Using Keras for building a DNN

In [1]:

```
import tensorflow as tf
import matplotlib.pyplot as plt
import os

from pandas import read_csv
from sklearn.model_selection import train_test_split
%matplotlib inline
```

1. Load and prepare the data

In [2]:

```
myfile = 'diamond_prices.csv'
diamonds = read_csv(myfile)
diamonds.head(10)
```

Out[2]:

	carat	cut	color	clarity	depth	table	price	x	y	z
0	0.23	Ideal	E	SI2	61.5	55.0	326	3.95	3.98	2.43
1	0.21	Premium	E	SI1	59.8	61.0	326	3.89	3.84	2.31
2	0.23	Good	E	VS1	56.9	65.0	327	4.05	4.07	2.31
3	0.29	Premium	I	VS2	62.4	58.0	334	4.20	4.23	2.63
4	0.31	Good	J	SI2	63.3	58.0	335	4.34	4.35	2.75
5	0.24	Very Good	J	VVS2	62.8	57.0	336	3.94	3.96	2.48
6	0.24	Very Good	I	VVS1	62.3	57.0	336	3.95	3.98	2.47
7	0.26	Very Good	H	SI1	61.9	55.0	337	4.07	4.11	2.53
8	0.22	Fair	E	VS2	65.1	61.0	337	3.87	3.78	2.49
9	0.23	Very Good	H	VS1	59.4	61.0	338	4.00	4.05	2.39

Splice the data to get predictive feature, feature vectors

In [3]:

```
from sklearn.preprocessing import LabelEncoder
```

In [4]:

```
encoder = LabelEncoder()
diamonds["cut"] = encoder.fit_transform(diamonds["cut"])
diamonds["color"] = encoder.fit_transform(diamonds["color"])
diamonds["clarity"] = encoder.fit_transform(diamonds["clarity"])
```

In [5]:

```
TARGET = 'price'
X_data = diamonds.iloc[:,1:].values
y_data = diamonds[TARGET].values
```

In [6]:

```
X_data
```

Out[6]:

```
array([[2.  , 1.  , 3.  , ..., 3.95, 3.98, 2.43],
       [3.  , 1.  , 2.  , ..., 3.89, 3.84, 2.31],
       [1.  , 1.  , 4.  , ..., 4.05, 4.07, 2.31],
       ...,
       [4.  , 0.  , 2.  , ..., 5.66, 5.68, 3.56],
       [3.  , 4.  , 3.  , ..., 6.15, 6.12, 3.74],
       [2.  , 0.  , 3.  , ..., 5.83, 5.87, 3.64]])
```

In [7]:

```
y_data
```

Out[7]:

```
array([ 326,  326,  327, ..., 2757, 2757, 2757], dtype=int64)
```

2. Splitting Data into training and testing sets

In [8]:

```
X_train, X_test, y_train, y_test = train_test_split(X_data, y_data, test_size=0.1, rand
om_state=60)
```

Number of Inputs

In [9]:

```
n_inputs = X_train.shape[1]
```

3. Build the DL model using Dense layers

In [10]:

```
model = tf.keras.models.Sequential()

# first hidden layer, you only need to set the input_dim for the first layer
model.add(tf.keras.layers.Dense(units=128, activation='relu', input_dim=n_inputs))
# second hidden layer
model.add(tf.keras.layers.Dense(units=64, activation='relu'))
# third hidden layer
model.add(tf.keras.layers.Dense(units=32, activation='relu'))
# output layer # for activation: If you don't specify anything, no activation is applie
d
model.add(tf.keras.layers.Dense(units=1))
```

4. Compile the model

In [11]:

```
model.compile(loss='mean_squared_error',
                  optimizer='adam',
                  metrics=['mean_squared_error'])
```

