Copy of car_price_predictor_enhanced

April 21, 2024

1 Installing some libraries

[ ]:
```
!pip install silence_tensorflow
 !apt-get install texlive-xetex
 !pip install nbconvert
```

```
Collecting silence_tensorflow
  Downloading silence_tensorflow-1.2.1.tar.gz (3.8 kB)
  Preparing metadata (setup.py) … done
Collecting support_developer (from silence_tensorflow)
  Downloading support_developer-1.0.5.tar.gz (4.9 kB)
  Preparing metadata (setup.py) … done
Building wheels for collected packages: silence_tensorflow, support_developer
  Building wheel for silence_tensorflow (setup.py) … done
  Created wheel for silence_tensorflow:
filename=silence_tensorflow-1.2.1-py3-none-any.whl size=4465
sha256=07ce20c7d9231cfdcde6dda4940d570b0dec5602371d31a5a3bbd1226eb991a2
  Stored in directory: /root/.cache/pip/wheels/7d/2c/24/e130d6102c0df56631b9db74
79d9a6a53c5d97fb06b5f61b98
  Building wheel for support_developer (setup.py) … done
  Created wheel for support_developer:
filename=support_developer-1.0.5-py3-none-any.whl size=5630
sha256=db20fc77722eb23f166e3c7283fb9d00b9e7fad7413cba8c5fd23b0681d5be4f
  Stored in directory: /root/.cache/pip/wheels/b6/72/c8/3054a5897ba0713dfa7a9413
64d68cbd42b0755c8e2ec1c18c
Successfully built silence_tensorflow support_developer
Installing collected packages: support_developer, silence_tensorflow
Successfully installed silence_tensorflow-1.2.1 support_developer-1.0.5
Reading package lists… Done
Building dependency tree… Done
Reading state information… Done
The following additional packages will be installed:
  dvisvgm fonts-droid-fallback fonts-lato fonts-lmodern fonts-noto-mono fonts-
texgyre
  fonts-urw-base35 libapache-pom-java libcommons-logging-java libcommons-parent-
java
  libfontbox-java libfontenc1 libgs9 libgs9-common libidn12 libijs-0.35
libjbig2dec0 libkpathsea6
```

```
  libpdfbox-java libptexenc1 libruby3.0 libsynctex2 libteckit0 libtexlua53
libtexluajit2 libwoff1
  libzzip-0-13 lmodern poppler-data preview-latex-style rake ruby ruby-net-
telnet ruby-rubygems
  ruby-webrick ruby-xmlrpc ruby3.0 rubygems-integration t1utils teckit tex-
common tex-gyre
  texlive-base texlive-binaries texlive-fonts-recommended texlive-latex-base
texlive-latex-extra
  texlive-latex-recommended texlive-pictures texlive-plain-generic tipa xfonts-
encodings
  xfonts-utils
Suggested packages:
  fonts-noto fonts-freefont-otf | fonts-freefont-ttf libavalon-framework-java
  libcommons-logging-java-doc libexcalibur-logkit-java liblog4j1.2-java poppler-
utils ghostscript
  fonts-japanese-mincho | fonts-ipafont-mincho fonts-japanese-gothic | fonts-
ipafont-gothic
  fonts-arphic-ukai fonts-arphic-uming fonts-nanum ri ruby-dev bundler debhelper
gv
  | postscript-viewer perl-tk xpdf | pdf-viewer xzdec texlive-fonts-recommended-
doc
  texlive-latex-base-doc python3-pygments icc-profiles libfile-which-perl
  libspreadsheet-parseexcel-perl texlive-latex-extra-doc texlive-latex-
recommended-doc
  texlive-luatex texlive-pstricks dot2tex prerex texlive-pictures-doc vprerex
default-jre-headless
  tipa-doc
The following NEW packages will be installed:
  dvisvgm fonts-droid-fallback fonts-lato fonts-lmodern fonts-noto-mono fonts-
texgyre
  fonts-urw-base35 libapache-pom-java libcommons-logging-java libcommons-parent-
java
  libfontbox-java libfontenc1 libgs9 libgs9-common libidn12 libijs-0.35
libjbig2dec0 libkpathsea6
  libpdfbox-java libptexenc1 libruby3.0 libsynctex2 libteckit0 libtexlua53
libtexluajit2 libwoff1
  libzzip-0-13 lmodern poppler-data preview-latex-style rake ruby ruby-net-
telnet ruby-rubygems
  ruby-webrick ruby-xmlrpc ruby3.0 rubygems-integration t1utils teckit tex-
common tex-gyre
  texlive-base texlive-binaries texlive-fonts-recommended texlive-latex-base
texlive-latex-extra
  texlive-latex-recommended texlive-pictures texlive-plain-generic texlive-xetex
tipa
  xfonts-encodings xfonts-utils
0 upgraded, 54 newly installed, 0 to remove and 45 not upgraded.
Need to get 182 MB of archives.
After this operation, 571 MB of additional disk space will be used.
```

```
Get:1 http://archive.ubuntu.com/ubuntu jammy/main amd64 fonts-droid-fallback all
1:6.0.1r16-1.1build1 [1,805 kB]
Get:2 http://archive.ubuntu.com/ubuntu jammy/main amd64 fonts-lato all 2.0-2.1
[2,696 kB]
Get:3 http://archive.ubuntu.com/ubuntu jammy/main amd64 poppler-data all
0.4.11-1 [2,171 kB]
Get:4 http://archive.ubuntu.com/ubuntu jammy/universe amd64 tex-common all 6.17
[33.7 kB]
Get:5 http://archive.ubuntu.com/ubuntu jammy/main amd64 fonts-urw-base35 all
20200910-1 [6,367 kB]
Get:6 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 libgs9-common
all 9.55.0~dfsg1-0ubuntu5.6 [751 kB]
Get:7 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 libidn12 amd64
1.38-4ubuntu1 [60.0 kB]
Get:8 http://archive.ubuntu.com/ubuntu jammy/main amd64 libijs-0.35 amd64
0.35-15build2 [16.5 kB]
Get:9 http://archive.ubuntu.com/ubuntu jammy/main amd64 libjbig2dec0 amd64
0.19-3build2 [64.7 kB]
Get:10 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 libgs9 amd64
9.55.0~dfsg1-0ubuntu5.6 [5,031 kB]
Get:11 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 libkpathsea6
amd64 2021.20210626.59705-1ubuntu0.2 [60.4 kB]
Get:12 http://archive.ubuntu.com/ubuntu jammy/main amd64 libwoff1 amd64
1.0.2-1build4 [45.2 kB]
Get:13 http://archive.ubuntu.com/ubuntu jammy/universe amd64 dvisvgm amd64
2.13.1-1 [1,221 kB]
Get:14 http://archive.ubuntu.com/ubuntu jammy/universe amd64 fonts-lmodern all
2.004.5-6.1 [4,532 kB]
Get:15 http://archive.ubuntu.com/ubuntu jammy/main amd64 fonts-noto-mono all
20201225-1build1 [397 kB]
Get:16 http://archive.ubuntu.com/ubuntu jammy/universe amd64 fonts-texgyre all
20180621-3.1 [10.2 MB]
Get:17 http://archive.ubuntu.com/ubuntu jammy/universe amd64 libapache-pom-java
all 18-1 [4,720 B]
Get:18 http://archive.ubuntu.com/ubuntu jammy/universe amd64 libcommons-parent-
java all 43-1 [10.8 kB]
Get:19 http://archive.ubuntu.com/ubuntu jammy/universe amd64 libcommons-logging-
java all 1.2-2 [60.3 kB]
Get:20 http://archive.ubuntu.com/ubuntu jammy/main amd64 libfontenc1 amd64
1:1.1.4-1build3 [14.7 kB]
Get:21 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 libptexenc1
amd64 2021.20210626.59705-1ubuntu0.2 [39.1 kB]
Get:22 http://archive.ubuntu.com/ubuntu jammy/main amd64 rubygems-integration
all 1.18 [5,336 B]
Get:23 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 ruby3.0 amd64
3.0.2-7ubuntu2.4 [50.1 kB]
Get:24 http://archive.ubuntu.com/ubuntu jammy/main amd64 ruby-rubygems all
3.3.5-2 [228 kB]
```

```
Get:25 http://archive.ubuntu.com/ubuntu jammy/main amd64 ruby amd64 1:3.0~exp1
[5,100 B]
Get:26 http://archive.ubuntu.com/ubuntu jammy/main amd64 rake all 13.0.6-2 [61.7
kB]
Get:27 http://archive.ubuntu.com/ubuntu jammy/main amd64 ruby-net-telnet all
0.1.1-2 [12.6 kB]
Get:28 http://archive.ubuntu.com/ubuntu jammy/universe amd64 ruby-webrick all
1.7.0-3 [51.8 kB]
Get:29 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 ruby-xmlrpc all
0.3.2-1ubuntu0.1 [24.9 kB]
Get:30 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 libruby3.0
amd64 3.0.2-7ubuntu2.4 [5,113 kB]
Get:31 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 libsynctex2
amd64 2021.20210626.59705-1ubuntu0.2 [55.6 kB]
Get:32 http://archive.ubuntu.com/ubuntu jammy/universe amd64 libteckit0 amd64
2.5.11+ds1-1 [421 kB]
Get:33 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 libtexlua53
amd64 2021.20210626.59705-1ubuntu0.2 [120 kB]
Get:34 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 libtexluajit2
amd64 2021.20210626.59705-1ubuntu0.2 [267 kB]
Get:35 http://archive.ubuntu.com/ubuntu jammy/universe amd64 libzzip-0-13 amd64
0.13.72+dfsg.1-1.1 [27.0 kB]
Get:36 http://archive.ubuntu.com/ubuntu jammy/main amd64 xfonts-encodings all
1:1.0.5-0ubuntu2 [578 kB]
Get:37 http://archive.ubuntu.com/ubuntu jammy/main amd64 xfonts-utils amd64
1:7.7+6build2 [94.6 kB]
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2.004.5-6.1 [9,471 kB]
Get:39 http://archive.ubuntu.com/ubuntu jammy/universe amd64 preview-latex-style
all 12.2-1ubuntu1 [185 kB]
Get:40 http://archive.ubuntu.com/ubuntu jammy/main amd64 t1utils amd64
1.41-4build2 [61.3 kB]
Get:41 http://archive.ubuntu.com/ubuntu jammy/universe amd64 teckit amd64
2.5.11+ds1-1 [699 kB]
Get:42 http://archive.ubuntu.com/ubuntu jammy/universe amd64 tex-gyre all
20180621-3.1 [6,209 kB]
Get:43 http://archive.ubuntu.com/ubuntu jammy-updates/universe amd64 texlive-
binaries amd64 2021.20210626.59705-1ubuntu0.2 [9,860 kB]
Get:44 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-base all
2021.20220204-1 [21.0 MB]
Get:45 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-fonts-
recommended all 2021.20220204-1 [4,972 kB]
Get:46 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-latex-base
all 2021.20220204-1 [1,128 kB]
Get:47 http://archive.ubuntu.com/ubuntu jammy/universe amd64 libfontbox-java all
1:1.8.16-2 [207 kB]
Get:48 http://archive.ubuntu.com/ubuntu jammy/universe amd64 libpdfbox-java all
1:1.8.16-2 [5,199 kB]
```

```
Get:49 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-latex-
recommended all 2021.20220204-1 [14.4 MB]
Get:50 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-pictures
all 2021.20220204-1 [8,720 kB]
Get:51 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-latex-extra
all 2021.20220204-1 [13.9 MB]
Get:52 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-plain-
generic all 2021.20220204-1 [27.5 MB]
Get:53 http://archive.ubuntu.com/ubuntu jammy/universe amd64 tipa all 2:1.3-21
[2,967 kB]
Get:54 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-xetex all
2021.20220204-1 [12.4 MB]
Fetched 182 MB in 5s (37.0 MB/s)
Extracting templates from packages: 100%
Preconfiguring packages …
Selecting previously unselected package fonts-droid-fallback.
(Reading database … 131015 files and directories currently installed.)
Preparing to unpack …/00-fonts-droid-fallback_1%3a6.0.1r16-1.1build1_all.deb
…
Unpacking fonts-droid-fallback (1:6.0.1r16-1.1build1) …
Selecting previously unselected package fonts-lato.
Preparing to unpack …/01-fonts-lato_2.0-2.1_all.deb …
Unpacking fonts-lato (2.0-2.1) …
Selecting previously unselected package poppler-data.
Preparing to unpack …/02-poppler-data_0.4.11-1_all.deb …
Unpacking poppler-data (0.4.11-1) …
Selecting previously unselected package tex-common.
Preparing to unpack …/03-tex-common_6.17_all.deb …
Unpacking tex-common (6.17) …
Selecting previously unselected package fonts-urw-base35.
Preparing to unpack …/04-fonts-urw-base35_20200910-1_all.deb …
Unpacking fonts-urw-base35 (20200910-1) …
Selecting previously unselected package libgs9-common.
Preparing to unpack …/05-libgs9-common_9.55.0~dfsg1-0ubuntu5.6_all.deb …
Unpacking libgs9-common (9.55.0~dfsg1-0ubuntu5.6) …
Selecting previously unselected package libidn12:amd64.
Preparing to unpack …/06-libidn12_1.38-4ubuntu1_amd64.deb …
Unpacking libidn12:amd64 (1.38-4ubuntu1) …
Selecting previously unselected package libijs-0.35:amd64.
Preparing to unpack …/07-libijs-0.35_0.35-15build2_amd64.deb …
Unpacking libijs-0.35:amd64 (0.35-15build2) …
Selecting previously unselected package libjbig2dec0:amd64.
Preparing to unpack …/08-libjbig2dec0_0.19-3build2_amd64.deb …
Unpacking libjbig2dec0:amd64 (0.19-3build2) …
Selecting previously unselected package libgs9:amd64.
Preparing to unpack …/09-libgs9_9.55.0~dfsg1-0ubuntu5.6_amd64.deb …
Unpacking libgs9:amd64 (9.55.0~dfsg1-0ubuntu5.6) …
Selecting previously unselected package libkpathsea6:amd64.
```

```
Preparing to unpack …/10-libkpathsea6_2021.20210626.59705-1ubuntu0.2_amd64.deb
…
Unpacking libkpathsea6:amd64 (2021.20210626.59705-1ubuntu0.2) …
Selecting previously unselected package libwoff1:amd64.
Preparing to unpack …/11-libwoff1_1.0.2-1build4_amd64.deb …
Unpacking libwoff1:amd64 (1.0.2-1build4) …
Selecting previously unselected package dvisvgm.
Preparing to unpack …/12-dvisvgm_2.13.1-1_amd64.deb …
Unpacking dvisvgm (2.13.1-1) …
```

