assignment-day-15

February 9, 2024

[40]:
```
import pandas as pd
import numpy as np
```

[41]:
```
df  = pd.read_csv("Boston.csv")
df
```

[41]:

	Unnamed: 0	crim	zn	indus	chas	nox	rm	age	dis	rad	tax	ptratio	black	lstat	medv
0	1	0.00632	18.0	2.31	0	0.538	6.575	65.2	4.0900	1	296	15.3	396.90	4.98	24.0
1	2	0.02731	0.0	7.07	0	0.469	6.421	78.9	4.9671	2	242	17.8	396.90	9.14	21.6
2	3	0.02729	0.0	7.07	0	0.469	7.185	61.1	4.9671	2	242	17.8	392.83	4.03	34.7
3	4	0.03237	0.0	2.18	0	0.458	6.998	45.8	6.0622	3	222	18.7	394.63	2.94	33.4
4	5	0.06905	0.0	2.18	0	0.458	7.147	54.2	6.0622	3	222	18.7	396.90	5.33	36.2
..	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
501	502	0.06263	0.0	11.93	0	0.573	6.593	69.1	2.4786	1	273	21.0	391.99	9.67	22.4
502	503	0.04527	0.0	11.93	0	0.573	6.120	76.7	2.2875	1	273	21.0	396.90	9.08	20.6
503	504	0.06076	0.0	11.93	0	0.573	6.976	91.0	2.1675	1	273	21.0	396.90	5.64	23.9
504	505	0.10959	0.0	11.93	0	0.573	6.794	89.3	2.3889	1	273	21.0	393.45	6.48	22.0
505	506	0.04741	0.0	11.93	0	0.573	6.030	80.8	2.5050	1	273	21.0	396.90	7.88	11.9

[506 rows x 15 columns]

[42]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 506 entries, 0 to 505
```

```
Data columns (total 15 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   Unnamed: 0  506 non-null    int64
 1   crim        506 non-null    float64
 2   zn          506 non-null    float64
 3   indus       506 non-null    float64
 4   chas        506 non-null    int64
 5   nox         506 non-null    float64
 6   rm          506 non-null    float64
 7   age         506 non-null    float64
 8   dis         506 non-null    float64
 9   rad         506 non-null    int64
 10  tax         506 non-null    int64
 11  ptratio     506 non-null    float64
 12  black       506 non-null    float64
 13  lstat       506 non-null    float64
 14  medv        506 non-null    float64
dtypes: float64(11), int64(4)
memory usage: 59.4 KB
```

[43]:
```
df.isnull().sum()
```

[43]:
```
Unnamed: 0    0
crim          0
zn            0
indus         0
chas          0
nox           0
rm            0
age           0
dis           0
rad           0
tax           0
ptratio       0
black         0
lstat         0
medv          0
dtype: int64
```

[44]:
```
x = df.drop(['medv','Unnamed: 0'],axis = 1)
y = df['medv']
```

[45]:
```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size = .2␣
 ↪,random_state = 43)
```

[46]:
```
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(x_train)
X_test_scaled = scaler.transform(x_test)
```

[47]:
```
import tensorflow
from tensorflow import keras
from tensorflow.keras import Sequential
from tensorflow.keras.layers import Dense
```

[48]:
```
model= Sequential()
model.add(Dense(7,activation = 'relu',input_dim = 13))
model.add(Dense(5,activation = 'relu'))
model.add(Dense(3,activation = 'linear'))
model.add(Dense(1,activation = 'linear'))
```

[49]:
```
model.summary()
```

```
Model: "sequential_7"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense_23 (Dense)            (None, 7)                 98

 dense_24 (Dense)            (None, 5)                 40

 dense_25 (Dense)            (None, 3)                 18

 dense_26 (Dense)            (None, 1)                 4

=================================================================
Total params: 160 (640.00 Byte)
Trainable params: 160 (640.00 Byte)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

[50]:
```
model.compile(loss = tensorflow.keras.losses.Huber(delta=1.0),optimizer =␣
↪'Adam')
```

