In [ ]:
```
Assignment 1 : Linear regression by using Deep Neural network: Implement Boston hou
```

In [1]:
```
import tensorflow as tf
from tensorflow import keras
from tensorflow.keras import Sequential
from tensorflow.keras.layers import Dense,Flatten
from sklearn import preprocessing
```

In [5]:
```
(X_train,y_train),(X_test,y_test)=keras.datasets.boston_housing.load_data()
```

In [6]:
```
print("Training data shape:",X_train.shape)
```

```
Training data shape: (404, 13)
```

In [7]:
```
print("Testing data shape:",X_test.shape)
```

```
Testing data shape: (102, 13)
```

In [8]:
```
print("Train output data shape:",y_train.shape)
```

```
Train output data shape: (404,)
```

In [9]:
```
print("Actual Test  output data shape:",y_test.shape)
```

```
Actual Test  output data shape: (102,)
```

In [10]:
```
X_train[0]
```

Out[10]:
```
array([  1.23247,   0.     ,   8.14   ,   0.     ,   0.538  ,   6.142  ,
        91.7    ,   3.9769 ,   4.     , 307.     ,  21.     , 396.9    ,
        18.72   ])
```

In [11]:
```
y_train[0]
```

Out[11]:
```
15.2
```

In [12]:
```
y_train
```

Out[12]:
```
array([15.2, 42.3, 50. , 21.1, 17.7, 18.5, 11.3, 15.6, 15.6, 14.4, 12.1,
       17.9, 23.1, 19.9, 15.7,  8.8, 50. , 22.5, 24.1, 27.5, 10.9, 30.8,
       32.9, 24. , 18.5, 13.3, 22.9, 34.7, 16.6, 17.5, 22.3, 16.1, 14.9,
       23.1, 34.9, 25. , 13.9, 13.1, 20.4, 20. , 15.2, 24.7, 22.2, 16.7,
       12.7, 15.6, 18.4, 21. , 30.1, 15.1, 18.7,  9.6, 31.5, 24.8, 19.1,
       22. , 14.5, 11. , 32. , 29.4, 20.3, 24.4, 14.6, 19.5, 14.1, 14.3,
       15.6, 10.5,  6.3, 19.3, 19.3, 13.4, 36.4, 17.8, 13.5, 16.5,  8.3,
       14.3, 16. , 13.4, 28.6, 43.5, 20.2, 22. , 23. , 20.7, 12.5, 48.5,
       14.6, 13.4, 23.7, 50. , 21.7, 39.8, 38.7, 22.2, 34.9, 22.5, 31.1,
       28.7, 46. , 41.7, 21. , 26.6, 15. , 24.4, 13.3, 21.2, 11.7, 21.7,
       19.4, 50. , 22.8, 19.7, 24.7, 36.2, 14.2, 18.9, 18.3, 20.6, 24.6,
       18.2,  8.7, 44. , 10.4, 13.2, 21.2, 37. , 30.7, 22.9, 20. , 19.3,
       31.7, 32. , 23.1, 18.8, 10.9, 50. , 19.6,  5. , 14.4, 19.8, 13.8,
       19.6, 23.9, 24.5, 25. , 19.9, 17.2, 24.6, 13.5, 26.6, 21.4, 11.9,
       22.6, 19.6,  8.5, 23.7, 23.1, 22.4, 20.5, 23.6, 18.4, 35.2, 23.1,
       27.9, 20.6, 23.7, 28. , 13.6, 27.1, 23.6, 20.6, 18.2, 21.7, 17.1,
        8.4, 25.3, 13.8, 22.2, 18.4, 20.7, 31.6, 30.5, 20.3,  8.8, 19.2,
       19.4, 23.1, 23. , 14.8, 48.8, 22.6, 33.4, 21.1, 13.6, 32.2, 13.1,
       23.4, 18.9, 23.9, 11.8, 23.3, 22.8, 19.6, 16.7, 13.4, 22.2, 20.4,
       21.8, 26.4, 14.9, 24.1, 23.8, 12.3, 29.1, 21. , 19.5, 23.3, 23.8,
       17.8, 11.5, 21.7, 19.9, 25. , 33.4, 28.5, 21.4, 24.3, 27.5, 33.1,
       16.2, 23.3, 48.3, 22.9, 22.8, 13.1, 12.7, 22.6, 15. , 15.3, 10.5,
       24. , 18.5, 21.7, 19.5, 33.2, 23.2,  5. , 19.1, 12.7, 22.3, 10.2,
       13.9, 16.3, 17. , 20.1, 29.9, 17.2, 37.3, 45.4, 17.8, 23.2, 29. ,
       22. , 18. , 17.4, 34.6, 20.1, 25. , 15.6, 24.8, 28.2, 21.2, 21.4,
       23.8, 31. , 26.2, 17.4, 37.9, 17.5, 20. ,  8.3, 23.9,  8.4, 13.8,
        7.2, 11.7, 17.1, 21.6, 50. , 16.1, 20.4, 20.6, 21.4, 20.6, 36.5,
        8.5, 24.8, 10.8, 21.9, 17.3, 18.9, 36.2, 14.9, 18.2, 33.3, 21.8,
       19.7, 31.6, 24.8, 19.4, 22.8,  7.5, 44.8, 16.8, 18.7, 50. , 50. ,
       19.5, 20.1, 50. , 17.2, 20.8, 19.3, 41.3, 20.4, 20.5, 13.8, 16.5,
       23.9, 20.6, 31.5, 23.3, 16.8, 14. , 33.8, 36.1, 12.8, 18.3, 18.7,
       19.1, 29. , 30.1, 50. , 50. , 22. , 11.9, 37.6, 50. , 22.7, 20.8,
       23.5, 27.9, 50. , 19.3, 23.9, 22.6, 15.2, 21.7, 19.2, 43.8, 20.3,
       33.2, 19.9, 22.5, 32.7, 22. , 17.1, 19. , 15. , 16.1, 25.1, 23.7,
       28.7, 37.2, 22.6, 16.4, 25. , 29.8, 22.1, 17.4, 18.1, 30.3, 17.5,
       24.7, 12.6, 26.5, 28.7, 13.3, 10.4, 24.4, 23. , 20. , 17.8,  7. ,
       11.8, 24.4, 13.8, 19.4, 25.2, 19.4, 19.4, 29.1])
```