2 Importing Libraries

[ ]:
```
import tensorflow as tf
import seaborn as sns
import pandas as pd
import matplotlib.pyplot as plt
from tensorflow.keras.layers import Dense, BatchNormalization, InputLayer
from tensorflow.keras.losses import Huber, MeanAbsoluteError, MeanSquaredError
from tensorflow.keras.optimizers import Adam, SGD
from tensorflow.keras.callbacks import EarlyStopping,␣
 ↪ModelCheckpoint,ReduceLROnPlateau
import numpy as np
import warnings
```

[ ]:
```
from silence_tensorflow import silence_tensorflow
silence_tensorflow()
```

[ ]:
```
sns.set_style('whitegrid')
warnings.filterwarnings('ignore')
```

3 Data Preparation

[ ]:
```
df = pd.read_csv('train.csv', sep=',')

df.head()
```

[ ]:

	v.id	on road old	on road now	years	km	rating	condition	economy	\
0	1	535651	798186	3	78945	1	2	14	
1	2	591911	861056	6	117220	5	9	9	
2	3	686990	770762	2	132538	2	8	15	
3	4	573999	722381	4	101065	4	3	11	
4	5	691388	811335	6	61559	3	9	12	

	top speed	hp	torque	current price
0	177	73	123	351318.0

```
1         148  74       95        285001.5
2         181  53       97        215386.0
3         197  54      116        244295.5
4         160  53      105        531114.5
```

[ ]:
```
mean = df['current price'].mean()
std  = df['current price'].std()
print(mean)
print(std)
OW=1.1   # Weight of outliers, 5=(Inputting all of them)
lower_bound= mean - OW*std
upper_bound= mean + OW*std
```

```
308520.2425
126073.25914983758
```

