```

In [24]:
```
model_details = client.repository.store_model(model=regressor,meta_props={
     client.repository.ModelMetaNames.NAME: "resale_model",
     client.repository.ModelMetaNames.SOFTWARE_SPEC_UID: software_spec_uid,
     client.repository.ModelMetaNames.TYPE: "scikit-learn_1.0"
})
model_id = client.repository.get_model_id(model_details)
```

In [25]:
```
model_id
```

Out[25]:
```
'cd8479e0-66e4-454e-aece-4824fe9d71bd'
```

In [26]:
```
X_train[0:]
```

Out[26]:
```
array([[2005.0, 179.0, '150000', ..., 1, 1, 4],
       [1997.0, 60.0, '150000', ..., 38, 7, 4],
       [2003.0, 170.0, '150000', ..., 2, 7, 1],
       ...,
       [2009.0, 174.0, '125000', ..., 25, 7, 7],
       [2000.0, 136.0, '150000', ..., 20, 7, 1],
       [2013.0, 170.0, '40000', ..., 1, 7, 8]], dtype=object)
```

In [27]:
```
regressor.predict([[2012.0, 179.0, '1500000', 12.0, 0, 0, 30, 1, 1, 4]])
```

```
regressor = RandomForestRegressor(n_estimators = 1000,max_depth = 10,random_state = 34)

regressor.fit(X_train, np.ravel(Y_train,order='C'))
```

Out[21]:
```
RandomForestRegressor(max_depth=10, n_estimators=1000, random_state=34)
```

In [22]:
```
y_pred = regressor.predict(X_test)
print(r2_score(Y_test,y_pred))
```

```
0.8310350387286918
```

In [23]:
```
filename='resale_model.sav'
pickle.dump(regressor,open(filename,'wb'))
```

In [24]:
```
model_details = client.repository.store_model(model=regressor,meta_props={
     client.repository.ModelMetaNames.NAME: "resale_model",
     client.repository.ModelMetaNames.SOFTWARE_SPEC_UID: software_spec_uid,
     client.repository.ModelMetaNames.TYPE: "scikit-learn_1.0"
})
model_id = client.repository.get_model_id(model_details)
```

In [25]:
```
model_id
```

Out[25]:
```
'cd8479e0-66e4-454e-aece-4824fe9d71bd'
```

In [26]:
```
X_train[0:]
```

Out[26]:
```
array([[2005.0, 179.0, '150000', ..., 1, 1, 4],
       [1997.0, 60.0, '150000', ..., 38, 7, 4],
       [2003.0, 170.0, '150000', ..., 2, 7, 1],
       ...,
       [2009.0, 174.0, '125000', ..., 25, 7, 7],
       [2000.0, 136.0, '150000', ..., 20, 7, 1],
       [2013.0, 170.0, '40000', ..., 1, 7, 8]], dtype=object)
```

In [27]:
```
regressor.predict([[2012.0, 179.0, '1500000', 12.0, 0, 0, 30, 1, 1, 4]])
```

Out[27]:
```
array([18518.37919135])
```