[54]:
```
history = model.fit(X_train_scaled,y_train,epochs = 200,validation_split= 0.2)
```

```
Epoch 1/200
11/11 [==============================] - 0s 16ms/step - loss: 1.9889 - val_loss:
2.4191
Epoch 2/200
11/11 [==============================] - 0s 9ms/step - loss: 1.9841 - val_loss:
2.4311
```

```
Epoch 3/200
11/11 [==============================] - 0s 11ms/step - loss: 1.9752 - val_loss:
2.4086
Epoch 4/200
11/11 [==============================] - 0s 10ms/step - loss: 1.9784 - val_loss:
2.4020
Epoch 5/200
11/11 [==============================] - 0s 11ms/step - loss: 1.9682 - val_loss:
2.4224
Epoch 6/200
11/11 [==============================] - 0s 11ms/step - loss: 1.9641 - val_loss:
2.4471
Epoch 7/200
11/11 [==============================] - 0s 17ms/step - loss: 1.9573 - val_loss:
2.4394
Epoch 8/200
11/11 [==============================] - 0s 11ms/step - loss: 1.9515 - val_loss:
2.4137
Epoch 9/200
11/11 [==============================] - 0s 6ms/step - loss: 1.9480 - val_loss:
2.4099
Epoch 10/200
11/11 [==============================] - 0s 5ms/step - loss: 1.9439 - val_loss:
2.3734
Epoch 11/200
11/11 [==============================] - 0s 7ms/step - loss: 1.9376 - val_loss:
2.3590
Epoch 12/200
11/11 [==============================] - 0s 7ms/step - loss: 1.9363 - val_loss:
2.3328
Epoch 13/200
11/11 [==============================] - 0s 7ms/step - loss: 1.9410 - val_loss:
2.3260
Epoch 14/200
11/11 [==============================] - 0s 5ms/step - loss: 1.9214 - val_loss:
2.3905
Epoch 15/200
11/11 [==============================] - 0s 6ms/step - loss: 1.9690 - val_loss:
2.4635
Epoch 16/200
11/11 [==============================] - 0s 7ms/step - loss: 1.9362 - val_loss:
2.3742
Epoch 17/200
11/11 [==============================] - 0s 6ms/step - loss: 1.9163 - val_loss:
2.3539
Epoch 18/200
11/11 [==============================] - 0s 7ms/step - loss: 1.9300 - val_loss:
2.3331
```

```
Epoch 19/200
11/11 [==============================] - 0s 6ms/step - loss: 1.9082 - val_loss:
2.3919
Epoch 20/200
11/11 [==============================] - 0s 5ms/step - loss: 1.9154 - val_loss:
2.4302
Epoch 21/200
11/11 [==============================] - 0s 7ms/step - loss: 1.9054 - val_loss:
2.3829
Epoch 22/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8936 - val_loss:
2.3790
Epoch 23/200
11/11 [==============================] - 0s 6ms/step - loss: 1.9106 - val_loss:
2.4003
Epoch 24/200
11/11 [==============================] - 0s 6ms/step - loss: 1.9050 - val_loss:
2.3509
Epoch 25/200
11/11 [==============================] - 0s 5ms/step - loss: 1.8881 - val_loss:
2.3021
Epoch 26/200
11/11 [==============================] - 0s 6ms/step - loss: 1.8855 - val_loss:
2.2942
Epoch 27/200
11/11 [==============================] - 0s 6ms/step - loss: 1.8816 - val_loss:
2.2991
Epoch 28/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8761 - val_loss:
2.2744
Epoch 29/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8776 - val_loss:
2.2540
Epoch 30/200
11/11 [==============================] - 0s 6ms/step - loss: 1.8739 - val_loss:
2.2651
Epoch 31/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8703 - val_loss:
2.2502
Epoch 32/200
11/11 [==============================] - 0s 5ms/step - loss: 1.8688 - val_loss:
2.2340
Epoch 33/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8693 - val_loss:
2.2607
Epoch 34/200
11/11 [==============================] - 0s 5ms/step - loss: 1.8601 - val_loss:
2.2901
```

```
Epoch 35/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8607 - val_loss:
2.3023
Epoch 36/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8609 - val_loss:
2.2759
Epoch 37/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8531 - val_loss:
2.2675
Epoch 38/200
11/11 [==============================] - 0s 5ms/step - loss: 1.8498 - val_loss:
2.2721
Epoch 39/200
11/11 [==============================] - 0s 5ms/step - loss: 1.8474 - val_loss:
2.2683
Epoch 40/200
11/11 [==============================] - 0s 6ms/step - loss: 1.8418 - val_loss:
2.2569
Epoch 41/200
11/11 [==============================] - 0s 6ms/step - loss: 1.8402 - val_loss:
2.2505
Epoch 42/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8379 - val_loss:
2.2210
Epoch 43/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8421 - val_loss:
2.2391
Epoch 44/200
11/11 [==============================] - 0s 8ms/step - loss: 1.8337 - val_loss:
2.2020
Epoch 45/200
11/11 [==============================] - 0s 6ms/step - loss: 1.8413 - val_loss:
2.2053
Epoch 46/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8268 - val_loss:
2.2309
Epoch 47/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8244 - val_loss:
2.2684
Epoch 48/200
11/11 [==============================] - 0s 6ms/step - loss: 1.8298 - val_loss:
2.2709
Epoch 49/200
11/11 [==============================] - 0s 6ms/step - loss: 1.8203 - val_loss:
2.2304
Epoch 50/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8194 - val_loss:
2.2058
```