[ ]:
```
filtered_df = df[(df['current price']>= lower_bound) & (df['current␣
↪price']<=upper_bound)]

filtered_df.head()
```

[ ]:
```
   v.id  on road old  on road now  years      km  rating  condition  economy  \
0     1       535651       798186      3   78945       1          2       14
1     2       591911       861056      6  117220       5          9        9
2     3       686990       770762      2  132538       2          8       15
3     4       573999       722381      4  101065       4          3       11
5     6       650007       844846      6  148846       2          9       13

   top speed  hp  torque  current price
0        177  73     123       351318.0
1        148  74      95       285001.5
2        181  53      97       215386.0
3        197  54     116       244295.5
5        138  61     109       177933.5
```

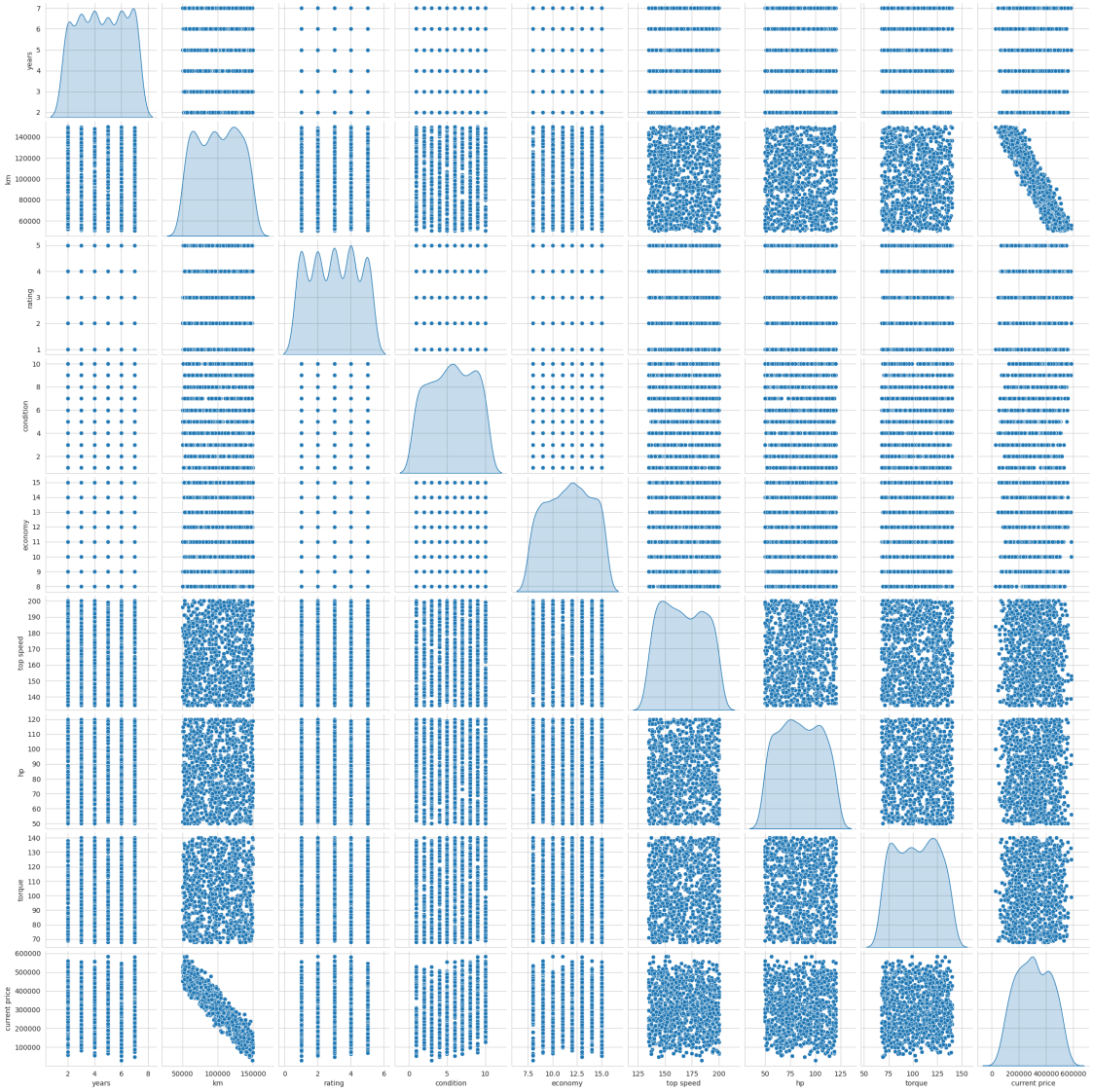
[ ]:
```
data   = tf.constant(filtered_df, dtype=tf.float32)
data   = tf.random.shuffle(data)
x_data = data[:, 3:-1]
y_data = data[:, -1]
y_data = tf.expand_dims(y_data, axis = -1)
print(y_data.shape)
print(x_data.shape)
```

```
(666, 1)
(666, 8)
```

4 Data Visualization

```
[ ]: sns.pairplot(df[['years','km','rating','condition','economy','top␣
     ↪speed','hp','torque','current price']], diag_kind='kde')
```

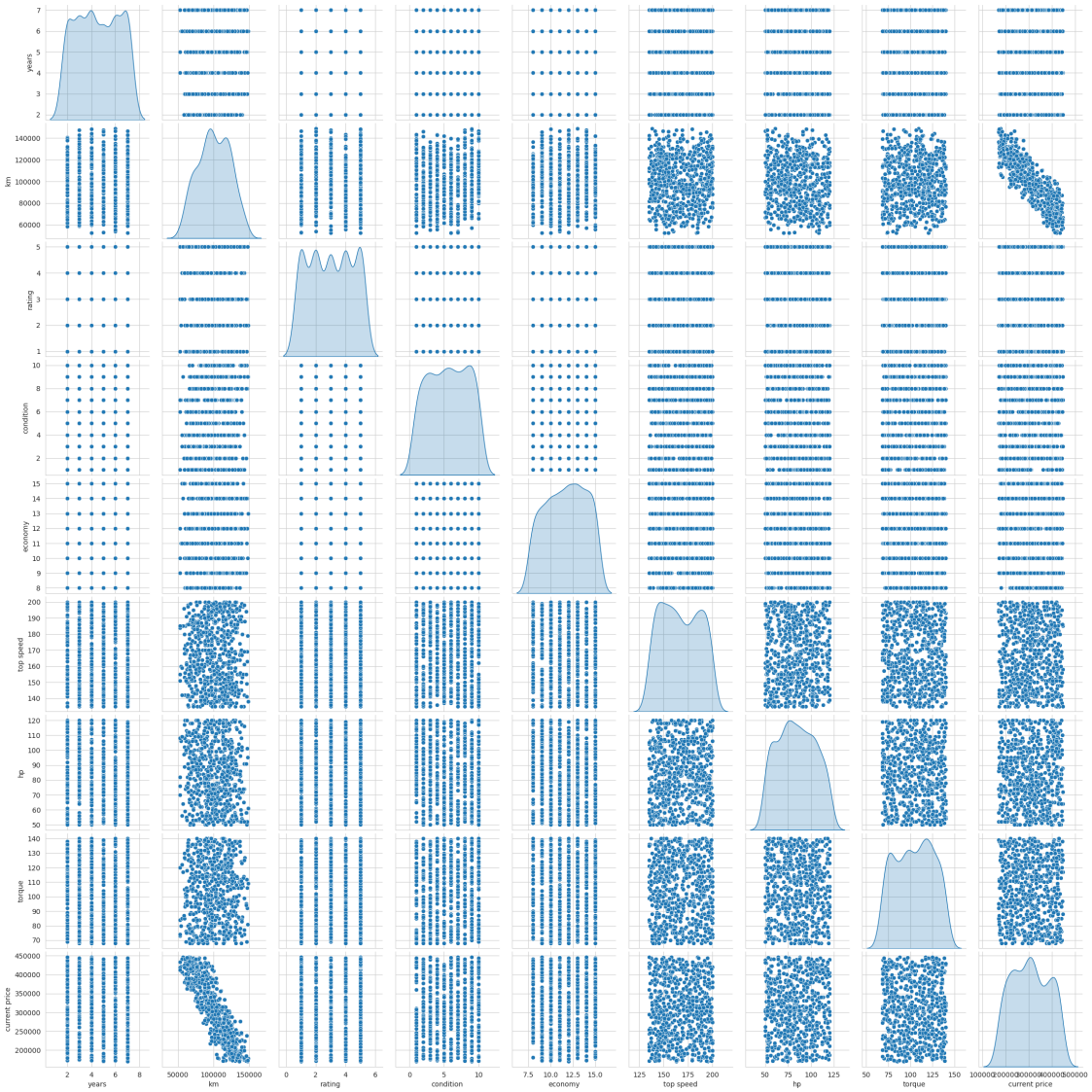
```
[ ]: <seaborn.axisgrid.PairGrid at 0x7b05f518f9a0>
```