5. Train the model

In [12]:

```
N_EPOCHS = 400
BATCH_SIZE = 128
model.fit(X_train, y_train, epochs=N_EPOCHS, batch_size=BATCH_SIZE)
```

```
Epoch 1/400
48546/48546 [==============================] - 2s 41us/step - loss: 85487
0.2177 - mean_squared_error: 854870.2177
Epoch 2/400
48546/48546 [==============================] - 1s 22us/step - loss: 5.1288
- mean_squared_error: 5.1288
Epoch 3/400
48546/48546 [==============================] - 1s 22us/step - loss: 0.9146
- mean_squared_error: 0.9146
Epoch 4/400
48546/48546 [==============================] - 1s 22us/step - loss: 1.3673
- mean_squared_error: 1.3673
Epoch 5/400
48546/48546 [==============================] - 1s 23us/step - loss: 6.3234
- mean_squared_error: 6.3234
Epoch 6/400
48546/48546 [==============================] - 1s 22us/step - loss: 0.1119
- mean_squared_error: 0.1119
Epoch 7/400
48546/48546 [==============================] - 1s 23us/step - loss: 1.3100
- mean_squared_error: 1.3100
Epoch 8/400
48546/48546 [==============================] - 1s 22us/step - loss: 5.2690
- mean_squared_error: 5.2690
Epoch 9/400
48546/48546 [==============================] - 1s 22us/step - loss: 0.1008
- mean_squared_error: 0.1008
Epoch 10/400
48546/48546 [==============================] - 1s 22us/step - loss: 0.1075
- mean_squared_error: 0.1075
Epoch 11/400
48546/48546 [==============================] - 1s 22us/step - loss: 2.2121
- mean_squared_error: 2.2121
Epoch 12/400
48546/48546 [==============================] - 1s 22us/step - loss: 3.0033
- mean_squared_error: 3.0033
Epoch 13/400
48546/48546 [==============================] - 1s 22us/step - loss: 1.2537
- mean_squared_error: 1.2537
Epoch 14/400
48546/48546 [==============================] - 1s 22us/step - loss: 10.833
4 - mean_squared_error: 10.8334
Epoch 15/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.8328
- mean_squared_error: 0.8328
Epoch 16/400
48546/48546 [==============================] - 1s 22us/step - loss: 0.2642
- mean_squared_error: 0.2642
Epoch 17/400
48546/48546 [==============================] - 1s 22us/step - loss: 92.356
4 - mean_squared_error: 92.3564
Epoch 18/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.7428
- mean_squared_error: 0.7428
Epoch 19/400
48546/48546 [==============================] - 1s 27us/step - loss: 1065.4
473 - mean_squared_error: 1065.4473
Epoch 20/400
48546/48546 [==============================] - 1s 29us/step - loss: 89.890
1 - mean_squared_error: 89.8901
Epoch 21/400
```

```
48546/48546 [==============================] - 1s 24us/step - loss: 0.1516
- mean_squared_error: 0.1516
Epoch 22/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.2276
- mean_squared_error: 0.2276
Epoch 23/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.2208
- mean_squared_error: 0.2208
Epoch 24/400
48546/48546 [==============================] - 1s 23us/step - loss: 14.061
5 - mean_squared_error: 14.0615
Epoch 25/400
48546/48546 [==============================] - 1s 24us/step - loss: 157.24
37 - mean_squared_error: 157.2437
Epoch 26/400
48546/48546 [==============================] - 1s 23us/step - loss: 70.366
6 - mean_squared_error: 70.3666
Epoch 27/400
48546/48546 [==============================] - 1s 23us/step - loss: 5.3282
- mean_squared_error: 5.3282
Epoch 28/400
48546/48546 [==============================] - 1s 24us/step - loss: 329.54
48 - mean_squared_error: 329.5448
Epoch 29/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.1733
- mean_squared_error: 0.1733
Epoch 30/400
48546/48546 [==============================] - 1s 25us/step - loss: 1.0335
- mean_squared_error: 1.0335 1s
Epoch 31/400
48546/48546 [==============================] - 1s 24us/step - loss: 315.45
48 - mean_squared_error: 315.4548
Epoch 32/400
48546/48546 [==============================] - 1s 24us/step - loss: 1.0494
- mean_squared_error: 1.0494
Epoch 33/400
48546/48546 [==============================] - 1s 24us/step - loss: 22.080
6 - mean_squared_error: 22.0806
Epoch 34/400
48546/48546 [==============================] - 1s 24us/step - loss: 159.56
61 - mean_squared_error: 159.5661
Epoch 35/400
48546/48546 [==============================] - 1s 24us/step - loss: 1.6696
- mean_squared_error: 1.6696
Epoch 36/400
48546/48546 [==============================] - 1s 24us/step - loss: 196.83
87 - mean_squared_error: 196.8387
Epoch 37/400
48546/48546 [==============================] - 1s 24us/step - loss: 296.68
57 - mean_squared_error: 296.6857
Epoch 38/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.1469
- mean_squared_error: 0.1469
Epoch 39/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.3247
- mean_squared_error: 0.3247
Epoch 40/400
48546/48546 [==============================] - 1s 25us/step - loss: 497.84
90 - mean_squared_error: 497.8490
Epoch 41/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.1347
```

```
- mean_squared_error: 0.1347
Epoch 42/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.1131
- mean_squared_error: 0.1131
Epoch 43/400
48546/48546 [==============================] - 1s 28us/step - loss: 0.1902
- mean_squared_error: 0.1902
Epoch 44/400
48546/48546 [==============================] - 1s 26us/step - loss: 298.00
79 - mean_squared_error: 298.0079
Epoch 45/400
48546/48546 [==============================] - 1s 27us/step - loss: 0.0935
- mean_squared_error: 0.0935
Epoch 46/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.2172
- mean_squared_error: 0.2172
Epoch 47/400
48546/48546 [==============================] - 1s 26us/step - loss: 1520.7
537 - mean_squared_error: 1520.7537
Epoch 48/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.0495
- mean_squared_error: 0.0495
Epoch 49/400
48546/48546 [==============================] - 1s 27us/step - loss: 0.0478
- mean_squared_error: 0.0478
Epoch 50/400
48546/48546 [==============================] - 1s 27us/step - loss: 0.0485
- mean_squared_error: 0.0485
Epoch 51/400
48546/48546 [==============================] - 1s 27us/step - loss: 0.0558
- mean_squared_error: 0.0558
Epoch 52/400
48546/48546 [==============================] - 1s 28us/step - loss: 0.1856
- mean_squared_error: 0.1856
Epoch 53/400
48546/48546 [==============================] - 1s 24us/step - loss: 5.3831
- mean_squared_error: 5.3831
Epoch 54/400
48546/48546 [==============================] - 1s 25us/step - loss: 105.90
65 - mean_squared_error: 105.9065
Epoch 55/400
48546/48546 [==============================] - 1s 23us/step - loss: 121.56
62 - mean_squared_error: 121.5662
Epoch 56/400
48546/48546 [==============================] - 1s 23us/step - loss: 4.4790
- mean_squared_error: 4.4790
Epoch 57/400
48546/48546 [==============================] - 1s 23us/step - loss: 92.363
2 - mean_squared_error: 92.3632
Epoch 58/400
48546/48546 [==============================] - 1s 23us/step - loss: 20.265
8 - mean_squared_error: 20.2658
Epoch 59/400
48546/48546 [==============================] - 1s 24us/step - loss: 108.88
90 - mean_squared_error: 108.8890
Epoch 60/400
48546/48546 [==============================] - 1s 23us/step - loss: 432.63
60 - mean_squared_error: 432.6360
Epoch 61/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0521
- mean_squared_error: 0.0521
```

```
Epoch 62/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0429
- mean_squared_error: 0.0429
Epoch 63/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.6492
- mean_squared_error: 0.6492
Epoch 64/400
48546/48546 [==============================] - 1s 24us/step - loss: 151.14
30 - mean_squared_error: 151.1430
Epoch 65/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0448
- mean_squared_error: 0.0448
Epoch 66/400
48546/48546 [==============================] - 1s 26us/step - loss: 217.82
01 - mean_squared_error: 217.8201
Epoch 67/400
48546/48546 [==============================] - 1s 27us/step - loss: 56.201
5 - mean_squared_error: 56.2015
Epoch 68/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0730
- mean_squared_error: 0.0730
Epoch 69/400
48546/48546 [==============================] - 1s 23us/step - loss: 34.916
5 - mean_squared_error: 34.9165
Epoch 70/400
48546/48546 [==============================] - 1s 24us/step - loss: 16.074
8 - mean_squared_error: 16.0748
Epoch 71/400
48546/48546 [==============================] - 1s 22us/step - loss: 557.74
42 - mean_squared_error: 557.7442
Epoch 72/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0197
- mean_squared_error: 0.0197
Epoch 73/400
48546/48546 [==============================] - 1s 22us/step - loss: 0.0298
- mean_squared_error: 0.0298
Epoch 74/400
48546/48546 [==============================] - 1s 22us/step - loss: 1.3228
- mean_squared_error: 1.3228
Epoch 75/400
48546/48546 [==============================] - 1s 23us/step - loss: 293.89
51 - mean_squared_error: 293.8951
Epoch 76/400
48546/48546 [==============================] - 1s 22us/step - loss: 0.0340
- mean_squared_error: 0.0340
Epoch 77/400
48546/48546 [==============================] - 1s 22us/step - loss: 0.0372
- mean_squared_error: 0.0372
Epoch 78/400
48546/48546 [==============================] - 1s 23us/step - loss: 381.92
86 - mean_squared_error: 381.9286
Epoch 79/400
48546/48546 [==============================] - 1s 22us/step - loss: 149.47
18 - mean_squared_error: 149.4718
Epoch 80/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0170
- mean_squared_error: 0.0170
Epoch 81/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0137
- mean_squared_error: 0.0137
Epoch 82/400
```

```
48546/48546 [==============================] - 1s 22us/step - loss: 0.1873
- mean_squared_error: 0.1873
Epoch 83/400
48546/48546 [==============================] - 1s 23us/step - loss: 179.49
53 - mean_squared_error: 179.4953
Epoch 84/400
48546/48546 [==============================] - 1s 22us/step - loss: 0.0186
- mean_squared_error: 0.0186
Epoch 85/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.8800
- mean_squared_error: 0.8800
Epoch 86/400
48546/48546 [==============================] - 1s 23us/step - loss: 125.55
41 - mean_squared_error: 125.5541
Epoch 87/400
48546/48546 [==============================] - 1s 22us/step - loss: 0.2643
- mean_squared_error: 0.2643
Epoch 88/400
48546/48546 [==============================] - 1s 22us/step - loss: 179.86
70 - mean_squared_error: 179.8670
Epoch 89/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.1407
- mean_squared_error: 0.1407
Epoch 90/400
48546/48546 [==============================] - 1s 22us/step - loss: 191.77
31 - mean_squared_error: 191.7731
Epoch 91/400
48546/48546 [==============================] - 1s 22us/step - loss: 0.0859
- mean_squared_error: 0.0859
Epoch 92/400
48546/48546 [==============================] - 1s 22us/step - loss: 0.3858
- mean_squared_error: 0.3858
Epoch 93/400
48546/48546 [==============================] - 1s 25us/step - loss: 387.53
78 - mean_squared_error: 387.5378
Epoch 94/400
48546/48546 [==============================] - 1s 29us/step - loss: 0.0116
- mean_squared_error: 0.0116
Epoch 95/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0150
- mean_squared_error: 0.0150
Epoch 96/400
48546/48546 [==============================] - 2s 32us/step - loss: 0.6605
- mean_squared_error: 0.6605
Epoch 97/400
48546/48546 [==============================] - 1s 24us/step - loss: 212.01
33 - mean_squared_error: 212.0133
Epoch 98/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0152
- mean_squared_error: 0.0152
Epoch 99/400
48546/48546 [==============================] - 1s 25us/step - loss: 9.5142
- mean_squared_error: 9.5142
Epoch 100/400
48546/48546 [==============================] - 1s 24us/step - loss: 98.457
9 - mean_squared_error: 98.4579
Epoch 101/400
48546/48546 [==============================] - 1s 25us/step - loss: 37.101
1 - mean_squared_error: 37.1011
Epoch 102/400
48546/48546 [==============================] - 1s 25us/step - loss: 32.891
```

```
2 - mean_squared_error: 32.8912
Epoch 103/400
48546/48546 [==============================] - 1s 24us/step - loss: 252.99
03 - mean_squared_error: 252.9903
Epoch 104/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0116
- mean_squared_error: 0.0116
Epoch 105/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0395
- mean_squared_error: 0.0395
Epoch 106/400
48546/48546 [==============================] - 1s 26us/step - loss: 120.67
68 - mean_squared_error: 120.6768
Epoch 107/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0362
- mean_squared_error: 0.0362
Epoch 108/400
48546/48546 [==============================] - 1s 25us/step - loss: 48.280
8 - mean_squared_error: 48.2808
Epoch 109/400
48546/48546 [==============================] - 1s 27us/step - loss: 151.23
73 - mean_squared_error: 151.2373
Epoch 110/400
48546/48546 [==============================] - 1s 25us/step - loss: 45.031
4 - mean_squared_error: 45.0314
Epoch 111/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0319
- mean_squared_error: 0.0319
Epoch 112/400
48546/48546 [==============================] - 1s 24us/step - loss: 257.08
49 - mean_squared_error: 257.0849
Epoch 113/400
48546/48546 [==============================] - 1s 25us/step - loss: 58.322
5 - mean_squared_error: 58.3225
Epoch 114/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0052
- mean_squared_error: 0.0052
Epoch 115/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0079
- mean_squared_error: 0.0079
Epoch 116/400
48546/48546 [==============================] - 1s 24us/step - loss: 49.667
5 - mean_squared_error: 49.6675
Epoch 117/400
48546/48546 [==============================] - 1s 24us/step - loss: 285.02
53 - mean_squared_error: 285.0253
Epoch 118/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.7030
- mean_squared_error: 0.7030
Epoch 119/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0066
- mean_squared_error: 0.0066
Epoch 120/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0210
- mean_squared_error: 0.0210
Epoch 121/400
48546/48546 [==============================] - 1s 24us/step - loss: 135.05
25 - mean_squared_error: 135.0525
Epoch 122/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.1528
- mean_squared_error: 0.1528
```

```
Epoch 123/400
48546/48546 [==============================] - 1s 24us/step - loss: 6.6564
- mean_squared_error: 6.6564
Epoch 124/400
48546/48546 [==============================] - 1s 24us/step - loss: 67.560
3 - mean_squared_error: 67.5603
Epoch 125/400
48546/48546 [==============================] - 1s 24us/step - loss: 83.360
6 - mean_squared_error: 83.3606
Epoch 126/400
48546/48546 [==============================] - 1s 25us/step - loss: 53.683
3 - mean_squared_error: 53.6833A: 0s - loss: 88.4724 - mean_sq
Epoch 127/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.9275
- mean_squared_error: 0.9275 1s -
Epoch 128/400
48546/48546 [==============================] - 1s 25us/step - loss: 160.18
87 - mean_squared_error: 160.1887
Epoch 129/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0841
- mean_squared_error: 0.0841
Epoch 130/400
48546/48546 [==============================] - 1s 24us/step - loss: 159.95
86 - mean_squared_error: 159.9586
Epoch 131/400
48546/48546 [==============================] - 1s 25us/step - loss: 6.5074
- mean_squared_error: 6.5074
Epoch 132/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.1162
- mean_squared_error: 0.1162
Epoch 133/400
48546/48546 [==============================] - 1s 24us/step - loss: 95.197
1 - mean_squared_error: 95.1971
Epoch 134/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.4931
- mean_squared_error: 0.4931
Epoch 135/400
48546/48546 [==============================] - 1s 25us/step - loss: 86.350
6 - mean_squared_error: 86.3506
Epoch 136/400
48546/48546 [==============================] - 1s 24us/step - loss: 1.8889
- mean_squared_error: 1.8889
Epoch 137/400
48546/48546 [==============================] - 1s 24us/step - loss: 80.695
7 - mean_squared_error: 80.6957
Epoch 138/400
48546/48546 [==============================] - 1s 23us/step - loss: 24.814
3 - mean_squared_error: 24.8143
Epoch 139/400
48546/48546 [==============================] - 1s 24us/step - loss: 261.01
90 - mean_squared_error: 261.0190
Epoch 140/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0021
- mean_squared_error: 0.0021
Epoch 141/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0047
- mean_squared_error: 0.0047
Epoch 142/400
48546/48546 [==============================] - 1s 23us/step - loss: 8.4646
- mean_squared_error: 8.4646
Epoch 143/400
```

```
48546/48546 [==============================] - 1s 25us/step - loss: 91.461
2 - mean_squared_error: 91.4612
Epoch 144/400
48546/48546 [==============================] - 1s 24us/step - loss: 45.692
1 - mean_squared_error: 45.6921
Epoch 145/400
48546/48546 [==============================] - 1s 28us/step - loss: 40.618
6 - mean_squared_error: 40.6186
Epoch 146/400
48546/48546 [==============================] - 1s 24us/step - loss: 103.37
41 - mean_squared_error: 103.3741
Epoch 147/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.1385
- mean_squared_error: 0.1385
Epoch 148/400
48546/48546 [==============================] - 1s 24us/step - loss: 179.97
96 - mean_squared_error: 179.9796
Epoch 149/400
48546/48546 [==============================] - 1s 24us/step - loss: 45.715
1 - mean_squared_error: 45.7151
Epoch 150/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.0019
- mean_squared_error: 0.0019
Epoch 151/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0175
- mean_squared_error: 0.0175
Epoch 152/400
48546/48546 [==============================] - 1s 25us/step - loss: 90.973
4 - mean_squared_error: 90.9734
Epoch 153/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.0772
- mean_squared_error: 0.0772
Epoch 154/400
48546/48546 [==============================] - 1s 26us/step - loss: 92.886
1 - mean_squared_error: 92.8861
Epoch 155/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0405
- mean_squared_error: 0.0405
Epoch 156/400
48546/48546 [==============================] - 1s 26us/step - loss: 248.99
59 - mean_squared_error: 248.9959
Epoch 157/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0021
- mean_squared_error: 0.0021
Epoch 158/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0096
- mean_squared_error: 0.0096
Epoch 159/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0711
- mean_squared_error: 0.0711
Epoch 160/400
48546/48546 [==============================] - 1s 24us/step - loss: 131.14
59 - mean_squared_error: 131.1459
Epoch 161/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0110
- mean_squared_error: 0.0110
Epoch 162/400
48546/48546 [==============================] - 1s 24us/step - loss: 26.245
7 - mean_squared_error: 26.2457
Epoch 163/400
48546/48546 [==============================] - 1s 24us/step - loss: 177.93
```

```
87 - mean_squared_error: 177.9387
Epoch 164/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0025
- mean_squared_error: 0.0025
Epoch 165/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.7416
- mean_squared_error: 0.7416
Epoch 166/400
48546/48546 [==============================] - 2s 43us/step - loss: 181.01
00 - mean_squared_error: 181.0100
Epoch 167/400
48546/48546 [==============================] - 2s 34us/step - loss: 0.0065
- mean_squared_error: 0.0065
Epoch 168/400
48546/48546 [==============================] - 2s 32us/step - loss: 0.8988
- mean_squared_error: 0.8988
Epoch 169/400
48546/48546 [==============================] - 2s 37us/step - loss: 72.841
1 - mean_squared_error: 72.8411
Epoch 170/400
48546/48546 [==============================] - 2s 32us/step - loss: 116.16
49 - mean_squared_error: 116.1649
Epoch 171/400
48546/48546 [==============================] - 1s 31us/step - loss: 4.2027
e-04 - mean_squared_error: 4.2027e-04 0s - loss: 2.6644e
Epoch 172/400
48546/48546 [==============================] - 1s 27us/step - loss: 56.990
9 - mean_squared_error: 56.9909
Epoch 173/400
48546/48546 [==============================] - 1s 25us/step - loss: 71.594
6 - mean_squared_error: 71.5946
Epoch 174/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.0034
- mean_squared_error: 0.0034
Epoch 175/400
48546/48546 [==============================] - 1s 25us/step - loss: 102.11
47 - mean_squared_error: 102.1147
Epoch 176/400
48546/48546 [==============================] - 1s 28us/step - loss: 5.4485
- mean_squared_error: 5.4485
Epoch 177/400
48546/48546 [==============================] - 1s 28us/step - loss: 444.86
48 - mean_squared_error: 444.8648
Epoch 178/400
48546/48546 [==============================] - 1s 29us/step - loss: 5.8720
- mean_squared_error: 5.8720
Epoch 179/400
48546/48546 [==============================] - 1s 29us/step - loss: 0.0012
- mean_squared_error: 0.0012
Epoch 180/400
48546/48546 [==============================] - 1s 30us/step - loss: 0.0011
- mean_squared_error: 0.0011
Epoch 181/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0048
- mean_squared_error: 0.0048
Epoch 182/400
48546/48546 [==============================] - 1s 25us/step - loss: 7.2004
- mean_squared_error: 7.2004
Epoch 183/400
48546/48546 [==============================] - 1s 24us/step - loss: 132.79
35 - mean_squared_error: 132.7935
```

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Epoch 184/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0319
- mean_squared_error: 0.0319
Epoch 185/400
48546/48546 [==============================] - 1s 24us/step - loss: 217.65
32 - mean_squared_error: 217.6532
Epoch 186/400
48546/48546 [==============================] - 1s 25us/step - loss: 22.635
0 - mean_squared_error: 22.6350
Epoch 187/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0017
- mean_squared_error: 0.0017
Epoch 188/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0044
- mean_squared_error: 0.0044
Epoch 189/400
48546/48546 [==============================] - 1s 25us/step - loss: 118.55
24 - mean_squared_error: 118.5524
Epoch 190/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0043
- mean_squared_error: 0.0043
Epoch 191/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.2386
- mean_squared_error: 0.2386
Epoch 192/400
48546/48546 [==============================] - 1s 24us/step - loss: 148.52
31 - mean_squared_error: 148.5231
Epoch 193/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0069
- mean_squared_error: 0.0069
Epoch 194/400
48546/48546 [==============================] - 1s 25us/step - loss: 94.905
7 - mean_squared_error: 94.9057
Epoch 195/400
48546/48546 [==============================] - 1s 30us/step - loss: 0.0206
- mean_squared_error: 0.0206
Epoch 196/400
48546/48546 [==============================] - ETA: 0s - loss: 145.4948 -
mean_squared_error: 145.49 - 1s 24us/step - loss: 170.6654 - mean_squared_
error: 170.6654
Epoch 197/400
48546/48546 [==============================] - 1s 24us/step - loss: 47.672
9 - mean_squared_error: 47.6729
Epoch 198/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0020
- mean_squared_error: 0.0020
Epoch 199/400
48546/48546 [==============================] - 1s 24us/step - loss: 1.7966
- mean_squared_error: 1.7966
Epoch 200/400
48546/48546 [==============================] - 1s 24us/step - loss: 128.10
34 - mean_squared_error: 128.1034
Epoch 201/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0033
- mean_squared_error: 0.0033
Epoch 202/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.9863
- mean_squared_error: 0.9863
Epoch 203/400
48546/48546 [==============================] - 1s 25us/step - loss: 52.779
8 - mean_squared_error: 52.7798
```

```
Epoch 204/400
48546/48546 [==============================] - 1s 25us/step - loss: 281.85
74 - mean_squared_error: 281.8574
Epoch 205/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0020
- mean_squared_error: 0.0020
Epoch 206/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0021
- mean_squared_error: 0.0021
Epoch 207/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0322
- mean_squared_error: 0.0322
Epoch 208/400
48546/48546 [==============================] - 1s 23us/step - loss: 756.18
94 - mean_squared_error: 756.1894
Epoch 209/400
48546/48546 [==============================] - 1s 23us/step - loss: 136.02
92 - mean_squared_error: 136.0292
Epoch 210/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0027
- mean_squared_error: 0.0027
Epoch 211/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0022
- mean_squared_error: 0.0022
Epoch 212/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0026
- mean_squared_error: 0.0026
Epoch 213/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0017
- mean_squared_error: 0.0017
Epoch 214/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0183
- mean_squared_error: 0.0183
Epoch 215/400
48546/48546 [==============================] - 1s 23us/step - loss: 97.947
1 - mean_squared_error: 97.9471
Epoch 216/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0064
- mean_squared_error: 0.0064
Epoch 217/400
48546/48546 [==============================] - 1s 23us/step - loss: 385.12
28 - mean_squared_error: 385.1228
Epoch 218/400
48546/48546 [==============================] - 1s 23us/step - loss: 12.714
2 - mean_squared_error: 12.7142
Epoch 219/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0013
- mean_squared_error: 0.0013
Epoch 220/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0015
- mean_squared_error: 0.0015
Epoch 221/400
48546/48546 [==============================] - 1s 23us/step - loss: 0.0036
- mean_squared_error: 0.0036
Epoch 222/400
48546/48546 [==============================] - 1s 25us/step - loss: 93.637
1 - mean_squared_error: 93.6371
Epoch 223/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.0028
- mean_squared_error: 0.0028
Epoch 224/400
```