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Epoch 51/200
11/11 [==============================] - 0s 5ms/step - loss: 1.8151 - val_loss:
2.1986
Epoch 52/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8088 - val_loss:
2.2029
Epoch 53/200
11/11 [==============================] - 0s 6ms/step - loss: 1.8072 - val_loss:
2.2205
Epoch 54/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8103 - val_loss:
2.2404
Epoch 55/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8055 - val_loss:
2.2165
Epoch 56/200
11/11 [==============================] - 0s 7ms/step - loss: 1.8017 - val_loss:
2.1920
Epoch 57/200
11/11 [==============================] - 0s 6ms/step - loss: 1.7976 - val_loss:
2.2027
Epoch 58/200
11/11 [==============================] - 0s 6ms/step - loss: 1.7923 - val_loss:
2.1954
Epoch 59/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7911 - val_loss:
2.1716
Epoch 60/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7949 - val_loss:
2.1606
Epoch 61/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7925 - val_loss:
2.1705
Epoch 62/200
11/11 [==============================] - 0s 5ms/step - loss: 1.7906 - val_loss:
2.1880
Epoch 63/200
11/11 [==============================] - 0s 5ms/step - loss: 1.7835 - val_loss:
2.1547
Epoch 64/200
11/11 [==============================] - 0s 6ms/step - loss: 1.8005 - val_loss:
2.1377
Epoch 65/200
11/11 [==============================] - 0s 6ms/step - loss: 1.7862 - val_loss:
2.1508
Epoch 66/200
11/11 [==============================] - 0s 5ms/step - loss: 1.7754 - val_loss:
2.1463
```

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Epoch 67/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7790 - val_loss:
2.1676
Epoch 68/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7707 - val_loss:
2.1529
Epoch 69/200
11/11 [==============================] - 0s 5ms/step - loss: 1.7711 - val_loss:
2.1733
Epoch 70/200
11/11 [==============================] - 0s 5ms/step - loss: 1.7724 - val_loss:
2.2022
Epoch 71/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7875 - val_loss:
2.1914
Epoch 72/200
11/11 [==============================] - 0s 6ms/step - loss: 1.7696 - val_loss:
2.2044
Epoch 73/200
11/11 [==============================] - 0s 5ms/step - loss: 1.7766 - val_loss:
2.1868
Epoch 74/200
11/11 [==============================] - 0s 6ms/step - loss: 1.7757 - val_loss:
2.1736
Epoch 75/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7620 - val_loss:
2.1443
Epoch 76/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7588 - val_loss:
2.1630
Epoch 77/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7579 - val_loss:
2.1507
Epoch 78/200
11/11 [==============================] - 0s 8ms/step - loss: 1.7545 - val_loss:
2.1836
Epoch 79/200
11/11 [==============================] - 0s 5ms/step - loss: 1.7544 - val_loss:
2.1765
Epoch 80/200
11/11 [==============================] - 0s 5ms/step - loss: 1.7433 - val_loss:
2.1692
Epoch 81/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7600 - val_loss:
2.1570
Epoch 82/200
11/11 [==============================] - 0s 6ms/step - loss: 1.7500 - val_loss:
2.1754
```

```
Epoch 83/200
11/11 [==============================] - 0s 5ms/step - loss: 1.7408 - val_loss:
2.1724
Epoch 84/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7416 - val_loss:
2.1692
Epoch 85/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7374 - val_loss:
2.1478
Epoch 86/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7371 - val_loss:
2.1407
Epoch 87/200
11/11 [==============================] - 0s 6ms/step - loss: 1.7353 - val_loss:
2.1414
Epoch 88/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7358 - val_loss:
2.1770
Epoch 89/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7333 - val_loss:
2.1438
Epoch 90/200
11/11 [==============================] - 0s 9ms/step - loss: 1.7260 - val_loss:
2.1447
Epoch 91/200
11/11 [==============================] - 0s 8ms/step - loss: 1.7278 - val_loss:
2.1555
Epoch 92/200
11/11 [==============================] - 0s 8ms/step - loss: 1.7237 - val_loss:
2.1625
Epoch 93/200
11/11 [==============================] - 0s 9ms/step - loss: 1.7188 - val_loss:
2.1713
Epoch 94/200
11/11 [==============================] - 0s 8ms/step - loss: 1.7218 - val_loss:
2.1652
Epoch 95/200
11/11 [==============================] - 0s 9ms/step - loss: 1.7174 - val_loss:
2.1894
Epoch 96/200
11/11 [==============================] - 0s 9ms/step - loss: 1.7202 - val_loss:
2.1852
Epoch 97/200
11/11 [==============================] - 0s 10ms/step - loss: 1.7128 - val_loss:
2.1730
Epoch 98/200
11/11 [==============================] - 0s 11ms/step - loss: 1.7263 - val_loss:
2.1705
```

```
Epoch 99/200
11/11 [==============================] - 0s 9ms/step - loss: 1.7141 - val_loss:
2.1759
Epoch 100/200
11/11 [==============================] - 0s 8ms/step - loss: 1.7157 - val_loss:
2.1685
Epoch 101/200
11/11 [==============================] - 0s 8ms/step - loss: 1.7101 - val_loss:
2.1421
Epoch 102/200
11/11 [==============================] - 0s 8ms/step - loss: 1.7049 - val_loss:
2.1321
Epoch 103/200
11/11 [==============================] - 0s 9ms/step - loss: 1.7119 - val_loss:
2.1320
Epoch 104/200
11/11 [==============================] - 0s 9ms/step - loss: 1.7051 - val_loss:
2.1490
Epoch 105/200
11/11 [==============================] - 0s 9ms/step - loss: 1.7053 - val_loss:
2.1535
Epoch 106/200
11/11 [==============================] - 0s 8ms/step - loss: 1.6988 - val_loss:
2.1325
Epoch 107/200
11/11 [==============================] - 0s 9ms/step - loss: 1.6973 - val_loss:
2.1375
Epoch 108/200
11/11 [==============================] - 0s 10ms/step - loss: 1.6966 - val_loss:
2.1249
Epoch 109/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6941 - val_loss:
2.1008
Epoch 110/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7039 - val_loss:
2.1100
Epoch 111/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6948 - val_loss:
2.1177
Epoch 112/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6912 - val_loss:
2.1139
Epoch 113/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6908 - val_loss:
2.1299
Epoch 114/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6820 - val_loss:
2.1284
```

```
Epoch 115/200
11/11 [==============================] - 0s 7ms/step - loss: 1.7048 - val_loss:
2.1302
Epoch 116/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6997 - val_loss:
2.1313
Epoch 117/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6843 - val_loss:
2.1507
Epoch 118/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6790 - val_loss:
2.1576
Epoch 119/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6789 - val_loss:
2.1511
Epoch 120/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6763 - val_loss:
2.1453
Epoch 121/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6779 - val_loss:
2.1465
Epoch 122/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6788 - val_loss:
2.1506
Epoch 123/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6738 - val_loss:
2.1464
Epoch 124/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6652 - val_loss:
2.1281
Epoch 125/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6683 - val_loss:
2.1215
Epoch 126/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6715 - val_loss:
2.1139
Epoch 127/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6796 - val_loss:
2.1505
Epoch 128/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6784 - val_loss:
2.1057
Epoch 129/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6740 - val_loss:
2.1036
Epoch 130/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6716 - val_loss:
2.1399
```

```
Epoch 131/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6629 - val_loss:
2.1282
Epoch 132/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6638 - val_loss:
2.1360
Epoch 133/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6608 - val_loss:
2.1511
Epoch 134/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6549 - val_loss:
2.1273
Epoch 135/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6508 - val_loss:
2.1116
Epoch 136/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6536 - val_loss:
2.1312
Epoch 137/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6585 - val_loss:
2.1269
Epoch 138/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6523 - val_loss:
2.1191
Epoch 139/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6464 - val_loss:
2.1418
Epoch 140/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6502 - val_loss:
2.1443
Epoch 141/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6491 - val_loss:
2.1580
Epoch 142/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6464 - val_loss:
2.1440
Epoch 143/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6407 - val_loss:
2.1546
Epoch 144/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6485 - val_loss:
2.1753
Epoch 145/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6471 - val_loss:
2.1895
Epoch 146/200
11/11 [==============================] - 0s 8ms/step - loss: 1.6472 - val_loss:
2.1691
```

```
Epoch 147/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6400 - val_loss:
2.1762
Epoch 148/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6364 - val_loss:
2.1589
Epoch 149/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6420 - val_loss:
2.1786
Epoch 150/200
11/11 [==============================] - 0s 8ms/step - loss: 1.6387 - val_loss:
2.1809
Epoch 151/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6332 - val_loss:
2.1625