More homogenous dataset after supressing outliers weight

```
[ ]: sns.pairplot(filtered_df[['years','km','rating','condition','economy','top␣
     ↪speed','hp','torque','current price']], diag_kind='kde')
```

```
[ ]: <seaborn.axisgrid.PairGrid at 0x7b05a8365db0>
```



5 Splitting Data

[ ]:
```
TrainRatio  = 0.8
ValRatio    = 0.1
TestRatio   = 0.1
DataSize    = len(y_data)
print(DataSize)
```

666

[ ]:
```
x_train = x_data[:int(DataSize*TrainRatio),:]
x_val   = x_data[int(DataSize*TrainRatio):int(DataSize*(TrainRatio+ValRatio)),:]
```

```
x_test  = x_data[int(DataSize*(TrainRatio+ValRatio)):
  ↪int(DataSize*(TrainRatio+ValRatio+TestRatio)),:]
y_train = y_data[:int(DataSize*TrainRatio),:]
y_val   = y_data[int(DataSize*TrainRatio):int(DataSize*(TrainRatio+ValRatio)),:]
y_test  = y_data[int(DataSize*(TrainRatio+ValRatio)):
  ↪int(DataSize*(TrainRatio+ValRatio+TestRatio)),:]

print(x_train.shape)
print(x_val.shape)
print(x_test.shape)
print(y_train.shape)
print(y_val.shape)
print(y_test.shape)
```

```
(532, 8)
(67, 8)
(67, 8)
(532, 1)
(67, 1)
(67, 1)
```

6 Model Creation

[ ]:
```
normalizer = BatchNormalization()
model= tf.keras.Sequential([
    InputLayer(input_shape=(8,)),
    normalizer,
    Dense(128, activation='relu'),
    Dense(32, activation='relu'),
    Dense(1),
])

model.summary()
```

```
Model: "sequential_7"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 batch_normalization_7 (Bat  (None, 8)                 32
 chNormalization)

 dense_21 (Dense)            (None, 128)               1152

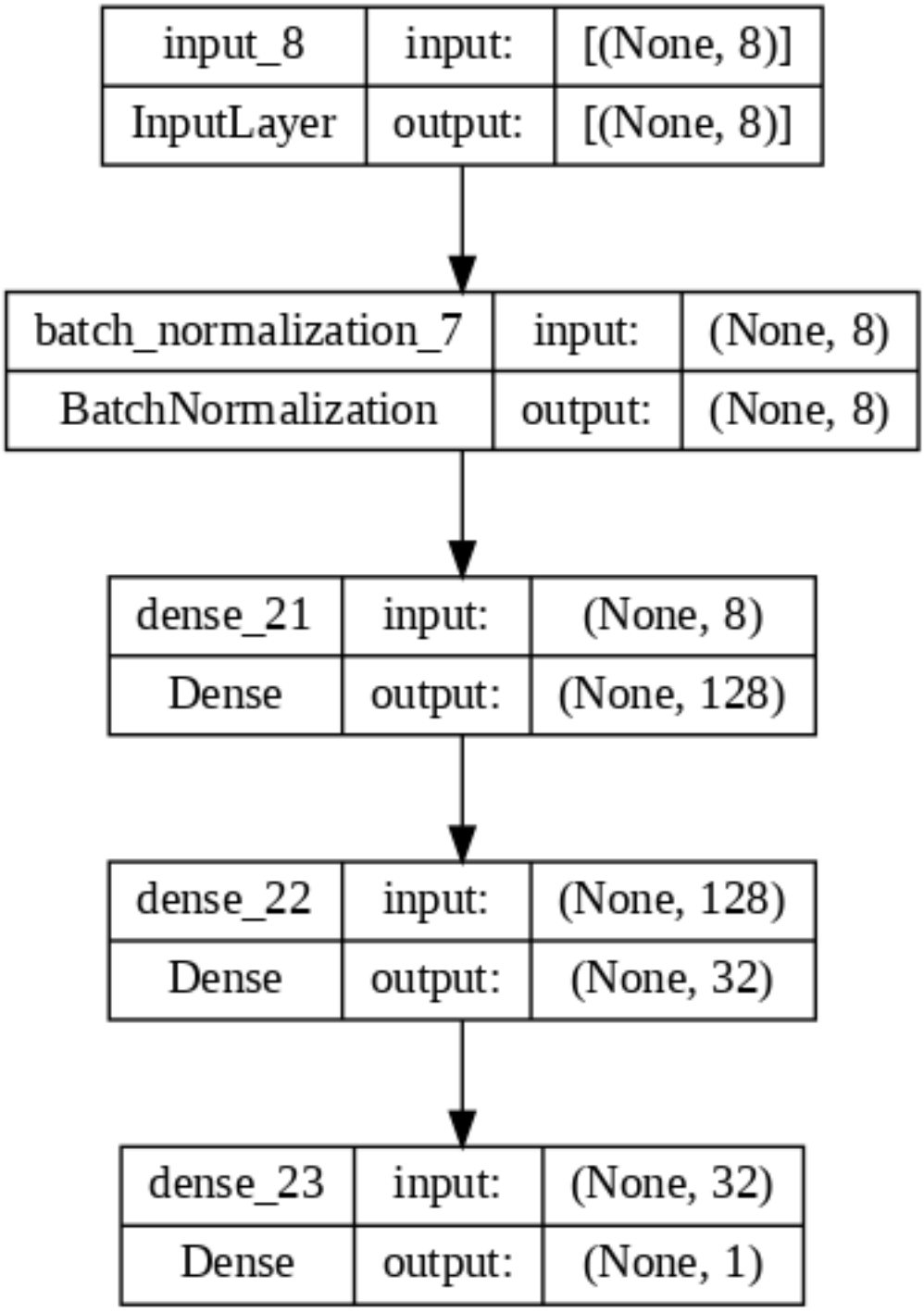
 dense_22 (Dense)            (None, 32)                4128

 dense_23 (Dense)            (None, 1)                 33
```

```
=================================================================
Total params: 5345 (20.88 KB)
Trainable params: 5329 (20.82 KB)
Non-trainable params: 16 (64.00 Byte)
_________________________________________________________________
```

[ ]:
```
tf.keras.utils.plot_model(model, show_shapes=True, dpi=100)
```

[ ]:



[ ]:
```
checkpoint = ModelCheckpoint('MyModel.keras', save_best_only=True)
earlystopping = EarlyStopping(monitor='val_loss', restore_best_weights=True,␣
 ↪patience=70)
reduce_lr = ReduceLROnPlateau(monitor='val_loss', factor=0.5, patience=5,␣
 ↪min_lr=1e-7)
```

[ ]:
```
TrainData = tf.data.Dataset.from_tensor_slices((x_train,y_train))
ValData   = tf.data.Dataset.from_tensor_slices((x_val, y_val))
TestData  = tf.data.Dataset.from_tensor_slices((x_test, y_test))

TrainData = TrainData.shuffle(buffer_size=8, reshuffle_each_iteration=True).
 ↪batch(32).prefetch(tf.data.AUTOTUNE)
ValData   = ValData.shuffle(buffer_size=8, reshuffle_each_iteration=True).
 ↪batch(32).prefetch(tf.data.AUTOTUNE)
TestData  = TestData.shuffle(buffer_size=8, reshuffle_each_iteration=True).
 ↪batch(32).prefetch(tf.data.AUTOTUNE)
model.compile(optimizer=Adam(learning_rate=0.01), loss=MeanAbsoluteError())
```

