assignment1-1

April 13, 2025

[12]:

**import pandas as pd**

**import matplotlib.pyplot as plt**

# Load Dataset

[13]:

url = "https://raw.githubusercontent.com/selva86/datasets/master/BostonHousing.

𝗌csv"

df = pd.read\_csv(url) df.head(10)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [13]: | crim | zn | indus | chas | nox | rm | age | dis | rad | tax | ptratio | \ |
| 0 | 0.00632 | 18.0 | 2.31 | 0 | 0.538 | 6.575 | 65.2 | 4.0900 | 1 | 296 | 15.3 |  |
| 1 | 0.02731 | 0.0 | 7.07 | 0 | 0.469 | 6.421 | 78.9 | 4.9671 | 2 | 242 | 17.8 |  |
| 2 | 0.02729 | 0.0 | 7.07 | 0 | 0.469 | 7.185 | 61.1 | 4.9671 | 2 | 242 | 17.8 |  |
| 3 | 0.03237 | 0.0 | 2.18 | 0 | 0.458 | 6.998 | 45.8 | 6.0622 | 3 | 222 | 18.7 |  |
| 4 | 0.06905 | 0.0 | 2.18 | 0 | 0.458 | 7.147 | 54.2 | 6.0622 | 3 | 222 | 18.7 |  |
| 5 | 0.02985 | 0.0 | 2.18 | 0 | 0.458 | 6.430 | 58.7 | 6.0622 | 3 | 222 | 18.7 |  |
| 6 | 0.08829 | 12.5 | 7.87 | 0 | 0.524 | 6.012 | 66.6 | 5.5605 | 5 | 311 | 15.2 |  |
| 7 | 0.14455 | 12.5 | 7.87 | 0 | 0.524 | 6.172 | 96.1 | 5.9505 | 5 | 311 | 15.2 |  |
| 8 | 0.21124 | 12.5 | 7.87 | 0 | 0.524 | 5.631 | 100.0 | 6.0821 | 5 | 311 | 15.2 |  |
| 9 | 0.17004 | 12.5 | 7.87 | 0 | 0.524 | 6.004 | 85.9 | 6.5921 | 5 | 311 | 15.2 |  |

|  |  |  |
| --- | --- | --- |
| b | lstat | medv |
| 0 396.90 | 4.98 | 24.0 |
| 1 396.90 | 9.14 | 21.6 |
| 2 392.83 | 4.03 | 34.7 |
| 3 394.63 | 2.94 | 33.4 |
| 4 396.90 | 5.33 | 36.2 |
| 5 394.12 | 5.21 | 28.7 |
| 6 395.60 | 12.43 | 22.9 |
| 7 396.90 | 19.15 | 27.1 |
| 8 386.63 | 29.93 | 16.5 |
| 9 386.71 | 17.10 | 18.9 |

# Checking for null values

df.isnull().sum()

[14]:

1. : crim 0

zn 0

indus 0

chas 0

nox 0

rm 0

age 0

dis 0

rad 0

tax 0

ptratio 0

b 0

lstat 0

medv 0

dtype: int64

1. :
2. :

df.info()

<class 'pandas.core.frame.DataFrame'> RangeIndex: 506 entries, 0 to 505 Data columns (total 14 columns):

# Column Non-Null Count Dtype

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 0 crim | 506 | non-null |  | float64 |
| 1 zn | 506 | non-null |  | float64 |
| 2 indus | 506 | non-null |  | float64 |
| 3 chas | 506 | non-null |  | int64 |
| 4 nox | 506 | non-null |  | float64 |
| 5 rm | 506 | non-null |  | float64 |
| 6 age | 506 | non-null |  | float64 |
| 7 dis | 506 | non-null |  | float64 |
| 8 rad | 506 | non-null |  | int64 |
| 9 tax | 506 | non-null |  | int64 |
| 10 ptratio | 506 | non-null |  | float64 |
| 11 b | 506 | non-null |  | float64 |
| 12 lstat | 506 | non-null |  | float64 |
| 13 medv | 506 | non-null |  | float64 |

dtypes: float64(11), int64(3) memory usage: 55.5 KB

df.describe()

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| [16]: | crim | zn | indus | chas | nox | rm \ |
| count | 506.000000 | 506.000000 | 506.000000 | 506.000000 | 506.000000 | 506.000000 |
| mean | 3.613524 | 11.363636 | 11.136779 | 0.069170 | 0.554695 | 6.284634 |
| std | 8.601545 | 23.322453 | 6.860353 | 0.253994 | 0.115878 | 0.702617 |
| min | 0.006320 | 0.000000 | 0.460000 | 0.000000 | 0.385000 | 3.561000 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 25% | 0.082045 | 0.000000 | 5.190000 | 0.000000 | 0.449000 | 5.885500 |  |
| 50% | 0.256510 | 0.000000 | 9.690000 | 0.000000 | 0.538000 | 6.208500 |
| 75% | 3.677083 | 12.500000 | 18.100000 | 0.000000 | 0.624000 | 6.623500 |
| max | 88.976200 | 100.000000 | 27.740000 | 1.000000 | 0.871000 | 8.780000 |
|  | age | dis | rad | tax | ptratio | b | \ |
| count | 506.000000 | 506.000000 | 506.000000 | 506.000000 | 506.000000 | 506.000000 |  |
| mean | 68.574901 | 3.795043 | 9.549407 | 408.237154 | 18.455534 | 356.674032 |  |
| std | 28.148861 | 2.105710 | 8.707259 | 168.537116 | 2.164946 | 91.294864 |  |
| min | 2.900000 | 1.129600 | 1.000000 | 187.000000 | 12.600000 | 0.320000 |  |
| 25% | 45.025000 | 2.100175 | 4.000000 | 279.000000 | 17.400000 | 375.377500 |  |
| 50% | 77.500000 | 3.207450 | 5.000000 | 330.000000 | 19.050000 | 391.440000 |  |
| 75% | 94.075000 | 5.188425 | 24.000000 | 666.000000 | 20.200000 | 396.225000 |  |
| max | 100.000000 | 12.126500 | 24.000000 | 711.000000 | 22.000000 | 396.900000 |  |
|  | lstat | medv |  |  |  |  |  |
| count | 506.000000 | 506.000000 |  |  |  |  |  |
| mean | 12.653063 | 22.532806 |  |  |  |  |  |
| std | 7.141062 | 9.197104 |  |  |  |  |  |
| min | 1.730000 | 5.000000 |  |  |  |  |  |
| 25% | 6.950000 | 17.025000 |  |  |  |  |  |
| 50% | 11.360000 | 21.200000 |  |  |  |  |  |
| 75% | 16.955000 | 25.000000 |  |  |  |  |  |
| max | 37.970000 | 50.000000 |  |  |  |  |  |

# Checking correlation with target variable MEDV

df.corr()['medv'].sort\_values()

[18]:

[18]: lstat -0.737663

ptratio -0.507787

indus -0.483725

tax -0.468536

nox -0.427321

crim -0.388305

rad -0.381626

age -0.376955

chas 0.175260

dis 0.249929

b 0.333461

zn 0.360445

rm 0.695360

medv 1.000000

Name: medv, dtype: float64

[20]:

X = df.loc[:,['lstat','ptratio','rm']] Y = df.loc[:,"medv"]

X.shape,Y.shape

1. : ((506, 3), (506,))

# Preparing training and testing data set

1. :

**from sklearn.model\_selection import** train\_test\_split x\_train,x\_test,y\_train,y\_test = train\_test\_split(X,Y,test\_size=0.

𝗌25,random\_state=10)

# Normalizing training and testing dataset

1. :

**from sklearn.preprocessing import** StandardScaler

1. :

scaler = StandardScaler()

1. :

scaler.fit(x\_train)

1. : StandardScaler()
2. :

x\_train = scaler.transform(x\_train) x\_test = scaler.transform(x\_test)

# Preparing model

1. :

**from keras.models import** Sequential

**from keras.layers import** Dense

1. :

model = Sequential()

1. :

model.add(Dense(128,input\_shape=(3,),activation='relu',name='input')) model.add(Dense(64,activation='relu',name='layer\_1')) model.add(Dense(1,activation='linear',name='output')) model.compile(optimizer='adam', loss='mse', metrics=['mae']) model.summary()

/usr/local/lib/python3.11/dist-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input\_shape`/`input\_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.

super(). init (activity\_regularizer=activity\_regularizer, \*\*kwargs)

# Model: "sequential"

**Layer (type) Output Shape Param #**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| input (Dense) |  | (None, | 128) | 512 |
| layer\_1 (Dense) |  | (None, | 64) | 8,256 |
| output (Dense)  **Total params:** 8,833 | (34.50 KB) | (None, | 1) | 65 |

**Trainable params:** 8,833 (34.50 KB)

**Non-trainable params:** 0 (0.00 B)

1. :

model.fit(x\_train,y\_train,epochs=100,validation\_split=0.05)

Epoch 1/100

**12/12 2s** 23ms/step -

loss: 558.1187 - mae: 21.8508 - val\_loss: 700.8205 - val\_mae: 23.7638 Epoch 2/100

**12/12 0s** 8ms/step - loss:

492.1137 - mae: 20.6388 - val\_loss: 656.5317 - val\_mae: 22.8078 Epoch 3/100

**12/12 0s** 8ms/step - loss:

469.1971 - mae: 19.9330 - val\_loss: 594.3977 - val\_mae: 21.4058 Epoch 4/100

**12/12 0s** 8ms/step - loss:

408.2853 - mae: 18.2776 - val\_loss: 512.5362 - val\_mae: 19.4592 Epoch 5/100

**12/12 0s** 7ms/step - loss:

331.6889 - mae: 16.3889 - val\_loss: 413.3873 - val\_mae: 17.1842 Epoch 6/100

**12/12 0s** 9ms/step - loss:

232.7548 - mae: 13.6839 - val\_loss: 304.6852 - val\_mae: 14.2029 Epoch 7/100

**12/12 0s** 12ms/step -

loss: 142.1357 - mae: 10.6499 - val\_loss: 207.0097 - val\_mae: 11.0110 Epoch 8/100

**12/12 0s** 8ms/step - loss:

72.1980 - mae: 7.3695 - val\_loss: 142.7724 - val\_mae: 8.6148 Epoch 9/100

**12/12 0s** 8ms/step - loss:

41.6749 - mae: 5.1260 - val\_loss: 111.3794 - val\_mae: 7.1523 Epoch 10/100

**12/12 0s** 11ms/step -

loss: 34.2609 - mae: 4.4484 - val\_loss: 102.3676 - val\_mae: 6.8814 Epoch 11/100

**12/12 0s** 8ms/step - loss:

34.1951 - mae: 4.5410 - val\_loss: 96.8025 - val\_mae: 6.6428 Epoch 12/100

**12/12 0s** 11ms/step -

loss: 31.5430 - mae: 4.1328 - val\_loss: 93.4553 - val\_mae: 6.5237 Epoch 13/100

**12/12 0s** 8ms/step - loss:

25.0297 - mae: 3.6735 - val\_loss: 88.1755 - val\_mae: 6.3738 Epoch 14/100

**12/12 0s** 8ms/step - loss:

26.2185 - mae: 3.8751 - val\_loss: 85.6054 - val\_mae: 6.3215 Epoch 15/100

**12/12 0s** 8ms/step - loss:

28.2955 - mae: 3.8190 - val\_loss: 85.0852 - val\_mae: 6.3433 Epoch 16/100

**12/12 0s** 8ms/step - loss:

22.4831 - mae: 3.5878 - val\_loss: 82.7764 - val\_mae: 6.2427 Epoch 17/100

**12/12 0s** 8ms/step - loss:

20.3968 - mae: 3.2710 - val\_loss: 82.5676 - val\_mae: 6.2068 Epoch 18/100

**12/12 0s** 8ms/step - loss:

22.6890 - mae: 3.4112 - val\_loss: 82.7573 - val\_mae: 6.1786 Epoch 19/100

**12/12 0s** 8ms/step - loss:

20.3038 - mae: 3.3030 - val\_loss: 82.6876 - val\_mae: 6.1875 Epoch 20/100

**12/12 0s** 12ms/step -

loss: 18.1940 - mae: 3.1957 - val\_loss: 82.3712 - val\_mae: 6.1761 Epoch 21/100

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **12/12** | **0s** 8ms/step - loss: |  | | |
| 21.1167 - mae: | 3.3282 - val\_loss: 84.2112 | - | val\_mae: | 6.1819 |
| Epoch 22/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 17.5337 - mae: | 3.1397 - val\_loss: 84.3052 | - | val\_mae: | 6.1591 |
| Epoch 23/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 18.7228 - mae: | 3.1415 - val\_loss: 82.2697 | - | val\_mae: | 6.0732 |
| Epoch 24/100 |  |  |  |  |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |
| 16.6766 - mae: | 3.0005 - val\_loss: 80.8897 | - | val\_mae: | 5.9858 |
| Epoch 25/100 |  |  |  |  |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |
| 16.6134 - mae: | 3.0370 - val\_loss: 81.4060 | - | val\_mae: | 5.9545 |
| Epoch 26/100 |  |  |  |  |
| **12/12** | **0s** 13ms/step - |  |  |  |

loss: 16.7044 - mae: 3.0033 - val\_loss: 80.2639 - val\_mae: 5.8787 Epoch 27/100

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| loss: | 13.8437 | - mae: 2.7731 - val\_loss: | 79.8047 | - val\_mae: | 5.5260 |
| Epoch | 40/100 |  |  |  |  |
| **12/12** |  | **0s** 17ms/step - |  |  |  |
| loss: | 13.4989 | - mae: 2.7144 - val\_loss: | 80.6228 | - val\_mae: | 5.5429 |
| Epoch | 41/100 |  |  |  |  |
| **12/12** |  | **0s** 13ms/step - |  |  |  |
| loss: | 14.2210 | - mae: 2.7939 - val\_loss: | 79.4670 | - val\_mae: | 5.4792 |
| Epoch | 42/100 |  |  |  |  |
| **12/12** |  | **0s** 10ms/step - |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **12/12** | **0s** 7ms/step - loss: |  | | |
| 15.2913 - mae: | 2.8955 - val\_loss: 81.5878 | - | val\_mae: | 5.8762 |
| Epoch 28/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 16.1182 - mae: | 3.0439 - val\_loss: 79.0019 | - | val\_mae: | 5.8053 |
| Epoch 29/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 16.8150 - mae: | 3.0625 - val\_loss: 79.0107 | - | val\_mae: | 5.7505 |
| Epoch 30/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 17.0178 - mae: | 2.9969 - val\_loss: 78.6634 | - | val\_mae: | 5.7050 |
| Epoch 31/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 15.9267 - mae: | 3.0086 - val\_loss: 78.9061 | - | val\_mae: | 5.6831 |
| Epoch 32/100 |  |  |  |  |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |
| 15.9151 - mae: | 2.9278 - val\_loss: 80.2465 | - | val\_mae: | 5.7070 |
| Epoch 33/100 |  |  |  |  |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |
| 15.2599 - mae: | 2.9143 - val\_loss: 78.9737 | - | val\_mae: | 5.6547 |
| Epoch 34/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 18.4289 - mae: | 3.0328 - val\_loss: 79.6162 | - | val\_mae: | 5.6304 |
| Epoch 35/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 12.4532 - mae: | 2.6375 - val\_loss: 80.3411 | - | val\_mae: | 5.6226 |
| Epoch 36/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 15.1316 - mae: | 2.8000 - val\_loss: 78.5153 | - | val\_mae: | 5.5424 |
| Epoch 37/100 |  |  |  |  |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |
| 14.6459 - mae: | 2.8143 - val\_loss: 79.2373 | - | val\_mae: | 5.5485 |
| Epoch 38/100 |  |  |  |  |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |
| 13.7781 - mae:  Epoch 39/100  **12/12** | 2.7703 - val\_loss: 81.3237  **0s** 14ms/step - | - | val\_mae: | 5.5947 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| loss: | 14.6390 | - mae: 2.8089 - val\_loss: | 79.1659 | - val\_mae: | 5.4624 |
| Epoch | 43/100 |  |  |  |  |
| **12/12** |  | **0s** 11ms/step - |  |  |  |
| loss: | 15.7153 | - mae: 2.8017 - val\_loss: | 79.1090 | - val\_mae: | 5.4569 |
| Epoch | 44/100 |  |  |  |  |
| **12/12** |  | **0s** 14ms/step - |  |  |  |
| loss: | 12.6706 | - mae: 2.6450 - val\_loss: | 81.5202 | - val\_mae: | 5.4822 |
| Epoch | 45/100 |  |  |  |  |
| **12/12** |  | **0s** 15ms/step - |  |  |  |
| loss: | 15.8215 | - mae: 2.8039 - val\_loss: | 77.5840 | - val\_mae: | 5.3745 |
| Epoch | 46/100 |  |  |  |  |
| **12/12** |  | **0s** 12ms/step - |  |  |  |
| loss: | 14.3290 | - mae: 2.7255 - val\_loss: | 78.9811 | - val\_mae: | 5.4156 |
| Epoch | 47/100 |  |  |  |  |
| **12/12** |  | **0s** 7ms/step - loss: |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 12.9319 - mae: | 2.7115 - val\_loss: 78.3627 | - | val\_mae: | 5.3878 |
| Epoch 48/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 14.2423 - mae: | 2.7802 - val\_loss: 78.9930 | - | val\_mae: | 5.3941 |
| Epoch 49/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 12.0062 - mae: | 2.5779 - val\_loss: 83.2168 | - | val\_mae: | 5.4871 |
| Epoch 50/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 17.9151 - mae: | 2.8245 - val\_loss: 79.7980 | - | val\_mae: | 5.3917 |
| Epoch 51/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 14.7325 - mae: | 2.7219 - val\_loss: 80.3248 | - | val\_mae: | 5.4057 |
| Epoch 52/100 |  |  |  |  |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |
| 13.0966 - mae: | 2.5347 - val\_loss: 80.3539 | - | val\_mae: | 5.3950 |
| Epoch 53/100 |  |  |  |  |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |
| 13.2195 - mae: | 2.7199 - val\_loss: 78.6914 | - | val\_mae: | 5.3392 |
| Epoch 54/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 11.7513 - mae: | 2.6655 - val\_loss: 80.4472 | - | val\_mae: | 5.3702 |
| Epoch 55/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 12.6565 - mae: | 2.5602 - val\_loss: 80.7330 | - | val\_mae: | 5.3987 |
| Epoch 56/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 11.2585 - mae: | 2.4854 - val\_loss: 78.8829 | - | val\_mae: | 5.3340 |
| Epoch 57/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 13.1163 - mae: | 2.5514 - val\_loss: 81.9629 | - | val\_mae: | 5.4354 |
| Epoch 58/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 12.8630 - mae: | 2.5923 - val\_loss: 79.1199 | - | val\_mae: | 5.3440 |
| Epoch 59/100 |  |  |  |  |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |
| 13.8013 - mae: | 2.7128 - val\_loss: 78.4612 | - | val\_mae: | 5.2757 |
| Epoch 60/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 11.1373 - mae: | 2.4907 - val\_loss: 81.3893 | - | val\_mae: | 5.3249 |
| Epoch 61/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 12.0066 - mae: | 2.5024 - val\_loss: 81.4757 | - | val\_mae: | 5.3353 |
| Epoch 62/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 10.8098 - mae: | 2.4688 - val\_loss: 79.1132 | - | val\_mae: | 5.2593 |
| Epoch 63/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 11.0650 - mae: | 2.5097 - val\_loss: 81.1247 | - | val\_mae: | 5.3110 |
| Epoch 64/100 |  |  |  |  |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |
| 12.7146 - mae: | 2.5578 - val\_loss: 81.1450 | - | val\_mae: | 5.3239 |
| Epoch 65/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 13.3256 - mae: | 2.6110 - val\_loss: 79.8177 | - | val\_mae: | 5.3016 |
| Epoch 66/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 12.9838 - mae: | 2.6001 - val\_loss: 82.4926 | - | val\_mae: | 5.3245 |
| Epoch 67/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 11.5377 - mae: | 2.4639 - val\_loss: 81.5450 | - | val\_mae: | 5.2797 |
| Epoch 68/100 |  |  |  |  |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |
| 11.8785 - mae: | 2.4991 - val\_loss: 79.1794 | - | val\_mae: | 5.2233 |
| Epoch 69/100 |  |  |  |  |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |
| 12.7058 - mae: | 2.5602 - val\_loss: 82.5923 | - | val\_mae: | 5.3161 |
| Epoch 70/100 |  |  |  |  |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |
| 12.2985 - mae: | 2.5662 - val\_loss: 82.3204 | - | val\_mae: | 5.2990 |
| Epoch 71/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 14.3597 - mae: | 2.6181 - val\_loss: 79.5691 | - | val\_mae: | 5.2133 |
| Epoch 72/100 |  |  |  |  |

**12/12 0s** 12ms/step -

loss: 11.6386 - mae: 2.4731 - val\_loss: 80.2985 - val\_mae: 5.2331 Epoch 73/100

**12/12 0s** 7ms/step - loss:

13.7512 - mae: 2.6286 - val\_loss: 81.7844 - val\_mae: 5.2861 Epoch 74/100

**12/12 0s** 7ms/step - loss:

12.6466 - mae: 2.5278 - val\_loss: 80.9901 - val\_mae: 5.2580 Epoch 75/100

**12/12 0s** 7ms/step - loss:

11.1071 - mae: 2.3967 - val\_loss: 80.5174 - val\_mae: 5.1992 Epoch 76/100

**12/12 0s** 7ms/step - loss:

12.8600 - mae: 2.5432 - val\_loss: 81.5574 - val\_mae: 5.2612 Epoch 77/100

**12/12 0s** 7ms/step - loss:

11.4877 - mae: 2.4095 - val\_loss: 82.2853 - val\_mae: 5.2791 Epoch 78/100

**12/12 0s** 7ms/step - loss:

10.6604 - mae: 2.3342 - val\_loss: 78.6105 - val\_mae: 5.1563 Epoch 79/100

**12/12 0s** 8ms/step - loss:

11.1722 - mae: 2.4850 - val\_loss: 83.1291 - val\_mae: 5.2623 Epoch 80/100

**12/12 0s** 9ms/step - loss:

12.6258 - mae: 2.5957 - val\_loss: 83.0356 - val\_mae: 5.2622 Epoch 81/100

**12/12 0s** 8ms/step - loss:

11.1563 - mae: 2.4442 - val\_loss: 81.5902 - val\_mae: 5.1938 Epoch 82/100

**12/12 0s** 7ms/step - loss:

14.3285 - mae: 2.5540 - val\_loss: 81.1910 - val\_mae: 5.1913 Epoch 83/100

**12/12 0s** 7ms/step - loss:

9.6534 - mae: 2.2786 - val\_loss: 84.0884 - val\_mae: 5.2746 Epoch 84/100

**12/12 0s** 7ms/step - loss:

9.7331 - mae: 2.2831 - val\_loss: 80.4482 - val\_mae: 5.1360 Epoch 85/100

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |
| 12.1052 - mae: | 2.4137 - val\_loss: 85.2986 | - | val\_mae: | 5.2826 |
| Epoch 86/100 |  |  |  |  |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |
| 10.5723 - mae: | 2.3271 - val\_loss: 81.0709 | - | val\_mae: | 5.1158 |
| Epoch 87/100 |  |  |  |  |
| **12/12** | **0s** 9ms/step - loss: |  |  |  |
| 10.7697 - mae: | 2.3541 - val\_loss: 81.7043 | - | val\_mae: | 5.1856 |
| Epoch 88/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 11.3862 - mae: | 2.3504 - val\_loss: 83.6433 | - | val\_mae: | 5.2358 |
| Epoch 89/100 |  |  |  |  |
| **12/12** | **0s** 8ms/step - loss: |  |  |  |
| 10.4779 - mae: | 2.3559 - val\_loss: 82.3865 | - | val\_mae: | 5.1840 |
| Epoch 90/100 |  |  |  |  |
| **12/12** | **0s** 7ms/step - loss: |  |  |  |

13.4379 - mae: 2.4991 - val\_loss: 81.7888 - val\_mae: 5.2069 Epoch 91/100

**12/12 0s** 7ms/step - loss:

9.4054 - mae: 2.2485 - val\_loss: 81.8825 - val\_mae: 5.1963 Epoch 92/100

**12/12 0s** 7ms/step - loss:

10.2854 - mae: 2.3362 - val\_loss: 81.0412 - val\_mae: 5.1106 Epoch 93/100

**12/12 0s** 7ms/step - loss:

10.6862 - mae: 2.4048 - val\_loss: 83.2576 - val\_mae: 5.2124 Epoch 94/100

**12/12 0s** 7ms/step - loss:

9.6060 - mae: 2.2149 - val\_loss: 81.4294 - val\_mae: 5.0666 Epoch 95/100

**12/12 0s** 8ms/step - loss:

9.5531 - mae: 2.2138 - val\_loss: 88.7827 - val\_mae: 5.3905 Epoch 96/100

**12/12 0s** 8ms/step - loss:

9.9675 - mae: 2.3416 - val\_loss: 82.0919 - val\_mae: 5.0625 Epoch 97/100

**12/12 0s** 8ms/step - loss:

10.0462 - mae: 2.3966 - val\_loss: 83.0600 - val\_mae: 5.1738 Epoch 98/100

**12/12 0s** 8ms/step - loss:

9.0970 - mae: 2.2369 - val\_loss: 88.1156 - val\_mae: 5.3620 Epoch 99/100

**12/12 0s** 8ms/step - loss:

11.5422 - mae: 2.4479 - val\_loss: 83.5703 - val\_mae: 5.1216 Epoch 100/100

**12/12 0s** 8ms/step - loss:

10.2971 - mae: 2.3681 - val\_loss: 84.1505 - val\_mae: 5.2347

[29]: <keras.src.callbacks.history.History at 0x7fd5fe6c44d0> [30]:

output = model.evaluate(x\_test,y\_test)

**4/4 0s** 11ms/step - loss: 20.8191 - mae: 3.0977

[31]:

print(f"Mean Squared Error: **{**output[0]**}**"

,f"Mean Absolute Error: **{**output[1]**}**",sep="**\n**")

[32]:

Mean Squared Error: 22.908056259155273 Mean Absolute Error: 3.1313369274139404

y\_pred = model.predict(x=x\_test)

**4/4 0s** 26ms/step

[33]:

print(\*zip(y\_pred,y\_test))

(array([24.398563], dtype=float32), 28.4) (array([30.642723], dtype=float32),

31.1) (array([26.176365], dtype=float32), 23.5) (array([27.232159],

dtype=float32), 26.6) (array([19.975266], dtype=float32), 19.6) (array([16.61432], dtype=float32), 14.3) (array([41.910316], dtype=float32),

50.0) (array([14.907179], dtype=float32), 14.3) (array([19.684042],

dtype=float32), 20.7) (array([42.172394], dtype=float32), 37.6) (array([18.18777], dtype=float32), 20.4) (array([26.123325], dtype=float32),

27.5) (array([22.385643], dtype=float32), 36.2) (array([32.33351],

dtype=float32), 32.0) (array([30.99995], dtype=float32), 33.1) (array([51.13626], dtype=float32), 48.8) (array([25.69979], dtype=float32),

24.6) (array([19.75602], dtype=float32), 26.4) (array([21.144825],

dtype=float32), 23.2) (array([19.387259], dtype=float32), 17.0) (array([33.214046], dtype=float32), 41.3) (array([15.868946], dtype=float32),

14.9) (array([22.070572], dtype=float32), 18.5) (array([24.727432],

dtype=float32), 25.0) (array([36.854473], dtype=float32), 36.4) (array([21.067219], dtype=float32), 19.5) (array([18.155659], dtype=float32),

27.1) (array([16.818901], dtype=float32), 14.9) (array([42.500572],

dtype=float32), 46.0) (array([10.98995], dtype=float32), 17.9) (array([34.53775], dtype=float32), 30.3) (array([31.79146], dtype=float32),

31.6) (array([26.373589], dtype=float32), 23.1) (array([24.002913],

dtype=float32), 24.7) (array([15.220239], dtype=float32), 16.7)

(array([19.823938], dtype=float32), 18.3) (array([8.75378], dtype=float32), 8.4) (array([31.637682], dtype=float32), 37.3) (array([24.803143], dtype=float32),

* 1. (array([24.12807], dtype=float32), 22.0) (array([38.498226],

dtype=float32), 46.7) (array([26.023102], dtype=float32), 30.1) (array([13.792907], dtype=float32), 12.1) (array([29.333698], dtype=float32),

29.1) (array([17.089588], dtype=float32), 16.6) (array([27.06791],

dtype=float32), 23.9) (array([17.87679], dtype=float32), 19.9) (array([18.509321], dtype=float32), 21.4) (array([43.958275], dtype=float32),

45.4) (array([16.591486], dtype=float32), 15.6) (array([20.114769],

dtype=float32), 22.7) (array([14.622158], dtype=float32), 12.5) (array([20.296051], dtype=float32), 24.3) (array([38.532288], dtype=float32),

43.8) (array([24.152489], dtype=float32), 22.0) (array([34.399048],

dtype=float32), 33.8) (array([19.507032], dtype=float32), 19.3) (array([18.91164], dtype=float32), 22.6) (array([22.18611], dtype=float32),

16.1) (array([21.447088], dtype=float32), 15.0) (array([18.676918],

dtype=float32), 19.6) (array([20.76945], dtype=float32), 21.2) (array([50.898426], dtype=float32), 50.0) (array([55.270145], dtype=float32),

50.0) (array([27.642078], dtype=float32), 29.4) (array([15.435604],

dtype=float32), 17.8) (array([24.540203], dtype=float32), 22.8) (array([11.377972], dtype=float32), 8.8) (array([27.366789], dtype=float32),

32.5) (array([39.37468], dtype=float32), 42.8) (array([16.866665],

dtype=float32), 12.6) (array([28.097702], dtype=float32), 28.6) (array([17.903156], dtype=float32), 19.1) (array([21.560253], dtype=float32),

50.0) (array([21.379505], dtype=float32), 27.5) (array([11.579738],

dtype=float32), 23.7) (array([47.035942], dtype=float32), 50.0) (array([9.9491825], dtype=float32), 7.2) (array([20.152653], dtype=float32),

18.7) (array([32.45575], dtype=float32), 37.0) (array([19.778667],

dtype=float32), 22.9) (array([25.007435], dtype=float32), 22.9) (array([19.67302], dtype=float32), 17.1) (array([24.248756], dtype=float32),

22.0) (array([30.96221], dtype=float32), 23.6) (array([25.785095],

dtype=float32), 23.9) (array([25.849838], dtype=float32), 27.1) (array([34.126625], dtype=float32), 29.0) (array([23.998955], dtype=float32),

* 1. (array([11.075442], dtype=float32), 7.0) (array([23.129673],

dtype=float32), 20.7) (array([21.060366], dtype=float32), 18.5) (array([23.529358], dtype=float32), 21.6) (array([24.402624], dtype=float32),

23.0) (array([18.886717], dtype=float32), 16.0) (array([18.79022],

dtype=float32), 15.0) (array([25.424364], dtype=float32), 23.9) (array([19.069595], dtype=float32), 24.4) (array([21.107948], dtype=float32),

22.6) (array([18.68443], dtype=float32), 19.8) (array([21.469868],

dtype=float32), 22.2) (array([19.680819], dtype=float32), 18.6) (array([19.106083], dtype=float32), 19.7) (array([23.26202], dtype=float32),

23.1) (array([13.743537], dtype=float32), 13.5) (array([20.69305],

dtype=float32), 21.2) (array([19.181442], dtype=float32), 23.1) (array([15.548941], dtype=float32), 13.6) (array([28.404343], dtype=float32),

22.8) (array([23.594297], dtype=float32), 18.2) (array([11.3621235],

dtype=float32), 13.1) (array([17.689964], dtype=float32), 23.2) (array([24.323505], dtype=float32), 22.8) (array([24.362988], dtype=float32),

25.1) (array([21.5598], dtype=float32), 18.9) (array([13.411655],

dtype=float32), 10.9) (array([13.9047365], dtype=float32), 19.3) (array([20.843494], dtype=float32), 17.4) (array([18.694859], dtype=float32),

15.6) (array([20.088127], dtype=float32), 20.6) (array([29.624937],

dtype=float32), 50.0) (array([35.08461], dtype=float32), 32.7) (array([20.963634], dtype=float32), 21.8) (array([16.399689], dtype=float32),

13.4) (array([17.689772], dtype=float32), 16.6) (array([23.295284],

dtype=float32), 23.6) (array([12.578907], dtype=float32), 11.0)