Epoch 152/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6298 - val_loss:
2.1628
Epoch 153/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6310 - val_loss:
2.1462
Epoch 154/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6315 - val_loss:
2.1557
Epoch 155/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6275 - val_loss:
2.1700
Epoch 156/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6270 - val_loss:
2.1637
Epoch 157/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6236 - val_loss:
2.1441
Epoch 158/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6246 - val_loss:
2.1296
Epoch 159/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6239 - val_loss:
2.1302
Epoch 160/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6209 - val_loss:
2.1369
Epoch 161/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6258 - val_loss:
2.1310
Epoch 162/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6208 - val_loss:
2.1630
```

```
Epoch 163/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6203 - val_loss:
2.1656
Epoch 164/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6228 - val_loss:
2.1378
Epoch 165/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6189 - val_loss:
2.1388
Epoch 166/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6238 - val_loss:
2.1645
Epoch 167/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6196 - val_loss:
2.1748
Epoch 168/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6149 - val_loss:
2.1718
Epoch 169/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6124 - val_loss:
2.1502
Epoch 170/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6137 - val_loss:
2.1580
Epoch 171/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6184 - val_loss:
2.1389
Epoch 172/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6102 - val_loss:
2.1479
Epoch 173/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6103 - val_loss:
2.1886
Epoch 174/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6093 - val_loss:
2.1635
Epoch 175/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6064 - val_loss:
2.1460
Epoch 176/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6021 - val_loss:
2.1452
Epoch 177/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6230 - val_loss:
2.1626
Epoch 178/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6021 - val_loss:
2.1383
```

```
Epoch 179/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6021 - val_loss:
2.1598
Epoch 180/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6007 - val_loss:
2.1421
Epoch 181/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6005 - val_loss:
2.1322
Epoch 182/200
11/11 [==============================] - 0s 7ms/step - loss: 1.6027 - val_loss:
2.1462
Epoch 183/200
11/11 [==============================] - 0s 6ms/step - loss: 1.6125 - val_loss:
2.1515
Epoch 184/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6162 - val_loss:
2.1123
Epoch 185/200
11/11 [==============================] - 0s 6ms/step - loss: 1.5940 - val_loss:
2.1473
Epoch 186/200
11/11 [==============================] - 0s 5ms/step - loss: 1.5958 - val_loss:
2.1729
Epoch 187/200
11/11 [==============================] - 0s 5ms/step - loss: 1.6032 - val_loss:
2.1841
Epoch 188/200
11/11 [==============================] - 0s 6ms/step - loss: 1.5903 - val_loss:
2.1538
Epoch 189/200
11/11 [==============================] - 0s 6ms/step - loss: 1.5915 - val_loss:
2.1568
Epoch 190/200
11/11 [==============================] - 0s 6ms/step - loss: 1.5920 - val_loss:
2.1541
Epoch 191/200
11/11 [==============================] - 0s 7ms/step - loss: 1.5857 - val_loss:
2.1541
Epoch 192/200
11/11 [==============================] - 0s 8ms/step - loss: 1.6003 - val_loss:
2.1761
Epoch 193/200
11/11 [==============================] - 0s 6ms/step - loss: 1.5893 - val_loss:
2.1850
Epoch 194/200
11/11 [==============================] - 0s 6ms/step - loss: 1.5981 - val_loss:
2.1704
```

```
Epoch 195/200
11/11 [==============================] - 0s 7ms/step - loss: 1.5938 - val_loss:
2.1349
Epoch 196/200
11/11 [==============================] - 0s 7ms/step - loss: 1.5943 - val_loss:
2.1458
Epoch 197/200
11/11 [==============================] - 0s 8ms/step - loss: 1.5844 - val_loss:
2.1813
Epoch 198/200
11/11 [==============================] - 0s 6ms/step - loss: 1.5853 - val_loss:
2.1544
Epoch 199/200
11/11 [==============================] - 0s 6ms/step - loss: 1.5849 - val_loss:
2.1598
Epoch 200/200
11/11 [==============================] - 0s 7ms/step - loss: 1.5794 - val_loss:
2.1593
```

[55]:
```
y_pred = model.predict(X_test_scaled)
```

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

[59]:
```
from sklearn.metrics import r2_score
r2_score(y_test,y_pred)
```

[59]:
```
0.8430391976125973
```