[ ]:
```
history = model.fit(TrainData, validation_data=ValData, epochs=500,␣
 ↪callbacks=[earlystopping,checkpoint,reduce_lr])
```

```
Epoch 1/500
17/17 [==============================] - 1s 17ms/step - loss: 307272.6250 -
val_loss: 306066.2188 - lr: 0.0100
Epoch 2/500
17/17 [==============================] - 0s 8ms/step - loss: 307096.8750 -
val_loss: 303308.8438 - lr: 0.0100
Epoch 3/500
17/17 [==============================] - 0s 10ms/step - loss: 306016.9375 -
val_loss: 290525.3125 - lr: 0.0100
Epoch 4/500
17/17 [==============================] - 0s 9ms/step - loss: 301048.7188 -
val_loss: 250759.5781 - lr: 0.0100
Epoch 5/500
17/17 [==============================] - 0s 9ms/step - loss: 283938.2188 -
val_loss: 159640.7188 - lr: 0.0100
Epoch 6/500
17/17 [==============================] - 0s 6ms/step - loss: 238381.2500 -
val_loss: 91631.4375 - lr: 0.0100
Epoch 7/500
17/17 [==============================] - 0s 4ms/step - loss: 157864.5625 -
val_loss: 226571.6719 - lr: 0.0100
Epoch 8/500
17/17 [==============================] - 0s 4ms/step - loss: 116611.4141 -
val_loss: 233455.5156 - lr: 0.0100
```

```
Epoch 9/500
17/17 [==============================] - 0s 5ms/step - loss: 103025.7266 -
val_loss: 145695.9062 - lr: 0.0100
Epoch 10/500
17/17 [==============================] - 0s 4ms/step - loss: 93197.4922 -
val_loss: 119718.4922 - lr: 0.0100
Epoch 11/500
17/17 [==============================] - 0s 5ms/step - loss: 86006.0234 -
val_loss: 100174.9688 - lr: 0.0100
Epoch 12/500
17/17 [==============================] - 0s 6ms/step - loss: 81368.4609 -
val_loss: 90384.7188 - lr: 0.0050
Epoch 13/500
17/17 [==============================] - 0s 6ms/step - loss: 80067.7109 -
val_loss: 82901.2266 - lr: 0.0050
Epoch 14/500
17/17 [==============================] - 0s 7ms/step - loss: 77311.4688 -
val_loss: 78186.8359 - lr: 0.0050
Epoch 15/500
17/17 [==============================] - 0s 6ms/step - loss: 76900.3125 -
val_loss: 76368.8906 - lr: 0.0050
Epoch 16/500
17/17 [==============================] - 0s 6ms/step - loss: 75247.8984 -
val_loss: 73278.2031 - lr: 0.0050
Epoch 17/500
17/17 [==============================] - 0s 6ms/step - loss: 74484.9141 -
val_loss: 71470.0469 - lr: 0.0050
Epoch 18/500
17/17 [==============================] - 0s 6ms/step - loss: 73111.4922 -
val_loss: 70532.7500 - lr: 0.0050
Epoch 19/500
17/17 [==============================] - 0s 7ms/step - loss: 72402.3750 -
val_loss: 69546.1328 - lr: 0.0050
Epoch 20/500
17/17 [==============================] - 0s 7ms/step - loss: 71596.8750 -
val_loss: 69145.4141 - lr: 0.0050
Epoch 21/500
17/17 [==============================] - 0s 6ms/step - loss: 71257.1562 -
val_loss: 68683.0391 - lr: 0.0050
Epoch 22/500
17/17 [==============================] - 0s 6ms/step - loss: 70493.7109 -
val_loss: 68509.5312 - lr: 0.0050
Epoch 23/500
17/17 [==============================] - 0s 7ms/step - loss: 69981.7656 -
val_loss: 68347.5938 - lr: 0.0050
Epoch 24/500
17/17 [==============================] - 0s 6ms/step - loss: 69292.6016 -
val_loss: 68177.5469 - lr: 0.0050
```

```
Epoch 25/500
17/17 [==============================] - 0s 6ms/step - loss: 69062.1094 -
val_loss: 68063.0547 - lr: 0.0050
Epoch 26/500
17/17 [==============================] - 0s 6ms/step - loss: 68096.8047 -
val_loss: 68000.6172 - lr: 0.0050
Epoch 27/500
17/17 [==============================] - 0s 7ms/step - loss: 68030.6875 -
val_loss: 67911.4609 - lr: 0.0050
Epoch 28/500
17/17 [==============================] - 0s 6ms/step - loss: 67639.9688 -
val_loss: 67825.5469 - lr: 0.0050
Epoch 29/500
17/17 [==============================] - 0s 7ms/step - loss: 67302.7031 -
val_loss: 67652.4297 - lr: 0.0050
Epoch 30/500
17/17 [==============================] - 0s 6ms/step - loss: 66606.7891 -
val_loss: 67511.3281 - lr: 0.0050
Epoch 31/500
17/17 [==============================] - 0s 7ms/step - loss: 66216.5312 -
val_loss: 67182.0312 - lr: 0.0050
Epoch 32/500
17/17 [==============================] - 0s 6ms/step - loss: 65714.3359 -
val_loss: 67001.2812 - lr: 0.0050
Epoch 33/500
17/17 [==============================] - 0s 6ms/step - loss: 65017.0742 -
val_loss: 66509.0234 - lr: 0.0050
Epoch 34/500
17/17 [==============================] - 0s 6ms/step - loss: 64572.1211 -
val_loss: 65924.1641 - lr: 0.0050
Epoch 35/500
17/17 [==============================] - 0s 7ms/step - loss: 63506.9336 -
val_loss: 65250.1953 - lr: 0.0050
Epoch 36/500
17/17 [==============================] - 0s 7ms/step - loss: 62595.9727 -
val_loss: 64334.7305 - lr: 0.0050
Epoch 37/500
17/17 [==============================] - 0s 7ms/step - loss: 61488.0039 -
val_loss: 63338.2617 - lr: 0.0050
Epoch 38/500
17/17 [==============================] - 0s 6ms/step - loss: 60157.0312 -
val_loss: 62086.3047 - lr: 0.0050
Epoch 39/500
17/17 [==============================] - 0s 6ms/step - loss: 58566.1719 -
val_loss: 60626.8555 - lr: 0.0050
Epoch 40/500
17/17 [==============================] - 0s 7ms/step - loss: 56331.9883 -
val_loss: 58841.2031 - lr: 0.0050
```

```
Epoch 41/500
17/17 [==============================] - 0s 6ms/step - loss: 54321.9844 -
val_loss: 56821.7773 - lr: 0.0050
Epoch 42/500
17/17 [==============================] - 0s 6ms/step - loss: 52020.1953 -
val_loss: 54444.2656 - lr: 0.0050
Epoch 43/500
17/17 [==============================] - 0s 6ms/step - loss: 48693.3242 -
val_loss: 51718.3164 - lr: 0.0050
Epoch 44/500
17/17 [==============================] - 0s 7ms/step - loss: 46072.3477 -
val_loss: 48678.5898 - lr: 0.0050
Epoch 45/500
17/17 [==============================] - 0s 6ms/step - loss: 42546.8594 -
val_loss: 45641.1875 - lr: 0.0050
Epoch 46/500
17/17 [==============================] - 0s 7ms/step - loss: 39240.8359 -
val_loss: 42593.5234 - lr: 0.0050
Epoch 47/500
17/17 [==============================] - 0s 8ms/step - loss: 36708.9219 -
val_loss: 39708.1055 - lr: 0.0050
Epoch 48/500
17/17 [==============================] - 0s 7ms/step - loss: 34395.7930 -
val_loss: 37534.4883 - lr: 0.0050
Epoch 49/500
17/17 [==============================] - 0s 7ms/step - loss: 34104.4336 -
val_loss: 36441.8086 - lr: 0.0050
Epoch 50/500
17/17 [==============================] - 0s 6ms/step - loss: 33439.6836 -
val_loss: 35211.4609 - lr: 0.0050
Epoch 51/500
17/17 [==============================] - 0s 6ms/step - loss: 32409.9434 -
val_loss: 34660.1367 - lr: 0.0050
Epoch 52/500
17/17 [==============================] - 0s 6ms/step - loss: 32823.9688 -
val_loss: 34169.0391 - lr: 0.0050
Epoch 53/500
17/17 [==============================] - 0s 6ms/step - loss: 31603.3457 -
val_loss: 33961.0977 - lr: 0.0050
Epoch 54/500
17/17 [==============================] - 0s 7ms/step - loss: 32762.4668 -
val_loss: 33549.5742 - lr: 0.0050
Epoch 55/500
17/17 [==============================] - 0s 8ms/step - loss: 31880.5645 -
val_loss: 33374.5781 - lr: 0.0050
Epoch 56/500
17/17 [==============================] - 0s 7ms/step - loss: 32313.8008 -
val_loss: 33267.7227 - lr: 0.0050
```

```
Epoch 57/500
17/17 [==============================] - 0s 7ms/step - loss: 32164.5039 -
val_loss: 33016.0000 - lr: 0.0050
Epoch 58/500
17/17 [==============================] - 0s 4ms/step - loss: 31086.3906 -
val_loss: 33124.4883 - lr: 0.0050
Epoch 59/500
17/17 [==============================] - 0s 6ms/step - loss: 31128.3105 -
val_loss: 32852.2539 - lr: 0.0050
Epoch 60/500
17/17 [==============================] - 0s 6ms/step - loss: 32226.2031 -
val_loss: 32791.5039 - lr: 0.0050
Epoch 61/500
17/17 [==============================] - 0s 5ms/step - loss: 30988.4277 -
val_loss: 32814.2109 - lr: 0.0050
Epoch 62/500
17/17 [==============================] - 0s 6ms/step - loss: 31190.4570 -
val_loss: 32642.1797 - lr: 0.0050
Epoch 63/500
17/17 [==============================] - 0s 8ms/step - loss: 31694.0156 -
val_loss: 32603.3398 - lr: 0.0050
Epoch 64/500
17/17 [==============================] - 0s 4ms/step - loss: 32168.0645 -
val_loss: 32633.4512 - lr: 0.0050
Epoch 65/500
17/17 [==============================] - 0s 4ms/step - loss: 32207.0527 -
val_loss: 32624.8398 - lr: 0.0050
Epoch 66/500
17/17 [==============================] - 0s 13ms/step - loss: 31149.5391 -
val_loss: 32591.2910 - lr: 0.0050
Epoch 67/500
17/17 [==============================] - 0s 10ms/step - loss: 31252.4297 -
val_loss: 32561.6641 - lr: 0.0050
Epoch 68/500
17/17 [==============================] - 0s 7ms/step - loss: 31664.7070 -
val_loss: 32501.8320 - lr: 0.0050
Epoch 69/500
17/17 [==============================] - 0s 7ms/step - loss: 32468.4219 -
val_loss: 32481.1797 - lr: 0.0050
Epoch 70/500
17/17 [==============================] - 0s 7ms/step - loss: 31310.3809 -
val_loss: 32418.8809 - lr: 0.0050
Epoch 71/500
17/17 [==============================] - 0s 6ms/step - loss: 31731.5859 -
val_loss: 32378.8066 - lr: 0.0050
Epoch 72/500
17/17 [==============================] - 0s 4ms/step - loss: 32143.7559 -
val_loss: 32454.7910 - lr: 0.0050
```

```
Epoch 73/500
17/17 [==============================] - 0s 4ms/step - loss: 31768.9746 -
val_loss: 32483.9668 - lr: 0.0050
Epoch 74/500
17/17 [==============================] - 0s 4ms/step - loss: 31956.7520 -