```
48546/48546 [==============================] - 1s 29us/step - loss: 198.67
59 - mean_squared_error: 198.6759
Epoch 225/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0024
- mean_squared_error: 0.0024
Epoch 226/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0014
- mean_squared_error: 0.0014
Epoch 227/400
48546/48546 [==============================] - 1s 25us/step - loss: 182.82
79 - mean_squared_error: 182.8279
Epoch 228/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.0127
- mean_squared_error: 0.0127
Epoch 229/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.0038
- mean_squared_error: 0.0038
Epoch 230/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0165
- mean_squared_error: 0.0165
Epoch 231/400
48546/48546 [==============================] - 1s 26us/step - loss: 114.99
85 - mean_squared_error: 114.9985
Epoch 232/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.0450
- mean_squared_error: 0.0450
Epoch 233/400
48546/48546 [==============================] - 1s 26us/step - loss: 339.13
11 - mean_squared_error: 339.1311
Epoch 234/400
48546/48546 [==============================] - 1s 28us/step - loss: 0.0225
- mean_squared_error: 0.0225
Epoch 235/400
48546/48546 [==============================] - ETA: 0s - loss: 8.4247e-04
- mean_squared_error: 8.4247e- - 1s 25us/step - loss: 8.3707e-04 - mean_sq
uared_error: 8.3707e-04
Epoch 236/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0012
- mean_squared_error: 0.0012
Epoch 237/400
48546/48546 [==============================] - 1s 26us/step - loss: 1.8799
- mean_squared_error: 1.8799
Epoch 238/400
48546/48546 [==============================] - 1s 28us/step - loss: 72.717
8 - mean_squared_error: 72.7178
Epoch 239/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.0377
- mean_squared_error: 0.0377
Epoch 240/400
48546/48546 [==============================] - 1s 30us/step - loss: 158.36
71 - mean_squared_error: 158.3671
Epoch 241/400
48546/48546 [==============================] - 2s 38us/step - loss: 9.5869
e-04 - mean_squared_error: 9.5869e-04
Epoch 242/400
48546/48546 [==============================] - 1s 29us/step - loss: 0.0141
- mean_squared_error: 0.0141
Epoch 243/400
48546/48546 [==============================] - ETA: 0s - loss: 241.4393 -
mean_squared_error: 241.43 - 1s 25us/step - loss: 236.1776 - mean_squared_
error: 236.1776
```

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Epoch 244/400
48546/48546 [==============================] - 1s 25us/step - loss: 5.6685
e-04 - mean_squared_error: 5.6685e-04
Epoch 245/400
48546/48546 [==============================] - 1s 25us/step - loss: 9.1781
e-04 - mean_squared_error: 9.1781e-04
Epoch 246/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0065
- mean_squared_error: 0.0065
Epoch 247/400
48546/48546 [==============================] - 1s 30us/step - loss: 32.130
8 - mean_squared_error: 32.1308
Epoch 248/400
48546/48546 [==============================] - 1s 25us/step - loss: 96.388
4 - mean_squared_error: 96.3884
Epoch 249/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.0225
- mean_squared_error: 0.0225
Epoch 250/400
48546/48546 [==============================] - 1s 24us/step - loss: 10.591
0 - mean_squared_error: 10.5910
Epoch 251/400
48546/48546 [==============================] - 1s 26us/step - loss: 141.06
66 - mean_squared_error: 141.0666
Epoch 252/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.0021
- mean_squared_error: 0.0021
Epoch 253/400
48546/48546 [==============================] - 1s 24us/step - loss: 9.9969
- mean_squared_error: 9.9969
Epoch 254/400
48546/48546 [==============================] - 1s 24us/step - loss: 45.110
6 - mean_squared_error: 45.1106
Epoch 255/400
48546/48546 [==============================] - 1s 24us/step - loss: 300.16
83 - mean_squared_error: 300.1683
Epoch 256/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0277
- mean_squared_error: 0.0277
Epoch 257/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0013
- mean_squared_error: 0.0013
Epoch 258/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0030
- mean_squared_error: 0.0030
Epoch 259/400
48546/48546 [==============================] - 1s 25us/step - loss: 107.30
68 - mean_squared_error: 107.3068
Epoch 260/400
48546/48546 [==============================] - 1s 25us/step - loss: 1.1877
- mean_squared_error: 1.1877
Epoch 261/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.1240
- mean_squared_error: 0.1240
Epoch 262/400
48546/48546 [==============================] - 1s 24us/step - loss: 42.470
1 - mean_squared_error: 42.4701
Epoch 263/400
48546/48546 [==============================] - 1s 24us/step - loss: 100.01
43 - mean_squared_error: 100.0143
Epoch 264/400
```

```
48546/48546 [==============================] - 1s 26us/step - loss: 0.0924
- mean_squared_error: 0.0924
Epoch 265/400
48546/48546 [==============================] - 1s 24us/step - loss: 149.29
10 - mean_squared_error: 149.2910
Epoch 266/400
48546/48546 [==============================] - 1s 25us/step - loss: 2.9806
- mean_squared_error: 2.9806
Epoch 267/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0040
- mean_squared_error: 0.0040
Epoch 268/400
48546/48546 [==============================] - 1s 24us/step - loss: 4.6653
- mean_squared_error: 4.6653
Epoch 269/400
48546/48546 [==============================] - 1s 31us/step - loss: 56.671
2 - mean_squared_error: 56.6712
Epoch 270/400
48546/48546 [==============================] - 2s 32us/step - loss: 45.148
3 - mean_squared_error: 45.1483
Epoch 271/400
48546/48546 [==============================] - 2s 32us/step - loss: 18.660
7 - mean_squared_error: 18.6607
Epoch 272/400
48546/48546 [==============================] - 1s 30us/step - loss: 103.63
07 - mean_squared_error: 103.6307
Epoch 273/400
48546/48546 [==============================] - 1s 27us/step - loss: 17.603
9 - mean_squared_error: 17.6039
Epoch 274/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.1856
- mean_squared_error: 0.1856
Epoch 275/400
48546/48546 [==============================] - 1s 28us/step - loss: 88.721
3 - mean_squared_error: 88.7213
Epoch 276/400
48546/48546 [==============================] - 1s 27us/step - loss: 0.0267
- mean_squared_error: 0.0267
Epoch 277/400
48546/48546 [==============================] - 2s 34us/step - loss: 190.88
42 - mean_squared_error: 190.8842
Epoch 278/400
48546/48546 [==============================] - 1s 25us/step - loss: 6.2893
- mean_squared_error: 6.2893
Epoch 279/400
48546/48546 [==============================] - 1s 30us/step - loss: 0.0028
- mean_squared_error: 0.0028
Epoch 280/400
48546/48546 [==============================] - 1s 28us/step - loss: 0.0042
- mean_squared_error: 0.0042
Epoch 281/400
48546/48546 [==============================] - 1s 25us/step - loss: 130.20
85 - mean_squared_error: 130.2085
Epoch 282/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0021
- mean_squared_error: 0.0021
Epoch 283/400
48546/48546 [==============================] - 1s 29us/step - loss: 0.1676
- mean_squared_error: 0.1676
Epoch 284/400
48546/48546 [==============================] - 1s 26us/step - loss: 640.51
```

```
74 - mean_squared_error: 640.5174
Epoch 285/400
48546/48546 [==============================] - 1s 27us/step - loss: 0.0024
- mean_squared_error: 0.0024
Epoch 286/400
48546/48546 [==============================] - 2s 37us/step - loss: 0.0017
- mean_squared_error: 0.0017
Epoch 287/400
48546/48546 [==============================] - 2s 32us/step - loss: 0.0016
- mean_squared_error: 0.0016
Epoch 288/400
48546/48546 [==============================] - 2s 32us/step - loss: 0.0024
- mean_squared_error: 0.0024 1s - l
Epoch 289/400
48546/48546 [==============================] - 1s 27us/step - loss: 0.0027
- mean_squared_error: 0.0027
Epoch 290/400
48546/48546 [==============================] - 1s 26us/step - loss: 30.601
5 - mean_squared_error: 30.6015
Epoch 291/400
48546/48546 [==============================] - 1s 25us/step - loss: 7.1580
- mean_squared_error: 7.1580
Epoch 292/400
48546/48546 [==============================] - 1s 25us/step - loss: 185.55
46 - mean_squared_error: 185.5546
Epoch 293/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.0046
- mean_squared_error: 0.0046
Epoch 294/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.0356
- mean_squared_error: 0.0356
Epoch 295/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.3462
- mean_squared_error: 0.3462
Epoch 296/400
48546/48546 [==============================] - 1s 25us/step - loss: 218.97
85 - mean_squared_error: 218.9785
Epoch 297/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.0046
- mean_squared_error: 0.0046
Epoch 298/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0078
- mean_squared_error: 0.0078
Epoch 299/400
48546/48546 [==============================] - 1s 24us/step - loss: 22.169
9 - mean_squared_error: 22.1699
Epoch 300/400
48546/48546 [==============================] - 1s 25us/step - loss: 36.727
7 - mean_squared_error: 36.7277
Epoch 301/400
48546/48546 [==============================] - 1s 25us/step - loss: 26.742
7 - mean_squared_error: 26.7427
Epoch 302/400
48546/48546 [==============================] - 1s 25us/step - loss: 39.825
6 - mean_squared_error: 39.8256
Epoch 303/400
48546/48546 [==============================] - 1s 25us/step - loss: 2.3291
- mean_squared_error: 2.3291
Epoch 304/400
48546/48546 [==============================] - 1s 25us/step - loss: 62.820
1 - mean_squared_error: 62.8201
```

```
Epoch 305/400
48546/48546 [==============================] - 1s 29us/step - loss: 85.728
0 - mean_squared_error: 85.7280
Epoch 306/400
48546/48546 [==============================] - 1s 27us/step - loss: 39.009
2 - mean_squared_error: 39.0092
Epoch 307/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0087
- mean_squared_error: 0.0087
Epoch 308/400
48546/48546 [==============================] - 1s 25us/step - loss: 66.330
7 - mean_squared_error: 66.3307
Epoch 309/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.1275
- mean_squared_error: 0.1275
Epoch 310/400
48546/48546 [==============================] - 1s 26us/step - loss: 119.41
76 - mean_squared_error: 119.4176
Epoch 311/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.6269
- mean_squared_error: 0.6269
Epoch 312/400
48546/48546 [==============================] - 1s 29us/step - loss: 0.0072