In [ ]:
```
## Normalize the data
```

In [13]:
```
X_train=preprocessing.normalize(X_train)
```

In [14]:
```
X_train
```

Out[14]:
```
array([[2.41189924e-03, 0.00000000e+00, 1.59296858e-02, ...,
        4.10962409e-02, 7.76718953e-01, 3.66343633e-02],
       [4.07923050e-05, 1.54587284e-01, 3.80378407e-03, ...,
        2.75446433e-02, 7.40857215e-01, 5.82747215e-03],
       [6.34505528e-03, 0.00000000e+00, 2.34463745e-02, ...,
        2.61666721e-02, 4.86441025e-01, 4.22293817e-03],
       ...,
       [7.29281484e-05, 7.36435428e-02, 1.27508534e-02, ...,
        3.55593107e-02, 7.62210668e-01, 1.64751126e-02],
       [4.37205159e-03, 0.00000000e+00, 3.98313637e-02, ...,
        2.99040371e-02, 5.32881804e-01, 3.21214113e-02],
       [3.09311543e-05, 1.28969372e-01, 6.29800433e-03, ...,
        3.35320367e-02, 8.09712706e-01, 9.41476414e-03]])
```

In [32]:
```
X_train[0]
```

Out[32]:
```
array([0.0024119 , 0.        , 0.01592969, 0.        , 0.00105285,
       0.01201967, 0.17945359, 0.00778265, 0.00782786, 0.6007879 ,
       0.04109624, 0.77671895, 0.03663436])
```

In [34]:
```
X_train[1]
```

Out[34]:
```
array([4.07923050e-05, 1.54587284e-01, 3.80378407e-03, 0.00000000e+00,
       7.77620881e-04, 1.42595058e-02, 2.94184285e-02, 1.17486336e-02,
       3.74757051e-03, 6.52077269e-01, 2.75446433e-02, 7.40857215e-01,
       5.82747215e-03])
```