val_loss: 32636.4922 - lr: 0.0050
Epoch 75/500
17/17 [==============================] - 0s 4ms/step - loss: 31754.2109 -
val_loss: 32766.4180 - lr: 0.0050
Epoch 76/500
17/17 [==============================] - 0s 6ms/step - loss: 31186.8184 -
val_loss: 32316.5195 - lr: 0.0050
Epoch 77/500
17/17 [==============================] - 0s 4ms/step - loss: 31179.5527 -
val_loss: 32401.8477 - lr: 0.0050
Epoch 78/500
17/17 [==============================] - 0s 5ms/step - loss: 32213.7285 -
val_loss: 32548.2305 - lr: 0.0050
Epoch 79/500
17/17 [==============================] - 0s 4ms/step - loss: 31110.7227 -
val_loss: 32352.5371 - lr: 0.0050
Epoch 80/500
17/17 [==============================] - 0s 4ms/step - loss: 32147.0332 -
val_loss: 32790.0547 - lr: 0.0050
Epoch 81/500
17/17 [==============================] - 0s 4ms/step - loss: 31547.3301 -
val_loss: 32368.9219 - lr: 0.0050
Epoch 82/500
17/17 [==============================] - 0s 4ms/step - loss: 30807.8477 -
val_loss: 32578.6270 - lr: 0.0025
Epoch 83/500
17/17 [==============================] - 0s 4ms/step - loss: 31019.9102 -
val_loss: 32451.5977 - lr: 0.0025
Epoch 84/500
17/17 [==============================] - 0s 5ms/step - loss: 31478.8613 -
val_loss: 32734.3516 - lr: 0.0025
Epoch 85/500
17/17 [==============================] - 0s 4ms/step - loss: 31430.8398 -
val_loss: 32739.5488 - lr: 0.0025
Epoch 86/500
17/17 [==============================] - 0s 6ms/step - loss: 31046.6113 -
val_loss: 32649.7539 - lr: 0.0025
Epoch 87/500
17/17 [==============================] - 0s 6ms/step - loss: 30839.2871 -
val_loss: 32657.1016 - lr: 0.0012
Epoch 88/500
17/17 [==============================] - 0s 7ms/step - loss: 30965.6270 -
val_loss: 32496.0938 - lr: 0.0012
```

```
Epoch 89/500
17/17 [==============================] - 0s 6ms/step - loss: 30881.0723 -
val_loss: 32505.6875 - lr: 0.0012
Epoch 90/500
17/17 [==============================] - 0s 6ms/step - loss: 31754.5527 -
val_loss: 32619.2793 - lr: 0.0012
Epoch 91/500
17/17 [==============================] - 0s 6ms/step - loss: 31466.9062 -
val_loss: 32514.8691 - lr: 0.0012
Epoch 92/500
17/17 [==============================] - 0s 7ms/step - loss: 31462.0176 -
val_loss: 32494.7832 - lr: 6.2500e-04
Epoch 93/500
17/17 [==============================] - 0s 7ms/step - loss: 31500.3164 -
val_loss: 32491.7793 - lr: 6.2500e-04
Epoch 94/500
17/17 [==============================] - 0s 7ms/step - loss: 31052.4512 -
val_loss: 32526.5488 - lr: 6.2500e-04
Epoch 95/500
17/17 [==============================] - 0s 6ms/step - loss: 31395.8281 -
val_loss: 32613.1602 - lr: 6.2500e-04
Epoch 96/500
17/17 [==============================] - 0s 7ms/step - loss: 30840.7773 -
val_loss: 32625.8438 - lr: 6.2500e-04
Epoch 97/500
17/17 [==============================] - 0s 7ms/step - loss: 30790.5742 -
val_loss: 32636.1934 - lr: 3.1250e-04
Epoch 98/500
17/17 [==============================] - 0s 6ms/step - loss: 30638.6523 -
val_loss: 32603.9590 - lr: 3.1250e-04
Epoch 99/500
17/17 [==============================] - 0s 6ms/step - loss: 31001.7852 -
val_loss: 32601.6074 - lr: 3.1250e-04
Epoch 100/500
17/17 [==============================] - 0s 6ms/step - loss: 31668.6504 -
val_loss: 32578.4180 - lr: 3.1250e-04
Epoch 101/500
17/17 [==============================] - 0s 5ms/step - loss: 31818.4883 -
val_loss: 32543.0039 - lr: 3.1250e-04
Epoch 102/500
17/17 [==============================] - 0s 5ms/step - loss: 31657.4180 -
val_loss: 32533.9062 - lr: 1.5625e-04
Epoch 103/500
17/17 [==============================] - 0s 5ms/step - loss: 30893.5859 -
val_loss: 32530.2949 - lr: 1.5625e-04
Epoch 104/500
17/17 [==============================] - 0s 4ms/step - loss: 31663.0820 -
val_loss: 32535.7246 - lr: 1.5625e-04
```

```
Epoch 105/500
17/17 [==============================] - 0s 4ms/step - loss: 31869.6621 -
val_loss: 32534.4961 - lr: 1.5625e-04
Epoch 106/500
17/17 [==============================] - 0s 4ms/step - loss: 31554.3379 -
val_loss: 32536.7871 - lr: 1.5625e-04
Epoch 107/500
17/17 [==============================] - 0s 4ms/step - loss: 31784.8203 -
val_loss: 32517.7305 - lr: 7.8125e-05
Epoch 108/500
17/17 [==============================] - 0s 4ms/step - loss: 31094.2324 -
val_loss: 32528.4062 - lr: 7.8125e-05
Epoch 109/500
17/17 [==============================] - 0s 4ms/step - loss: 30575.7129 -
val_loss: 32549.0742 - lr: 7.8125e-05
Epoch 110/500
17/17 [==============================] - 0s 4ms/step - loss: 30818.2617 -
val_loss: 32570.2617 - lr: 7.8125e-05
Epoch 111/500
17/17 [==============================] - 0s 5ms/step - loss: 31075.7754 -
val_loss: 32564.8398 - lr: 7.8125e-05
Epoch 112/500
17/17 [==============================] - 0s 4ms/step - loss: 30953.2188 -
val_loss: 32573.1035 - lr: 3.9062e-05
Epoch 113/500
17/17 [==============================] - 0s 4ms/step - loss: 30921.6855 -
val_loss: 32567.6309 - lr: 3.9062e-05
Epoch 114/500
17/17 [==============================] - 0s 5ms/step - loss: 31422.5137 -
val_loss: 32549.7871 - lr: 3.9062e-05
Epoch 115/500
17/17 [==============================] - 0s 4ms/step - loss: 31361.0293 -
val_loss: 32547.7715 - lr: 3.9062e-05
Epoch 116/500
17/17 [==============================] - 0s 4ms/step - loss: 30978.0430 -
val_loss: 32544.8359 - lr: 3.9062e-05
Epoch 117/500
17/17 [==============================] - 0s 5ms/step - loss: 31300.9805 -
val_loss: 32537.6270 - lr: 1.9531e-05
Epoch 118/500
17/17 [==============================] - 0s 5ms/step - loss: 32071.3262 -
val_loss: 32515.7754 - lr: 1.9531e-05
Epoch 119/500
17/17 [==============================] - 0s 4ms/step - loss: 31318.4023 -
val_loss: 32516.1152 - lr: 1.9531e-05
Epoch 120/500
17/17 [==============================] - 0s 4ms/step - loss: 32138.3242 -
val_loss: 32506.5449 - lr: 1.9531e-05
```

```
Epoch 121/500
17/17 [==============================] - 0s 6ms/step - loss: 31246.1426 -
val_loss: 32516.6035 - lr: 1.9531e-05
Epoch 122/500
17/17 [==============================] - 0s 4ms/step - loss: 31105.2500 -
val_loss: 32524.0039 - lr: 9.7656e-06
Epoch 123/500
17/17 [==============================] - 0s 4ms/step - loss: 31079.0723 -
val_loss: 32531.0820 - lr: 9.7656e-06
Epoch 124/500
17/17 [==============================] - 0s 4ms/step - loss: 31523.8320 -
val_loss: 32537.3320 - lr: 9.7656e-06
Epoch 125/500
17/17 [==============================] - 0s 5ms/step - loss: 30727.9883 -
val_loss: 32553.4707 - lr: 9.7656e-06
Epoch 126/500
17/17 [==============================] - 0s 4ms/step - loss: 30818.0742 -
val_loss: 32561.3848 - lr: 9.7656e-06
Epoch 127/500
17/17 [==============================] - 0s 4ms/step - loss: 31455.3496 -
val_loss: 32543.2988 - lr: 4.8828e-06
Epoch 128/500
17/17 [==============================] - 0s 5ms/step - loss: 31170.7227 -
val_loss: 32545.8965 - lr: 4.8828e-06
Epoch 129/500
17/17 [==============================] - 0s 4ms/step - loss: 31020.3008 -
val_loss: 32542.8320 - lr: 4.8828e-06
Epoch 130/500
17/17 [==============================] - 0s 4ms/step - loss: 31136.0254 -
val_loss: 32554.0078 - lr: 4.8828e-06
Epoch 131/500
17/17 [==============================] - 0s 5ms/step - loss: 30512.7129 -
val_loss: 32570.2051 - lr: 4.8828e-06
Epoch 132/500
17/17 [==============================] - 0s 4ms/step - loss: 31132.2461 -
val_loss: 32575.4922 - lr: 2.4414e-06
Epoch 133/500
17/17 [==============================] - 0s 5ms/step - loss: 31468.4922 -
val_loss: 32553.4102 - lr: 2.4414e-06
Epoch 134/500
17/17 [==============================] - 0s 4ms/step - loss: 31283.6816 -
val_loss: 32553.2051 - lr: 2.4414e-06
Epoch 135/500
17/17 [==============================] - 0s 4ms/step - loss: 31298.0957 -
val_loss: 32547.7656 - lr: 2.4414e-06
Epoch 136/500
17/17 [==============================] - 0s 4ms/step - loss: 31512.3242 -
val_loss: 32541.5000 - lr: 2.4414e-06
```

```
Epoch 137/500
17/17 [==============================] - 0s 5ms/step - loss: 31631.1660 -
val_loss: 32545.2168 - lr: 1.2207e-06
Epoch 138/500
17/17 [==============================] - 0s 4ms/step - loss: 31303.8281 -
val_loss: 32545.3438 - lr: 1.2207e-06
Epoch 139/500
17/17 [==============================] - 0s 4ms/step - loss: 30726.8848 -
val_loss: 32560.2383 - lr: 1.2207e-06
Epoch 140/500
17/17 [==============================] - 0s 5ms/step - loss: 30816.1836 -
val_loss: 32566.1484 - lr: 1.2207e-06
Epoch 141/500
17/17 [==============================] - 0s 4ms/step - loss: 32337.3379 -
val_loss: 32550.8125 - lr: 1.2207e-06
Epoch 142/500
17/17 [==============================] - 0s 6ms/step - loss: 31116.8320 -
val_loss: 32553.5449 - lr: 6.1035e-07
Epoch 143/500
17/17 [==============================] - 0s 4ms/step - loss: 32258.4766 -
val_loss: 32539.1758 - lr: 6.1035e-07
Epoch 144/500
17/17 [==============================] - 0s 4ms/step - loss: 30829.5996 -
val_loss: 32532.7246 - lr: 6.1035e-07
Epoch 145/500
17/17 [==============================] - 0s 4ms/step - loss: 32003.5156 -
val_loss: 32540.3984 - lr: 6.1035e-07
Epoch 146/500
17/17 [==============================] - 0s 5ms/step - loss: 31143.1211 -
val_loss: 32555.6074 - lr: 6.1035e-07
```