- mean_squared_error: 0.0072
Epoch 313/400
48546/48546 [==============================] - 1s 30us/step - loss: 183.36
74 - mean_squared_error: 183.3674
Epoch 314/400
48546/48546 [==============================] - 2s 42us/step - loss: 0.8527
- mean_squared_error: 0.8527
Epoch 315/400
48546/48546 [==============================] - 2s 35us/step - loss: 0.0041
- mean_squared_error: 0.0041
Epoch 316/400
48546/48546 [==============================] - 2s 31us/step - loss: 0.0035
- mean_squared_error: 0.0035
Epoch 317/400
48546/48546 [==============================] - 2s 35us/step - loss: 36.290
9 - mean_squared_error: 36.2909
Epoch 318/400
48546/48546 [==============================] - 2s 35us/step - loss: 27.612
3 - mean_squared_error: 27.6123
Epoch 319/400
48546/48546 [==============================] - 1s 28us/step - loss: 181.02
74 - mean_squared_error: 181.0274
Epoch 320/400
48546/48546 [==============================] - 1s 29us/step - loss: 0.0016
- mean_squared_error: 0.0016
Epoch 321/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0043
- mean_squared_error: 0.0043
Epoch 322/400
48546/48546 [==============================] - 1s 28us/step - loss: 226.72
63 - mean_squared_error: 226.7263
Epoch 323/400
48546/48546 [==============================] - 1s 29us/step - loss: 0.0157
- mean_squared_error: 0.0157
Epoch 324/400
48546/48546 [==============================] - 2s 37us/step - loss: 0.0012
- mean_squared_error: 0.0012
Epoch 325/400
```

```
48546/48546 [==============================] - 1s 25us/step - loss: 0.0029
- mean_squared_error: 0.0029
Epoch 326/400
48546/48546 [==============================] - 1s 29us/step - loss: 0.0643
- mean_squared_error: 0.0643
Epoch 327/400
48546/48546 [==============================] - 1s 29us/step - loss: 194.62
98 - mean_squared_error: 194.6298
Epoch 328/400
48546/48546 [==============================] - 1s 30us/step - loss: 6.9672
e-04 - mean_squared_error: 6.9672e-04
Epoch 329/400
48546/48546 [==============================] - 1s 31us/step - loss: 0.0019
- mean_squared_error: 0.0019
Epoch 330/400
48546/48546 [==============================] - 1s 30us/step - loss: 38.179
8 - mean_squared_error: 38.1798
Epoch 331/400
48546/48546 [==============================] - 1s 31us/step - loss: 26.778
4 - mean_squared_error: 26.7784
Epoch 332/400
48546/48546 [==============================] - 1s 29us/step - loss: 32.910
6 - mean_squared_error: 32.9106
Epoch 333/400
48546/48546 [==============================] - 1s 28us/step - loss: 2.8765
- mean_squared_error: 2.8765
Epoch 334/400
48546/48546 [==============================] - 1s 30us/step - loss: 103.72
13 - mean_squared_error: 103.7213
Epoch 335/400
48546/48546 [==============================] - 1s 30us/step - loss: 0.0058
- mean_squared_error: 0.0058
Epoch 336/400
48546/48546 [==============================] - 1s 29us/step - loss: 29.636
5 - mean_squared_error: 29.6365
Epoch 337/400
48546/48546 [==============================] - 1s 27us/step - loss: 22.533
7 - mean_squared_error: 22.5337
Epoch 338/400
48546/48546 [==============================] - 1s 28us/step - loss: 220.73
63 - mean_squared_error: 220.7363
Epoch 339/400
48546/48546 [==============================] - 1s 29us/step - loss: 0.0026
- mean_squared_error: 0.0026
Epoch 340/400
48546/48546 [==============================] - 1s 29us/step - loss: 0.0020
- mean_squared_error: 0.0020
Epoch 341/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0023
- mean_squared_error: 0.0023
Epoch 342/400
48546/48546 [==============================] - 1s 24us/step - loss: 62.767
3 - mean_squared_error: 62.7673
Epoch 343/400
48546/48546 [==============================] - 1s 24us/step - loss: 33.577
0 - mean_squared_error: 33.5770
Epoch 344/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0183
- mean_squared_error: 0.0183
Epoch 345/400
48546/48546 [==============================] - 1s 25us/step - loss: 130.88
```

```
31 - mean_squared_error: 130.8831
Epoch 346/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0018
- mean_squared_error: 0.0018
Epoch 347/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0023
- mean_squared_error: 0.0023
Epoch 348/400
48546/48546 [==============================] - 1s 24us/step - loss: 124.41
47 - mean_squared_error: 124.4147
Epoch 349/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0019
- mean_squared_error: 0.0019
Epoch 350/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0268
- mean_squared_error: 0.0268
Epoch 351/400
48546/48546 [==============================] - 1s 24us/step - loss: 70.784
3 - mean_squared_error: 70.7843
Epoch 352/400
48546/48546 [==============================] - 1s 25us/step - loss: 2.5766
- mean_squared_error: 2.5766
Epoch 353/400
48546/48546 [==============================] - 1s 25us/step - loss: 13.938
2 - mean_squared_error: 13.9382
Epoch 354/400
48546/48546 [==============================] - 1s 25us/step - loss: 136.74
79 - mean_squared_error: 136.7479
Epoch 355/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0042
- mean_squared_error: 0.0042
Epoch 356/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0851
- mean_squared_error: 0.0851
Epoch 357/400
48546/48546 [==============================] - 1s 26us/step - loss: 473.07
68 - mean_squared_error: 473.0768
Epoch 358/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0014
- mean_squared_error: 0.0014
Epoch 359/400
48546/48546 [==============================] - 1s 25us/step - loss: 9.6885
e-04 - mean_squared_error: 9.6885e-04
Epoch 360/400
48546/48546 [==============================] - ETA: 0s - loss: 7.2687e-04
- mean_squared_error: 7.2687e- - 1s 25us/step - loss: 7.2394e-04 - mean_sq
uared_error: 7.2394e-04
Epoch 361/400
48546/48546 [==============================] - 1s 24us/step - loss: 6.7745
e-04 - mean_squared_error: 6.7745e-04
Epoch 362/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0031
- mean_squared_error: 0.0031
Epoch 363/400
48546/48546 [==============================] - 1s 24us/step - loss: 248.04
56 - mean_squared_error: 248.0456
Epoch 364/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.0252
- mean_squared_error: 0.0252
Epoch 365/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.0012
```

```
- mean_squared_error: 0.0012
Epoch 366/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0011
- mean_squared_error: 0.0011
Epoch 367/400
48546/48546 [==============================] - 1s 24us/step - loss: 30.082
7 - mean_squared_error: 30.0827
Epoch 368/400
48546/48546 [==============================] - 1s 25us/step - loss: 53.565
5 - mean_squared_error: 53.5655
Epoch 369/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0052
- mean_squared_error: 0.0052
Epoch 370/400
48546/48546 [==============================] - 1s 24us/step - loss: 19.047
4 - mean_squared_error: 19.0474
Epoch 371/400
48546/48546 [==============================] - 1s 24us/step - loss: 38.108
3 - mean_squared_error: 38.1083
Epoch 372/400
48546/48546 [==============================] - 1s 24us/step - loss: 66.465
4 - mean_squared_error: 66.4654
Epoch 373/400
48546/48546 [==============================] - 1s 25us/step - loss: 14.240
4 - mean_squared_error: 14.2404
Epoch 374/400
48546/48546 [==============================] - 1s 26us/step - loss: 0.8439
- mean_squared_error: 0.8439
Epoch 375/400
48546/48546 [==============================] - 1s 25us/step - loss: 46.059
5 - mean_squared_error: 46.0595
Epoch 376/400
48546/48546 [==============================] - 1s 27us/step - loss: 72.587
0 - mean_squared_error: 72.5870
Epoch 377/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0092
- mean_squared_error: 0.0092
Epoch 378/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.0028
- mean_squared_error: 0.0028
Epoch 379/400
48546/48546 [==============================] - 1s 28us/step - loss: 116.10
74 - mean_squared_error: 116.1074
Epoch 380/400
48546/48546 [==============================] - 1s 28us/step - loss: 0.0052
- mean_squared_error: 0.0052
Epoch 381/400
48546/48546 [==============================] - 1s 27us/step - loss: 4.4453
- mean_squared_error: 4.4453
Epoch 382/400
48546/48546 [==============================] - 1s 28us/step - loss: 48.704
7 - mean_squared_error: 48.7047
Epoch 383/400
48546/48546 [==============================] - 1s 28us/step - loss: 17.455
4 - mean_squared_error: 17.4554
Epoch 384/400
48546/48546 [==============================] - 1s 28us/step - loss: 235.89
87 - mean_squared_error: 235.8987
Epoch 385/400
48546/48546 [==============================] - 1s 28us/step - loss: 0.0124
- mean_squared_error: 0.0124
```

```
Epoch 386/400
48546/48546 [==============================] - 1s 29us/step - loss: 9.3536
e-04 - mean_squared_error: 9.3536e-04
Epoch 387/400
48546/48546 [==============================] - 1s 29us/step - loss: 0.0041
- mean_squared_error: 0.0041
Epoch 388/400
48546/48546 [==============================] - 1s 29us/step - loss: 3.1611
- mean_squared_error: 3.1611 0s - loss: 1.7938 - mean
Epoch 389/400
48546/48546 [==============================] - 1s 27us/step - loss: 70.790
1 - mean_squared_error: 70.7901
Epoch 390/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.3529
- mean_squared_error: 0.3529
Epoch 391/400
48546/48546 [==============================] - 1s 25us/step - loss: 66.562
7 - mean_squared_error: 66.5627
Epoch 392/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.1179
- mean_squared_error: 0.1179
Epoch 393/400
48546/48546 [==============================] - 1s 25us/step - loss: 50.666
2 - mean_squared_error: 50.6662
Epoch 394/400
48546/48546 [==============================] - 1s 24us/step - loss: 0.5648
- mean_squared_error: 0.5648
Epoch 395/400
48546/48546 [==============================] - 1s 24us/step - loss: 35.385
2 - mean_squared_error: 35.3852
Epoch 396/400
48546/48546 [==============================] - 1s 25us/step - loss: 4.7387
- mean_squared_error: 4.7387
Epoch 397/400
48546/48546 [==============================] - 1s 24us/step - loss: 71.112
3 - mean_squared_error: 71.1123
Epoch 398/400
48546/48546 [==============================] - 1s 25us/step - loss: 0.1701
- mean_squared_error: 0.1701
Epoch 399/400
48546/48546 [==============================] - 1s 26us/step - loss: 50.931
2 - mean_squared_error: 50.9312
Epoch 400/400
48546/48546 [==============================] - 1s 25us/step - loss: 21.791
1 - mean_squared_error: 21.7911
```