In [15]:
```
X_test=preprocessing.normalize(X_test)
```

In [16]:
```
X_test
```

Out[16]:
```
array([[2.67567471e-02, 0.00000000e+00, 2.67795319e-02, ...,
        2.98865495e-02, 4.03172511e-02, 4.29804090e-02],
       [2.07806276e-04, 0.00000000e+00, 1.68719346e-02, ...,
        3.00020416e-02, 6.65691367e-01, 2.73220840e-02],
       [1.19845746e-04, 0.00000000e+00, 1.13152524e-02, ...,
        4.40400960e-02, 8.65322480e-01, 2.12351750e-02],
       ...,
       [3.21889389e-03, 0.00000000e+00, 3.43696005e-02, ...,
        2.58035305e-02, 6.83898879e-01, 3.37025704e-03],
       [7.07644197e-04, 0.00000000e+00, 1.22522104e-02, ...,
        3.43852356e-02, 7.74063034e-01, 1.91885424e-02],
       [6.10350794e-03, 0.00000000e+00, 4.08709594e-02, ...,
        3.06845303e-02, 5.01305905e-01, 2.04772274e-02]])
```

In [29]:
```
X_test[0]
```

Out[29]:
```
array([0.02675675, 0.        , 0.02677953, 0.        , 0.0010046 ,
       0.00951931, 0.14795322, 0.0027145 , 0.03550877, 0.98536841,
       0.02988655, 0.04031725, 0.04298041])
```

In [30]:
```
y_test[0]
```

Out[30]:
```
7.2
```

In [ ]:
```
## Model Building
```

In [17]:
```
X_train[0].shape
```

Out[17]:
```
(13,)
```

In [20]:
```
model=Sequential()
model.add(Dense(128,activation='relu',input_shape= X_train[0].shape))
model.add(Dense(64,activation='relu'))
model.add(Dense(32,activation='relu'))
model.add(Dense(1))
```

In [21]:
```
model.summary()
```

```
Model: "sequential_2"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense_2 (Dense)             (None, 128)               1792

 dense_3 (Dense)             (None, 64)                8256

 dense_4 (Dense)             (None, 32)                2080

 dense_5 (Dense)             (None, 1)                 33

=================================================================
Total params: 12,161
Trainable params: 12,161
Non-trainable params: 0
_________________________________________________________________
```

In [26]:
```
model.compile(loss='mse',optimizer='rmsprop',metrics=['mae'])
```

In [28]:
```
history= model.fit(X_train,y_train,epochs=100,batch_size=1,verbose=1,validation_da
```

```
Epoch 1/100
404/404 [==============================] - 1s 1ms/step - loss: 46.0892 - mae: 4.62
83 - val_loss: 49.9646 - val_mae: 4.9288
Epoch 2/100
404/404 [==============================] - 0s 1ms/step - loss: 44.3705 - mae: 4.50
80 - val_loss: 44.7263 - val_mae: 4.6579
Epoch 3/100
404/404 [==============================] - 0s 982us/step - loss: 42.1977 - mae: 4.
3674 - val_loss: 42.6602 - val_mae: 4.9223
Epoch 4/100
404/404 [==============================] - 0s 995us/step - loss: 42.4866 - mae: 4.
4143 - val_loss: 40.3412 - val_mae: 4.3943
Epoch 5/100
404/404 [==============================] - 0s 1ms/step - loss: 40.4584 - mae: 4.31
17 - val_loss: 36.9364 - val_mae: 4.3354
Epoch 6/100
404/404 [==============================] - 0s 985us/step - loss: 38.6106 - mae: 4.
3190 - val_loss: 47.0975 - val_mae: 4.7888
Epoch 7/100
404/404 [==============================] - 0s 1ms/step - loss: 37.7276 - mae: 4.24
28 - val_loss: 40.7833 - val_mae: 4.4129
Epoch 8/100
404/404 [==============================] - 0s 991us/step - loss: 37.8747 - mae: 4.
3096 - val_loss: 34.1874 - val_mae: 4.2422
Epoch 9/100
404/404 [==============================] - 0s 990us/step - loss: 34.6658 - mae: 4.
1117 - val_loss: 42.6545 - val_mae: 4.5179
Epoch 10/100
404/404 [==============================] - 0s 1ms/step - loss: 34.9294 - mae: 4.10
50 - val_loss: 31.9306 - val_mae: 3.9168
Epoch 11/100
404/404 [==============================] - 0s 1ms/step - loss: 34.7040 - mae: 4.22
05 - val_loss: 44.0729 - val_mae: 4.5981
Epoch 12/100
404/404 [==============================] - 0s 1ms/step - loss: 34.0162 - mae: 4.11
05 - val_loss: 30.1802 - val_mae: 3.8526
Epoch 13/100
404/404 [==============================] - 0s 999us/step - loss: 32.7211 - mae: 4.
0763 - val_loss: 29.9802 - val_mae: 3.8750
Epoch 14/100
404/404 [==============================] - 0s 1ms/step - loss: 32.2446 - mae: 3.95
82 - val_loss: 27.8819 - val_mae: 3.8118
Epoch 15/100
404/404 [==============================] - 0s 958us/step - loss: 30.8436 - mae: 3.
9040 - val_loss: 29.0124 - val_mae: 3.8536
Epoch 16/100
404/404 [==============================] - 0s 945us/step - loss: 30.9640 - mae: 3.
8839 - val_loss: 28.0989 - val_mae: 3.9456
Epoch 17/100
404/404 [==============================] - 0s 929us/step - loss: 29.1573 - mae: 3.
8263 - val_loss: 47.9449 - val_mae: 4.9457
Epoch 18/100
404/404 [==============================] - 0s 911us/step - loss: 29.6104 - mae: 3.
8059 - val_loss: 26.6959 - val_mae: 3.7711
Epoch 19/100
404/404 [==============================] - 0s 959us/step - loss: 28.3297 - mae: 3.
8169 - val_loss: 26.7015 - val_mae: 3.6642
Epoch 20/100
404/404 [==============================] - 0s 950us/step - loss: 26.0085 - mae: 3.
6706 - val_loss: 28.1687 - val_mae: 3.7185
Epoch 21/100
404/404 [==============================] - 0s 918us/step - loss: 27.1008 - mae: 3.
7228 - val_loss: 26.6665 - val_mae: 3.6985
Epoch 22/100
```

```
404/404 [==============================] - 0s 977us/step - loss: 26.5233 - mae: 3.
6308 - val_loss: 27.8919 - val_mae: 3.7148
Epoch 23/100
404/404 [==============================] - 0s 946us/step - loss: 26.7145 - mae: 3.
6572 - val_loss: 25.5191 - val_mae: 3.6621
Epoch 24/100
404/404 [==============================] - 0s 960us/step - loss: 24.8619 - mae: 3.
5089 - val_loss: 30.5179 - val_mae: 3.8810
Epoch 25/100
404/404 [==============================] - 0s 998us/step - loss: 24.1435 - mae: 3.
5787 - val_loss: 30.1012 - val_mae: 3.8342
Epoch 26/100
404/404 [==============================] - 0s 985us/step - loss: 24.7670 - mae: 3.
5325 - val_loss: 33.9442 - val_mae: 4.1577
Epoch 27/100
404/404 [==============================] - 0s 973us/step - loss: 23.1435 - mae: 3.
5011 - val_loss: 30.6998 - val_mae: 3.8525
Epoch 28/100
404/404 [==============================] - 0s 1ms/step - loss: 23.1500 - mae: 3.44
75 - val_loss: 25.7436 - val_mae: 3.6350
Epoch 29/100
404/404 [==============================] - 0s 1ms/step - loss: 21.9577 - mae: 3.33
07 - val_loss: 29.6767 - val_mae: 3.8754
Epoch 30/100
404/404 [==============================] - 0s 1ms/step - loss: 21.9644 - mae: 3.35
25 - val_loss: 27.6268 - val_mae: 3.9813
Epoch 31/100
404/404 [==============================] - 0s 1ms/step - loss: 21.5842 - mae: 3.38
21 - val_loss: 28.4405 - val_mae: 3.7137
Epoch 32/100
404/404 [==============================] - 0s 1ms/step - loss: 21.4341 - mae: 3.33
75 - val_loss: 32.5281 - val_mae: 4.0548
Epoch 33/100
404/404 [==============================] - 0s 946us/step - loss: 21.0383 - mae: 3.
2599 - val_loss: 27.8818 - val_mae: 3.7149
Epoch 34/100
404/404 [==============================] - 0s 940us/step - loss: 21.5877 - mae: 3.
3035 - val_loss: 26.1322 - val_mae: 3.5963
Epoch 35/100
404/404 [==============================] - 0s 960us/step - loss: 20.0472 - mae: 3.
2076 - val_loss: 27.2689 - val_mae: 3.6797
Epoch 36/100
404/404 [==============================] - 0s 1ms/step - loss: 21.2193 - mae: 3.31
43 - val_loss: 27.2873 - val_mae: 3.9418
Epoch 37/100
404/404 [==============================] - 0s 1ms/step - loss: 21.4498 - mae: 3.31
10 - val_loss: 29.6900 - val_mae: 4.2140
Epoch 38/100
404/404 [==============================] - 0s 1ms/step - loss: 20.3501 - mae: 3.28
61 - val_loss: 28.4663 - val_mae: 3.7461
Epoch 39/100
404/404 [==============================] - 0s 1ms/step - loss: 19.7302 - mae: 3.22
34 - val_loss: 27.0087 - val_mae: 3.6454
Epoch 40/100
404/404 [==============================] - 0s 974us/step - loss: 19.7583 - mae: 3.
1595 - val_loss: 30.8638 - val_mae: 3.9156
Epoch 41/100
404/404 [==============================] - 0s 1ms/step - loss: 19.3827 - mae: 3.16
63 - val_loss: 26.3918 - val_mae: 3.6275
Epoch 42/100
404/404 [==============================] - 0s 999us/step - loss: 19.8880 - mae: 3.
2770 - val_loss: 30.0912 - val_mae: 3.8169
Epoch 43/100
404/404 [==============================] - 0s 993us/step - loss: 19.3441 - mae: 3.
```

```
1649 - val_loss: 27.3875 - val_mae: 3.6395
Epoch 44/100
404/404 [==============================] - 0s 972us/step - loss: 18.8513 - mae: 3.
0664 - val_loss: 34.1382 - val_mae: 4.6318
Epoch 45/100
404/404 [==============================] - 0s 992us/step - loss: 19.3380 - mae: 3.
1785 - val_loss: 29.8565 - val_mae: 3.7891
Epoch 46/100
404/404 [==============================] - 0s 1ms/step - loss: 18.6316 - mae: 3.12
12 - val_loss: 35.0335 - val_mae: 4.1274
Epoch 47/100
404/404 [==============================] - 0s 983us/step - loss: 17.9113 - mae: 3.
0885 - val_loss: 51.0103 - val_mae: 5.3813
Epoch 48/100
404/404 [==============================] - 0s 1ms/step - loss: 18.1548 - mae: 3.09
82 - val_loss: 27.4622 - val_mae: 3.6744
Epoch 49/100
404/404 [==============================] - 0s 999us/step - loss: 18.0226 - mae: 3.
1263 - val_loss: 27.2752 - val_mae: 3.7503
Epoch 50/100
404/404 [==============================] - 0s 1ms/step - loss: 18.8926 - mae: 3.14
92 - val_loss: 36.5538 - val_mae: 4.1842
Epoch 51/100
404/404 [==============================] - 0s 1ms/step - loss: 18.6949 - mae: 3.11
08 - val_loss: 32.7353 - val_mae: 4.1851
Epoch 52/100
404/404 [==============================] - 0s 980us/step - loss: 17.6869 - mae: 3.
0412 - val_loss: 29.8501 - val_mae: 3.9471
Epoch 53/100
404/404 [==============================] - 0s 999us/step - loss: 18.0694 - mae: 3.
0759 - val_loss: 28.4243 - val_mae: 3.7648
Epoch 54/100
404/404 [==============================] - 0s 992us/step - loss: 17.5870 - mae: 3.
1316 - val_loss: 38.2918 - val_mae: 4.2861
Epoch 55/100
404/404 [==============================] - 0s 1ms/step - loss: 18.5063 - mae: 3.12
77 - val_loss: 40.4409 - val_mae: 4.5245
Epoch 56/100
404/404 [==============================] - 0s 1ms/step - loss: 17.9146 - mae: 3.09
71 - val_loss: 29.6376 - val_mae: 3.6763
Epoch 57/100
404/404 [==============================] - 0s 1ms/step - loss: 18.5416 - mae: 2.99
71 - val_loss: 35.2872 - val_mae: 4.3048
Epoch 58/100
404/404 [==============================] - 0s 1ms/step - loss: 18.8342 - mae: 3.10
00 - val_loss: 32.5464 - val_mae: 3.9327
Epoch 59/100
404/404 [==============================] - 0s 1ms/step - loss: 17.2722 - mae: 2.98
50 - val_loss: 29.5740 - val_mae: 3.7216
Epoch 60/100
404/404 [==============================] - 0s 1ms/step - loss: 18.3899 - mae: 3.05
37 - val_loss: 29.1419 - val_mae: 3.8994
Epoch 61/100
404/404 [==============================] - 0s 973us/step - loss: 17.9928 - mae: 2.
9647 - val_loss: 30.4862 - val_mae: 3.7215
Epoch 62/100
404/404 [==============================] - 0s 1ms/step - loss: 18.3809 - mae: 3.07
04 - val_loss: 27.6368 - val_mae: 3.5819
Epoch 63/100
404/404 [==============================] - 0s 989us/step - loss: 17.7045 - mae: 3.
0129 - val_loss: 31.0083 - val_mae: 3.8201
Epoch 64/100
404/404 [==============================] - 0s 995us/step - loss: 17.4557 - mae: 3.
0251 - val_loss: 30.8498 - val_mae: 3.7829
```

```
Epoch 65/100
404/404 [==============================] - 0s 1ms/step - loss: 18.1587 - mae: 3.04
92 - val_loss: 42.7948 - val_mae: 4.8277
Epoch 66/100
404/404 [==============================] - 0s 1ms/step - loss: 16.2356 - mae: 2.89
42 - val_loss: 26.7497 - val_mae: 3.5876
Epoch 67/100
404/404 [==============================] - 0s 1ms/step - loss: 18.5653 - mae: 3.11
42 - val_loss: 32.4707 - val_mae: 3.8437
Epoch 68/100
404/404 [==============================] - 0s 966us/step - loss: 16.1462 - mae: 2.
9517 - val_loss: 35.5325 - val_mae: 4.0320
Epoch 69/100
404/404 [==============================] - 0s 1ms/step - loss: 17.6008 - mae: 3.06
32 - val_loss: 33.0800 - val_mae: 3.9025
Epoch 70/100
404/404 [==============================] - 0s 981us/step - loss: 17.8259 - mae: 3.
0408 - val_loss: 28.1816 - val_mae: 3.6830
Epoch 71/100
404/404 [==============================] - 0s 969us/step - loss: 17.9496 - mae: 2.
9978 - val_loss: 31.1657 - val_mae: 3.8045
Epoch 72/100
404/404 [==============================] - 0s 930us/step - loss: 16.5462 - mae: 2.
9641 - val_loss: 31.9390 - val_mae: 4.0774
Epoch 73/100
404/404 [==============================] - 0s 1ms/step - loss: 16.7700 - mae: 2.97
77 - val_loss: 28.9413 - val_mae: 3.6603
Epoch 74/100
404/404 [==============================] - 0s 946us/step - loss: 17.7316 - mae: 3.
0521 - val_loss: 28.4542 - val_mae: 3.7993
Epoch 75/100
404/404 [==============================] - 0s 1ms/step - loss: 15.9054 - mae: 2.88
96 - val_loss: 29.9460 - val_mae: 3.7431
Epoch 76/100
404/404 [==============================] - 0s 1ms/step - loss: 16.8765 - mae: 2.88
93 - val_loss: 30.4498 - val_mae: 3.8112
Epoch 77/100
404/404 [==============================] - 0s 1ms/step - loss: 16.2005 - mae: 2.82
96 - val_loss: 52.4993 - val_mae: 5.3929
Epoch 78/100
404/404 [==============================] - 0s 1ms/step - loss: 16.1792 - mae: 2.87
66 - val_loss: 28.1404 - val_mae: 3.5619
Epoch 79/100
404/404 [==============================] - 0s 998us/step - loss: 18.5551 - mae: 2.
9965 - val_loss: 27.0045 - val_mae: 3.5189
Epoch 80/100
404/404 [==============================] - 0s 998us/step - loss: 17.0552 - mae: 2.
9869 - val_loss: 30.8579 - val_mae: 3.7272
Epoch 81/100
404/404 [==============================] - 0s 1ms/step - loss: 16.1179 - mae: 2.82
10 - val_loss: 29.6417 - val_mae: 3.6085
Epoch 82/100
404/404 [==============================] - 0s 1ms/step - loss: 16.1979 - mae: 2.91
36 - val_loss: 56.7975 - val_mae: 5.3745
Epoch 83/100
404/404 [==============================] - 0s 1ms/step - loss: 16.8976 - mae: 2.88
21 - val_loss: 27.3394 - val_mae: 3.5278
Epoch 84/100
404/404 [==============================] - 0s 1ms/step - loss: 17.7511 - mae: 2.93
16 - val_loss: 27.8850 - val_mae: 3.6482
Epoch 85/100
404/404 [==============================] - 0s 1ms/step - loss: 17.9281 - mae: 2.86
11 - val_loss: 30.1690 - val_mae: 3.7145
Epoch 86/100
```

```
404/404 [==============================] - 0s 1ms/step - loss: 16.4794 - mae: 2.89
60 - val_loss: 28.0448 - val_mae: 3.5846
Epoch 87/100
404/404 [==============================] - 0s 1ms/step - loss: 17.2154 - mae: 2.85
19 - val_loss: 33.3170 - val_mae: 3.8780
Epoch 88/100
404/404 [==============================] - 0s 1ms/step - loss: 17.1874 - mae: 3.00
35 - val_loss: 28.7203 - val_mae: 3.5926
Epoch 89/100
404/404 [==============================] - 0s 1ms/step - loss: 16.9987 - mae: 2.95
26 - val_loss: 33.9969 - val_mae: 4.0096
Epoch 90/100
404/404 [==============================] - 0s 996us/step - loss: 16.3795 - mae: 2.
8490 - val_loss: 27.8055 - val_mae: 3.5351
Epoch 91/100
404/404 [==============================] - 0s 1ms/step - loss: 16.2646 - mae: 2.82
38 - val_loss: 30.6611 - val_mae: 3.9814
Epoch 92/100
404/404 [==============================] - 0s 1ms/step - loss: 16.3229 - mae: 2.92
13 - val_loss: 27.3043 - val_mae: 3.5043
Epoch 93/100
404/404 [==============================] - 0s 1ms/step - loss: 16.9649 - mae: 2.86
13 - val_loss: 26.2089 - val_mae: 3.5476
Epoch 94/100
404/404 [==============================] - 0s 1ms/step - loss: 15.7348 - mae: 2.82
07 - val_loss: 32.5453 - val_mae: 3.7439
Epoch 95/100
404/404 [==============================] - 0s 1ms/step - loss: 17.5342 - mae: 2.90
78 - val_loss: 28.9323 - val_mae: 3.5856
Epoch 96/100
404/404 [==============================] - 0s 988us/step - loss: 16.7090 - mae: 2.
8969 - val_loss: 38.9846 - val_mae: 4.3424
Epoch 97/100
404/404 [==============================] - 0s 1ms/step - loss: 16.2601 - mae: 2.83
84 - val_loss: 27.9643 - val_mae: 3.5780
Epoch 98/100
404/404 [==============================] - 0s 1ms/step - loss: 16.0425 - mae: 2.87
97 - val_loss: 33.4448 - val_mae: 3.9222
Epoch 99/100
404/404 [==============================] - 0s 1ms/step - loss: 16.7640 - mae: 2.88
65 - val_loss: 29.9986 - val_mae: 3.6049
Epoch 100/100
404/404 [==============================] - 0s 988us/step - loss: 16.6790 - mae: 2.
9483 - val_loss: 33.7663 - val_mae: 4.1300
```

In [33]:

```
#test_input=[(0.02675675,0.00000000,0.026779,0.0000000,0.0010046,0.00951931,0.14795
test_input=[(0.0024119 , 0.        , 0.01592969, 0.        , 0.00105285,
       0.01201967, 0.17945359, 0.00778265, 0.00782786, 0.6007879 ,
       0.04109624, 0.77671895, 0.03663436)]
print("Actual output:15.2")
print("Predicted Output:",model.predict(test_input))
```

```
Actual output:15.2
1/1 [==============================] - 0s 35ms/step
Predicted Output: [[19.028976]]
```

In [35]:

```
test_input=[(4.07923050e-05, 1.54587284e-01, 3.80378407e-03, 0.00000000e+00,
       7.77620881e-04, 1.42595058e-02, 2.94184285e-02, 1.17486336e-02,
       3.74757051e-03, 6.52077269e-01, 2.75446433e-02, 7.40857215e-01,
       5.82747215e-03)]
print("Actual output:42.3")
print("Predicted Output:",model.predict(test_input))
```

```
Actual output:15.2
1/1 [==============================] - 0s 31ms/step
Predicted Output: [[40.964622]]
```

In [ ]:

In [36]:
```
y_pred=model.predict(X_test)
```

```
4/4 [==============================] - 0s 1ms/step
```

In [38]:
```
y_pred
```

Out[38]:
```
array([[11.097237],
       [19.891884],
       [23.978962],
       [40.476723],
       [26.403244],
       [21.40718 ],
       [32.07225 ],
       [25.6069  ],
       [20.62743 ],
       [21.268955],
       [17.37386 ],
       [20.698256],
       [18.5992  ],
       [41.50633 ],
       [18.21064 ],
       [22.572397],
       [25.298908],
       [23.109997],
       [19.927784],
       [27.85856 ],
       [13.668438],
       [14.813995],
       [22.408125],
       [18.345507],
       [23.607265],
       [24.582129],
       [27.933378],
       [34.176117],
       [13.13487 ],
       [24.00893 ],
       [22.303371],
       [14.461793],
       [36.94349 ],
       [24.489891],
       [18.347946],
       [12.185698],
       [16.732141],
       [17.521435],
       [21.416134],
       [30.097702],
       [26.238407],
       [28.245678],
       [17.77951 ],
       [35.275093],
       [41.748577],
       [24.055986],
       [31.252777],
       [20.595137],
       [29.46723 ],
       [23.791147],
       [35.15451 ],
       [20.54555 ],
       [14.32721 ],
       [18.445818],
       [37.121414],
       [29.647758],
       [15.700004],
       [37.14074 ],
       [41.326622],
       [26.030615],
       [24.362774],
       [18.76081 ],
       [14.259814],
       [21.51795 ],
```

```
[26.83842 ],
[26.393326],
[16.266272],
[26.503115],
[15.069317],
[12.685591],
[24.90866 ],
[27.922209],
[23.157509],
[16.486818],
[25.105095],
[21.656   ],
[23.366562],
[23.893047],
[37.68934 ],
[13.075663],
[22.410603],
[41.262825],
[20.03372 ],
[17.176804],
[22.404095],
[19.403023],
[20.523266],
[21.30436 ],
[23.721615],
[37.52248 ],
[19.733585],
[23.46988 ],
[22.990068],
[29.615524],
[38.18324 ],
[20.517712],
[41.10894 ],
[51.21684 ],
[25.474052],
[58.165623],
[29.631712],
[19.510073]], dtype=float32)
```

In [39]:
```
y_test
```

Out[39]:
```
array([ 7.2, 18.8, 19. , 27. , 22.2, 24.5, 31.2, 22.9, 20.5, 23.2, 18.6,
       14.5, 17.8, 50. , 20.8, 24.3, 24.2, 19.8, 19.1, 22.7, 12. , 10.2,
       20. , 18.5, 20.9, 23. , 27.5, 30.1,  9.5, 22. , 21.2, 14.1, 33.1,
       23.4, 20.1,  7.4, 15.4, 23.8, 20.1, 24.5, 33. , 28.4, 14.1, 46.7,
       32.5, 29.6, 28.4, 19.8, 20.2, 25. , 35.4, 20.3,  9.7, 14.5, 34.9,
       26.6,  7.2, 50. , 32.4, 21.6, 29.8, 13.1, 27.5, 21.2, 23.1, 21.9,
       13. , 23.2,  8.1,  5.6, 21.7, 29.6, 19.6,  7. , 26.4, 18.9, 20.9,
       28.1, 35.4, 10.2, 24.3, 43.1, 17.6, 15.4, 16.2, 27.1, 21.4, 21.5,
       22.4, 25. , 16.6, 18.6, 22. , 42.8, 35.1, 21.5, 36. , 21.9, 24.1,
       50. , 26.7, 25. ])
```

In [37]:
```
from sklearn.metrics import accuracy_score
accuracy_score(y_test,y_pred)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
~\AppData\Local\Temp/ipykernel_7644/3104149303.py in <module>
      1 from sklearn.metrics import accuracy_score
----> 2 accuracy_score(y_test,y_pred)

~\anaconda31\lib\site-packages\sklearn\metrics\_classification.py in accuracy_scor
e(y_true, y_pred, normalize, sample_weight)
    209
    210     # Compute accuracy for each possible representation
--> 211     y_type, y_true, y_pred = _check_targets(y_true, y_pred)
    212     check_consistent_length(y_true, y_pred, sample_weight)
    213     if y_type.startswith("multilabel"):

~\anaconda31\lib\site-packages\sklearn\metrics\_classification.py in _check_target
s(y_true, y_pred)
    102     # No metrics support "multiclass-multioutput" format
    103     if y_type not in ["binary", "multiclass", "multilabel-indicator"]:
--> 104         raise ValueError("{0} is not supported".format(y_type))
    105
    106     if y_type in ["binary", "multiclass"]:

ValueError: continuous is not supported
```