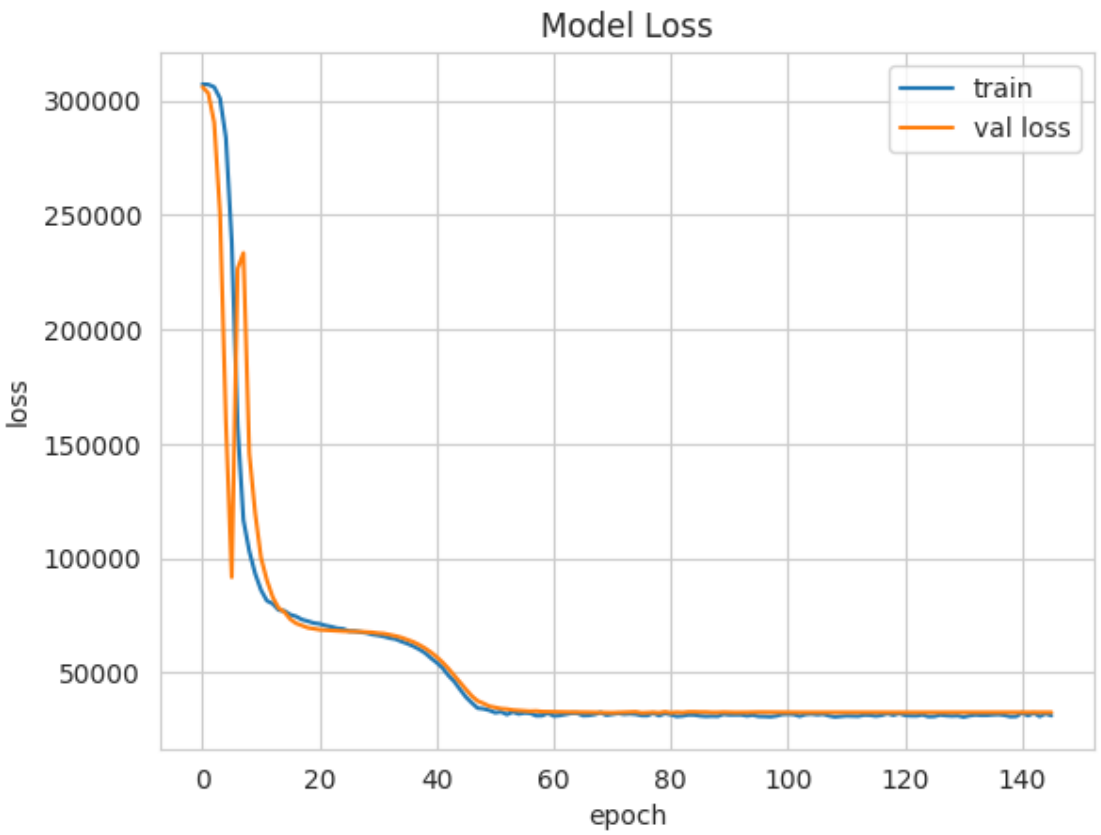
[ ]:
```
model.evaluate(x_test,y_test)
```

```
3/3 [==============================] - 0s 4ms/step - loss: 25537.2344
```