Out[12]:

```
<tensorflow.python.keras.callbacks.History at 0x249adfab518>
```

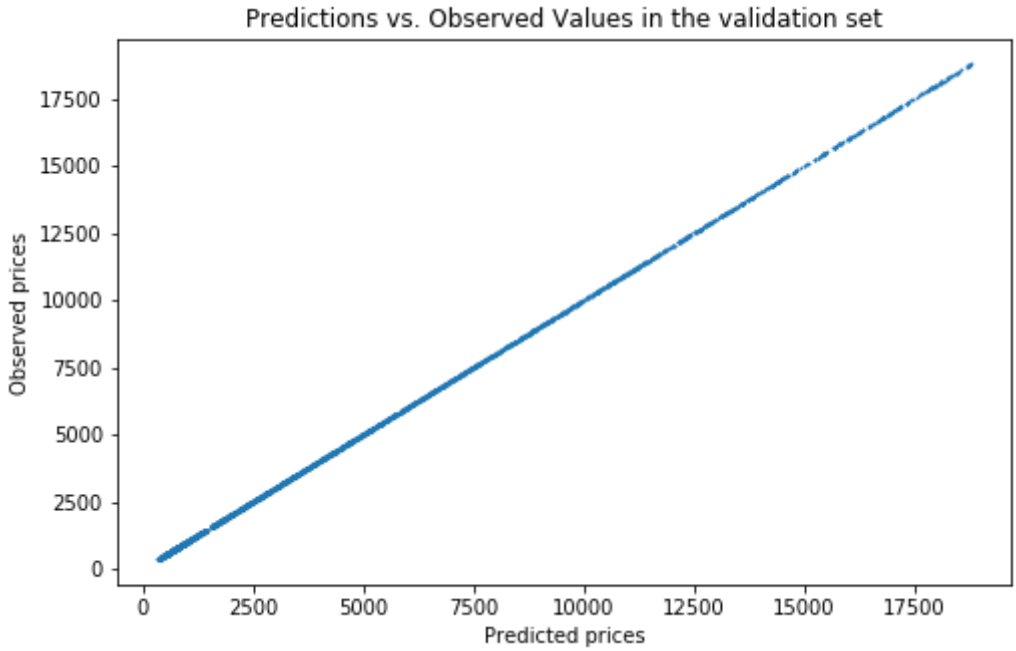
6. Visualize/analyze the results of the model

In [13]:

```
## Getting the predictions from the model
predictions = model.predict(X_test).flatten()
```

In [14]:

```
fig, ax = plt.subplots(figsize=(8,5))
ax.scatter(x=predictions, y=y_test, s=0.5)
ax.set_xlabel('Predicted prices')
ax.set_ylabel('Observed prices')
ax.set_title("Predictions vs. Observed Values in the validation set");
```



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