[ ]:
```
25537.234375
```

7 Plotting Results

[ ]:
```
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('Model Loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train','val loss'])
plt.show()
```



[ ]:
```
y_pred=list(model.predict(x_test)[:,0])
y_true = list(y_test[:,0].numpy())
```

```
3/3 [==============================] - 0s 4ms/step
```

8 Closest Prediction

[ ]:
```
x=0
min=float('inf')
for i,(pred,true) in enumerate(zip(y_pred,y_true)):
  diff=abs(pred-true)
  if(diff)<min:
    min=diff
    x=i

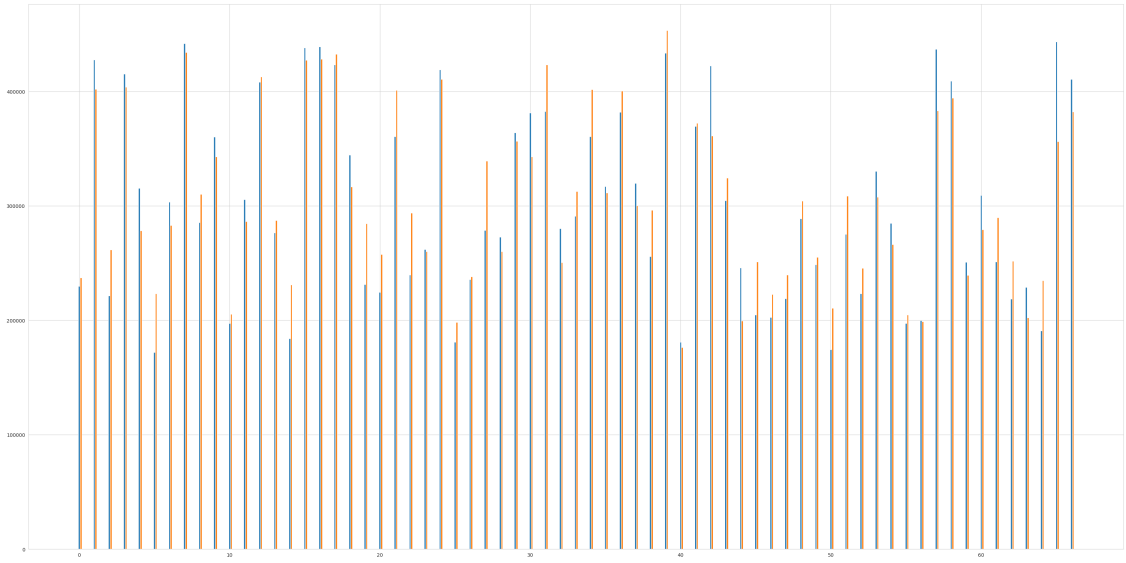
print(y_true[x],y_pred[x],x)
```

```
199798.0 198828.89 56
```

[ ]:
```
shape=tf.shape(y_test)[0]
print(shape.numpy())
```

67

[ ]:
```
ind=np.arange(shape.numpy())
plt.figure(figsize=(40,20))
width=0.11
plt.bar(ind,y_true,width, label='true values')
plt.bar(ind+width,y_pred,width,label='predicted values')
plt.show()
```



9 Sorting Layers by redundancy (least weights)

[ ]:
```
weights = []
Magnitudes = []
indexes = []
for layer in model.layers:
  if isinstance(layer, Dense):
    weights.append(layer.get_weights())

for weight in weights:
  Magnitudes.append(np.mean(np.abs(weight[0])))
  weights.pop()

for m in Magnitudes:
    least = np.argmin(Magnitudes)
    indexes.append(least)
```

```
    Magnitudes[least]=1000
print(indexes)
```

```
[1, 0]
```

[7]:
```
!jupyter nbconvert --to pdf "/content/drives/MyDrive/Colab Notebooks/Copy of␣
↪car_price_predictor_enhanced.ipynb" --output-dir="/content/drives/MyDrive/
↪Colab Notebooks/Output"
```

```
[NbConvertApp] Converting notebook /content/drives/MyDrive/Colab Notebooks/Copy
of car_price_predictor_enhanced.ipynb to pdf
[NbConvertApp] Support files will be in Copy of
car_price_predictor_enhanced_files/
[NbConvertApp] Making directory ./Copy of car_price_predictor_enhanced_files
[NbConvertApp] Making directory ./Copy of car_price_predictor_enhanced_files
[NbConvertApp] Making directory ./Copy of car_price_predictor_enhanced_files
[NbConvertApp] Making directory ./Copy of car_price_predictor_enhanced_files
[NbConvertApp] Making directory ./Copy of car_price_predictor_enhanced_files
[NbConvertApp] Writing 76215 bytes to notebook.tex
[NbConvertApp] Building PDF
Traceback (most recent call last):
  File "/usr/local/bin/jupyter-nbconvert", line 8, in <module>
    sys.exit(main())
  File "/usr/local/lib/python3.10/dist-packages/jupyter_core/application.py",
line 283, in launch_instance
    super().launch_instance(argv=argv, **kwargs)
  File "/usr/local/lib/python3.10/dist-
packages/traitlets/config/application.py", line 992, in launch_instance
    app.start()
  File "/usr/local/lib/python3.10/dist-packages/nbconvert/nbconvertapp.py", line
423, in start
    self.convert_notebooks()
  File "/usr/local/lib/python3.10/dist-packages/nbconvert/nbconvertapp.py", line
597, in convert_notebooks
    self.convert_single_notebook(notebook_filename)
  File "/usr/local/lib/python3.10/dist-packages/nbconvert/nbconvertapp.py", line
560, in convert_single_notebook
    output, resources = self.export_single_notebook(
  File "/usr/local/lib/python3.10/dist-packages/nbconvert/nbconvertapp.py", line
488, in export_single_notebook
    output, resources = self.exporter.from_filename(
  File "/usr/local/lib/python3.10/dist-
packages/nbconvert/exporters/exporter.py", line 189, in from_filename
    return self.from_file(f, resources=resources, **kw)
  File "/usr/local/lib/python3.10/dist-
packages/nbconvert/exporters/exporter.py", line 206, in from_file
    return self.from_notebook_node(
  File "/usr/local/lib/python3.10/dist-packages/nbconvert/exporters/pdf.py",
```

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line 194, in from_notebook_node
    self.run_latex(tex_file)
  File "/usr/local/lib/python3.10/dist-packages/nbconvert/exporters/pdf.py",
line 164, in run_latex
    return self.run_command(
  File "/usr/local/lib/python3.10/dist-packages/nbconvert/exporters/pdf.py",
line 111, in run_command
    raise OSError(
OSError: xelatex not found on PATH, if you have not installed xelatex you may
need to do so. Find further instructions at
https://nbconvert.readthedocs.io/en/latest/install.html#installing-tex.
```

[ ]: