linear_regression_with_synthetic_data

August 19, 2021

[10]:
```
from jupyterthemes import jtplot
jtplot.style()
```

[1]:
```
#@title Copyright 2020 Google LLC. Double-click here for license information.
# Licensed under the Apache License, Version 2.0 (the "License");
# you may not use this file except in compliance with the License.
# You may obtain a copy of the License at
#
# https://www.apache.org/licenses/LICENSE-2.0
#
# Unless required by applicable law or agreed to in writing, software
# distributed under the License is distributed on an "AS IS" BASIS,
# WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
# See the License for the specific language governing permissions and
# limitations under the License.
```

1 Simple Linear Regression with Synthetic Data

In this first Colab, you'll explore linear regression with a simple database.

1.1 Learning objectives:

After doing this exercise, you'll know how to do the following:

- Run Colabs.
- Tune the following hyperparameters:
  - learning rate
  - number of epochs
  - batch size
- Interpret different kinds of loss curves.

1.2 About Colabs

Machine Learning Crash Course uses Colaboratories (**Colabs**) for all programming exercises. Colab is Google's implementation of Jupyter Notebook. Like all Jupyter Notebooks, a Colab consists of two kinds of components:

- **Text cells**, which contain explanations. You are currently reading a text cell.

- **Code cells**, which contain Python code for you to run. Code cells have a light gray background.

You *read* the text cells and *run* the code cells.

1.2.1 Running code cells

You must run code cells in order. In other words, you may only run a code cell once all the code cells preceding it have already been run.

To run a code cell:

1. Place the cursor anywhere inside the [ ] area at the top left of a code cell. The area inside the [ ] will display an arrow.
2. Click the arrow.

Alternatively, you may invoke **Runtime->Run all**. Note, though, that some of the code cells will fail because not all the coding is complete. (You'll complete the coding as part of the exercise.)

1.2.2 Understanding hidden code cells

We've **hidden** the code in code cells that don't advance the learning objectives. For example, we've hidden the code that plots graphs. However, **you must still run code cells containing hidden code**. You'll know that the code is hidden because you'll see a title (for example, "Load the functions that build and train a model") without seeing the code.

To view the hidden code, just double click the header.

1.2.3 Why did you see an error?

If a code cell returns an error when you run it, consider two common problems:

- You didn't run *all* of the code cells preceding the current code cell.
- If the code cell is labeled as a **Task**, then you haven't written the necessary code.

1.3 Use the right version of TensorFlow

The following hidden code cell ensures that the Colab will run on TensorFlow 2.X, which is the most recent version of TensorFlow:

[2]:
```
#@title Run this Colab on TensorFlow 2.x
# %tensorflow_version 2.x
```

1.4 Import relevant modules

The following cell imports the packages that the program requires:

[3]:
```
import pandas as pd
import tensorflow as tf
from matplotlib import pyplot as plt
```

1.5 Define functions that build and train a model

The following code defines two functions:

- `build_model(my_learning_rate)`, which builds an empty model.
- `train_model(model, feature, label, epochs)`, which trains the model from the examples (feature and label) you pass.

Since you don't need to understand model building code right now, we've hidden this code cell. You may optionally double-click the headline to explore this code.

[4]:
```
#@title Define the functions that build and train a model
def build_model(my_learning_rate):
  """Create and compile a simple linear regression model."""
  # Most simple tf.keras models are sequential.
  # A sequential model contains one or more layers.
  model = tf.keras.models.Sequential()

  # Describe the topography of the model.
  # The topography of a simple linear regression model
  # is a single node in a single layer.
  model.add(tf.keras.layers.Dense(units=1,
                                  input_shape=(1,)))

  # Compile the model topography into code that
  # TensorFlow can efficiently execute. Configure
  # training to minimize the model's mean squared error.
  model.compile(optimizer=tf.keras.optimizers.
 ↪RMSprop(learning_rate=my_learning_rate),
                loss="mean_squared_error",
                metrics=[tf.keras.metrics.RootMeanSquaredError()])

  return model


def train_model(model, feature, label, epochs, batch_size):
  """Train the model by feeding it data."""

  # Feed the feature values and the label values to the
  # model. The model will train for the specified number
  # of epochs, gradually learning how the feature values
  # relate to the label values.
  history = model.fit(x=feature,
                      y=label,
                      batch_size=None,
                      epochs=epochs)

  # Gather the trained model's weight and bias.
  trained_weight = model.get_weights()[0]
```

```
  trained_bias = model.get_weights()[1]

  # The list of epochs is stored separately from the
  # rest of history.
  epochs = history.epoch

  # Gather the history (a snapshot) of each epoch.
  hist = pd.DataFrame(history.history)

  # Specifically gather the model's root mean
  #squared error at each epoch.
  rmse = hist["root_mean_squared_error"]

  return trained_weight, trained_bias, epochs, rmse

print("Defined create_model and train_model")
```

```
Defined create_model and train_model
```

1.6 Define plotting functions

We're using a popular Python library called Matplotlib to create the following two plots:

- a plot of the feature values vs. the label values, and a line showing the output of the trained model.
- a loss curve.

We hid the following code cell because learning Matplotlib is not relevant to the learning objectives. Regardless, you must still run all hidden code cells.

[5]:
```
#@title Define the plotting functions
def plot_the_model(trained_weight, trained_bias, feature, label):
  """Plot the trained model against the training feature and label."""

  # Label the axes.
  plt.xlabel("feature")
  plt.ylabel("label")

  # Plot the feature values vs. label values.
  plt.scatter(feature, label)

  # Create a red line representing the model. The red line starts
  # at coordinates (x0, y0) and ends at coordinates (x1, y1).
  x0 = 0
  y0 = trained_bias
  x1 = my_feature[-1]
  y1 = trained_bias + (trained_weight * x1)
  plt.plot([x0, x1], [y0, y1], c='r')
```

```
  # Render the scatter plot and the red line.
  plt.show()

def plot_the_loss_curve(epochs, rmse):
  """Plot the loss curve, which shows loss vs. epoch."""

  plt.figure()
  plt.xlabel("Epoch")
  plt.ylabel("Root Mean Squared Error")

  plt.plot(epochs, rmse, label="Loss")
  plt.legend()
  plt.ylim([rmse.min()*0.97, rmse.max()])
  plt.show()

print("Defined the plot_the_model and plot_the_loss_curve functions.")
```

```
Defined the plot_the_model and plot_the_loss_curve functions.
```

1.7 Define the dataset

The dataset consists of 12 examples. Each example consists of one feature and one label.

[6]:
```
my_feature = ([1.0, 2.0,  3.0,  4.0,  5.0,  6.0,  7.0,  8.0,  9.0, 10.0, 11.0,␣
 ↪12.0])
my_label   = ([5.0, 8.8,  9.6, 14.2, 18.8, 19.5, 21.4, 26.8, 28.9, 32.0, 33.8,␣
 ↪38.2])
```

1.8 Specify the hyperparameters

The hyperparameters in this Colab are as follows:

- learning rate
- epochs
- batch_size

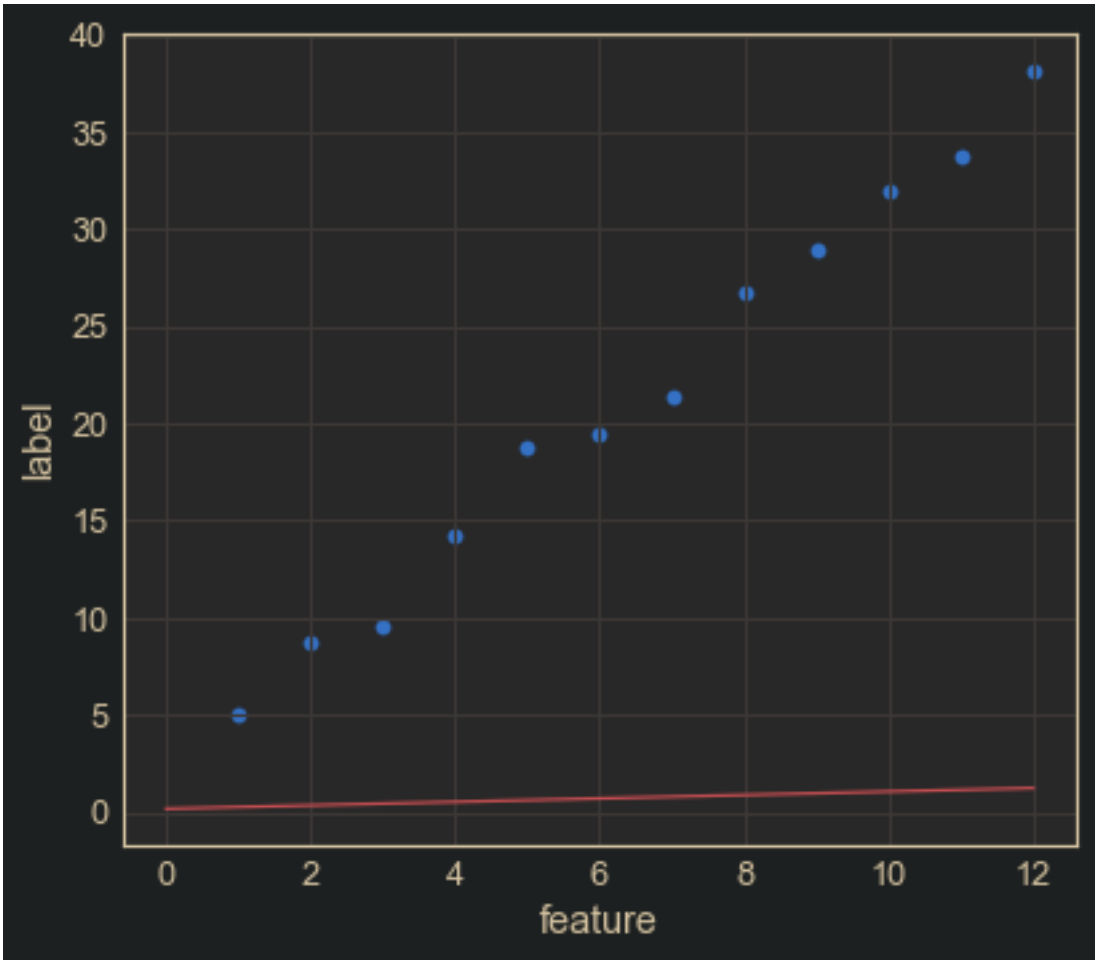
The following code cell initializes these hyperparameters and then invokes the functions that build and train the model.

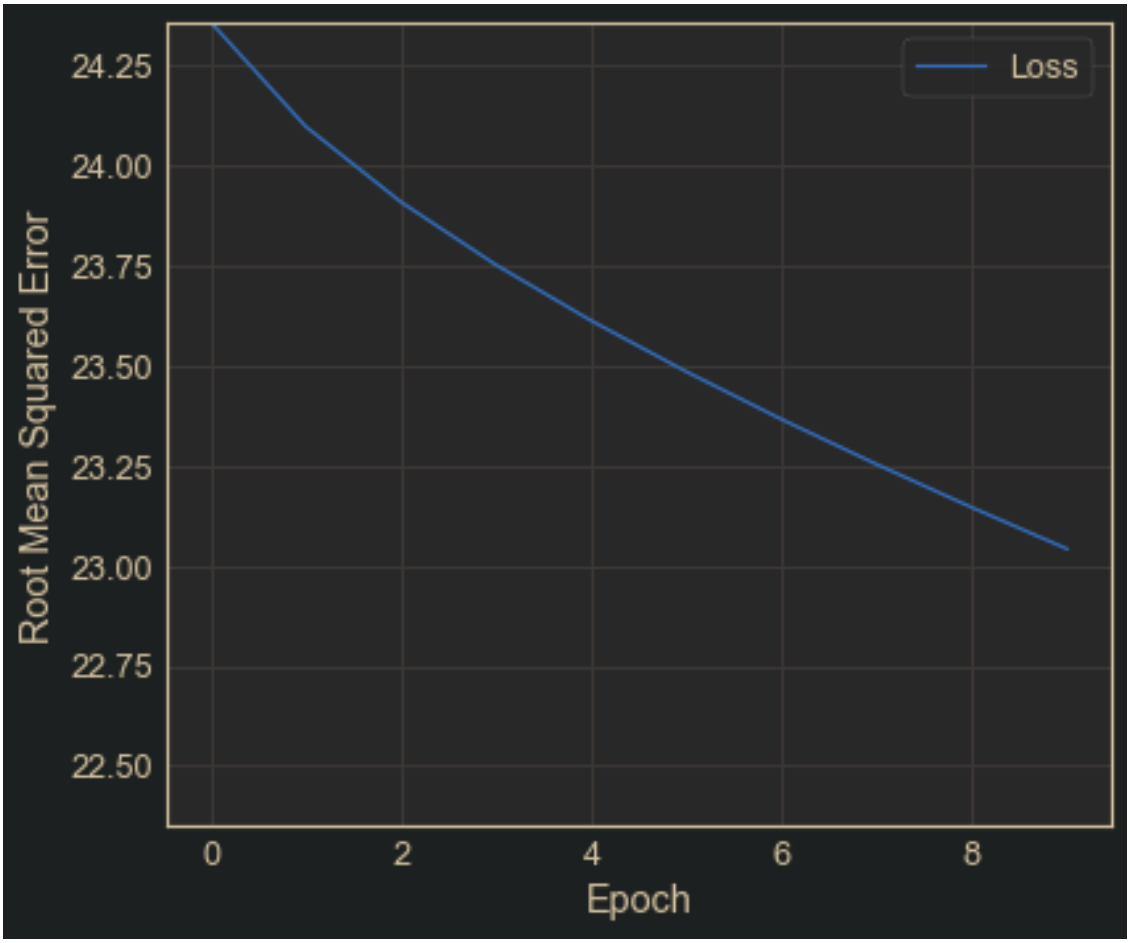
[11]:
```
learning_rate=0.01
epochs=10
my_batch_size=12

my_model = build_model(learning_rate)
trained_weight, trained_bias, epochs, rmse = train_model(my_model, my_feature,
                                                         my_label, epochs,
                                                         my_batch_size)
plot_the_model(trained_weight, trained_bias, my_feature, my_label)
plot_the_loss_curve(epochs, rmse)
```

```
Epoch 1/10
1/1 [==============================] - 0s 222ms/step - loss: 593.2425 -
root_mean_squared_error: 24.3566
Epoch 2/10
1/1 [==============================] - 0s 3ms/step - loss: 580.6030 -
root_mean_squared_error: 24.0957
Epoch 3/10
1/1 [==============================] - 0s 3ms/step - loss: 571.5651 -
root_mean_squared_error: 23.9074
Epoch 4/10
1/1 [==============================] - 0s 4ms/step - loss: 564.0753 -
root_mean_squared_error: 23.7503
Epoch 5/10
1/1 [==============================] - 0s 4ms/step - loss: 557.4833 -
root_mean_squared_error: 23.6111
Epoch 6/10
1/1 [==============================] - 0s 3ms/step - loss: 551.4881 -
root_mean_squared_error: 23.4838
Epoch 7/10
1/1 [==============================] - 0s 3ms/step - loss: 545.9219 -
root_mean_squared_error: 23.3650
Epoch 8/10
1/1 [==============================] - 0s 3ms/step - loss: 540.6804 -
root_mean_squared_error: 23.2525
Epoch 9/10
1/1 [==============================] - 0s 3ms/step - loss: 535.6942 -
root_mean_squared_error: 23.1451
Epoch 10/10
1/1 [==============================] - 0s 3ms/step - loss: 530.9139 -
root_mean_squared_error: 23.0416

C:\Users\Arunabh\anaconda3\envs\mlcc\lib\site-
packages\numpy\core\_asarray.py:136: VisibleDeprecationWarning: Creating an
ndarray from ragged nested sequences (which is a list-or-tuple of lists-or-
tuples-or ndarrays with different lengths or shapes) is deprecated. If you meant
to do this, you must specify 'dtype=object' when creating the ndarray
  return array(a, dtype, copy=False, order=order, subok=True)
```


40
35
30
25
20
15
10
5
0
label
0
2
4
6
8
10
12
feature



1.9 Task 1: Examine the graphs

Examine the top graph. The blue dots identify the actual data; the red line identifies the output of the trained model. Ideally, the red line should align nicely with the blue dots. Does it? Probably not.

A certain amount of randomness plays into training a model, so you'll get somewhat different results every time you train. That said, unless you are an extremely lucky person, the red line probably *doesn't* align nicely with the blue dots.

Examine the bottom graph, which shows the loss curve. Notice that the loss curve decreases but doesn't flatten out, which is a sign that the model hasn't trained sufficiently.

1.10 Task 2: Increase the number of epochs

Training loss should steadily decrease, steeply at first, and then more slowly. Eventually, training loss should eventually stay steady (zero slope or nearly zero slope), which indicates that training has converged.

In Task 1, the training loss did not converge. One possible solution is to train for more epochs.

Your task is to increase the number of epochs sufficiently to get the model to converge. However, it is inefficient to train past convergence, so don't just set the number of epochs to an arbitrarily high value.

Examine the loss curve. Does the model converge?

[13]:
```
learning_rate=0.01
epochs= 200   # Replace ? with an integer.
my_batch_size=12

my_model = build_model(learning_rate)
trained_weight, trained_bias, epochs, rmse = train_model(my_model, my_feature,
                                                         my_label, epochs,
                                                         my_batch_size)
plot_the_model(trained_weight, trained_bias, my_feature, my_label)
plot_the_loss_curve(epochs, rmse)
```

```
Epoch 1/200
1/1 [==============================] - 0s 224ms/step - loss: 146.9996 -
root_mean_squared_error: 12.1243
Epoch 2/200
1/1 [==============================] - 0s 4ms/step - loss: 140.7581 -
root_mean_squared_error: 11.8642
Epoch 3/200
1/1 [==============================] - 0s 4ms/step - loss: 136.3612 -
root_mean_squared_error: 11.6774
Epoch 4/200
1/1 [==============================] - 0s 3ms/step - loss: 132.7566 -
root_mean_squared_error: 11.5220
Epoch 5/200
1/1 [==============================] - 0s 4ms/step - loss: 129.6127 -
root_mean_squared_error: 11.3848
Epoch 6/200
1/1 [==============================] - 0s 4ms/step - loss: 126.7765 -
root_mean_squared_error: 11.2595
Epoch 7/200
1/1 [==============================] - 0s 4ms/step - loss: 124.1626 -
root_mean_squared_error: 11.1428
Epoch 8/200
1/1 [==============================] - 0s 3ms/step - loss: 121.7184 -
root_mean_squared_error: 11.0326
Epoch 9/200
1/1 [==============================] - 0s 3ms/step - loss: 119.4085 -
root_mean_squared_error: 10.9274
Epoch 10/200
1/1 [==============================] - 0s 3ms/step - loss: 117.2082 -
root_mean_squared_error: 10.8263
Epoch 11/200
1/1 [==============================] - 0s 3ms/step - loss: 115.0990 -
```

```
root_mean_squared_error: 10.7284
Epoch 12/200
1/1 [==============================] - 0s 3ms/step - loss: 113.0673 -
root_mean_squared_error: 10.6333
Epoch 13/200
1/1 [==============================] - 0s 4ms/step - loss: 111.1023 -
root_mean_squared_error: 10.5405
Epoch 14/200
1/1 [==============================] - 0s 4ms/step - loss: 109.1956 -
root_mean_squared_error: 10.4497
Epoch 15/200
1/1 [==============================] - 0s 4ms/step - loss: 107.3403 -
root_mean_squared_error: 10.3605
Epoch 16/200
1/1 [==============================] - 0s 3ms/step - loss: 105.5308 -
root_mean_squared_error: 10.2728
Epoch 17/200
1/1 [==============================] - 0s 3ms/step - loss: 103.7626 -
root_mean_squared_error: 10.1864
Epoch 18/200
1/1 [==============================] - 0s 3ms/step - loss: 102.0319 -
root_mean_squared_error: 10.1011
Epoch 19/200
1/1 [==============================] - 0s 4ms/step - loss: 100.3353 -
root_mean_squared_error: 10.0168
Epoch 20/200
1/1 [==============================] - 0s 4ms/step - loss: 98.6702 -
root_mean_squared_error: 9.9333
Epoch 21/200
1/1 [==============================] - 0s 4ms/step - loss: 97.0342 -
root_mean_squared_error: 9.8506
Epoch 22/200
1/1 [==============================] - 0s 4ms/step - loss: 95.4254 -
root_mean_squared_error: 9.7686
Epoch 23/200
1/1 [==============================] - 0s 3ms/step - loss: 93.8419 -
root_mean_squared_error: 9.6872
Epoch 24/200
1/1 [==============================] - 0s 3ms/step - loss: 92.2823 -
root_mean_squared_error: 9.6064
Epoch 25/200
1/1 [==============================] - 0s 3ms/step - loss: 90.7452 -
root_mean_squared_error: 9.5260
Epoch 26/200
1/1 [==============================] - 0s 4ms/step - loss: 89.2296 -
root_mean_squared_error: 9.4461
Epoch 27/200
1/1 [==============================] - 0s 4ms/step - loss: 87.7344 -
```

```
root_mean_squared_error: 9.3667
Epoch 28/200
1/1 [==============================] - 0s 3ms/step - loss: 86.2587 -
root_mean_squared_error: 9.2876
Epoch 29/200
1/1 [==============================] - 0s 3ms/step - loss: 84.8018 -
root_mean_squared_error: 9.2088
Epoch 30/200
1/1 [==============================] - 0s 3ms/step - loss: 83.3630 -
root_mean_squared_error: 9.1303
Epoch 31/200
1/1 [==============================] - 0s 3ms/step - loss: 81.9416 -
root_mean_squared_error: 9.0522
Epoch 32/200
1/1 [==============================] - 0s 3ms/step - loss: 80.5372 -
root_mean_squared_error: 8.9743
Epoch 33/200
1/1 [==============================] - 0s 3ms/step - loss: 79.1492 -
root_mean_squared_error: 8.8966
Epoch 34/200
1/1 [==============================] - 0s 4ms/step - loss: 77.7772 -
root_mean_squared_error: 8.8191
Epoch 35/200
1/1 [==============================] - 0s 3ms/step - loss: 76.4209 -
root_mean_squared_error: 8.7419
Epoch 36/200
1/1 [==============================] - 0s 3ms/step - loss: 75.0799 -
root_mean_squared_error: 8.6649
Epoch 37/200
1/1 [==============================] - 0s 4ms/step - loss: 73.7539 -
root_mean_squared_error: 8.5880
Epoch 38/200
1/1 [==============================] - 0s 4ms/step - loss: 72.4426 -
root_mean_squared_error: 8.5113
Epoch 39/200
1/1 [==============================] - 0s 4ms/step - loss: 71.1458 -
root_mean_squared_error: 8.4348
Epoch 40/200
1/1 [==============================] - 0s 3ms/step - loss: 69.8633 -
root_mean_squared_error: 8.3584
Epoch 41/200
1/1 [==============================] - 0s 3ms/step - loss: 68.5948 -
root_mean_squared_error: 8.2822
Epoch 42/200
1/1 [==============================] - 0s 3ms/step - loss: 67.3402 -
root_mean_squared_error: 8.2061
Epoch 43/200
1/1 [==============================] - 0s 3ms/step - loss: 66.0994 -
```

```
root_mean_squared_error: 8.1302
Epoch 44/200
1/1 [==============================] - 0s 3ms/step - loss: 64.8721 -
root_mean_squared_error: 8.0543
Epoch 45/200
1/1 [==============================] - 0s 3ms/step - loss: 63.6583 -
root_mean_squared_error: 7.9786
Epoch 46/200
1/1 [==============================] - 0s 3ms/step - loss: 62.4578 -
root_mean_squared_error: 7.9030
Epoch 47/200
1/1 [==============================] - 0s 3ms/step - loss: 61.2705 -
root_mean_squared_error: 7.8275
Epoch 48/200
1/1 [==============================] - 0s 4ms/step - loss: 60.0964 -
root_mean_squared_error: 7.7522
Epoch 49/200
1/1 [==============================] - 0s 3ms/step - loss: 58.9353 -
root_mean_squared_error: 7.6769
Epoch 50/200
1/1 [==============================] - 0s 3ms/step - loss: 57.7871 -
root_mean_squared_error: 7.6018
Epoch 51/200
1/1 [==============================] - 0s 3ms/step - loss: 56.6518 -
root_mean_squared_error: 7.5267
Epoch 52/200
1/1 [==============================] - 0s 3ms/step - loss: 55.5294 -
root_mean_squared_error: 7.4518
Epoch 53/200
1/1 [==============================] - 0s 3ms/step - loss: 54.4196 -
root_mean_squared_error: 7.3770
Epoch 54/200
1/1 [==============================] - 0s 3ms/step - loss: 53.3226 -
root_mean_squared_error: 7.3022
Epoch 55/200
1/1 [==============================] - 0s 3ms/step - loss: 52.2382 -
root_mean_squared_error: 7.2276
Epoch 56/200
1/1 [==============================] - 0s 3ms/step - loss: 51.1664 -
root_mean_squared_error: 7.1531
Epoch 57/200
1/1 [==============================] - 0s 3ms/step - loss: 50.1071 -
root_mean_squared_error: 7.0786
Epoch 58/200
1/1 [==============================] - 0s 3ms/step - loss: 49.0603 -
root_mean_squared_error: 7.0043
Epoch 59/200
1/1 [==============================] - 0s 4ms/step - loss: 48.0260 -
```

```
root_mean_squared_error: 6.9301
Epoch 60/200
1/1 [==============================] - 0s 3ms/step - loss: 47.0041 -
root_mean_squared_error: 6.8560
Epoch 61/200
1/1 [==============================] - 0s 4ms/step - loss: 45.9946 -
root_mean_squared_error: 6.7819
Epoch 62/200
1/1 [==============================] - 0s 4ms/step - loss: 44.9974 -
root_mean_squared_error: 6.7080
Epoch 63/200
1/1 [==============================] - 0s 4ms/step - loss: 44.0126 -
root_mean_squared_error: 6.6342
Epoch 64/200
1/1 [==============================] - 0s 3ms/step - loss: 43.0400 -
root_mean_squared_error: 6.5605
Epoch 65/200
1/1 [==============================] - 0s 3ms/step - loss: 42.0796 -
root_mean_squared_error: 6.4869
Epoch 66/200
1/1 [==============================] - 0s 3ms/step - loss: 41.1315 -
root_mean_squared_error: 6.4134
Epoch 67/200
1/1 [==============================] - 0s 3ms/step - loss: 40.1956 -
root_mean_squared_error: 6.3400
Epoch 68/200
1/1 [==============================] - 0s 3ms/step - loss: 39.2718 -
root_mean_squared_error: 6.2667
Epoch 69/200
1/1 [==============================] - 0s 3ms/step - loss: 38.3602 -
root_mean_squared_error: 6.1936
Epoch 70/200
1/1 [==============================] - 0s 3ms/step - loss: 37.4607 -
root_mean_squared_error: 6.1205
Epoch 71/200
1/1 [==============================] - 0s 3ms/step - loss: 36.5733 -
root_mean_squared_error: 6.0476
Epoch 72/200
1/1 [==============================] - 0s 4ms/step - loss: 35.6979 -
root_mean_squared_error: 5.9748
Epoch 73/200
1/1 [==============================] - 0s 4ms/step - loss: 34.8346 -
root_mean_squared_error: 5.9021
Epoch 74/200
1/1 [==============================] - 0s 4ms/step - loss: 33.9833 -
root_mean_squared_error: 5.8295
Epoch 75/200
1/1 [==============================] - 0s 4ms/step - loss: 33.1440 -
```

```
root_mean_squared_error: 5.7571
Epoch 76/200
1/1 [==============================] - 0s 4ms/step - loss: 32.3167 -
root_mean_squared_error: 5.6848
Epoch 77/200
1/1 [==============================] - 0s 4ms/step - loss: 31.5013 -
root_mean_squared_error: 5.6126
Epoch 78/200
1/1 [==============================] - 0s 4ms/step - loss: 30.6978 -
root_mean_squared_error: 5.5406
Epoch 79/200
1/1 [==============================] - 0s 3ms/step - loss: 29.9062 -
root_mean_squared_error: 5.4687
Epoch 80/200
1/1 [==============================] - 0s 3ms/step - loss: 29.1264 -
root_mean_squared_error: 5.3969
Epoch 81/200
1/1 [==============================] - 0s 3ms/step - loss: 28.3586 -
root_mean_squared_error: 5.3253
Epoch 82/200
1/1 [==============================] - 0s 3ms/step - loss: 27.6025 -
root_mean_squared_error: 5.2538
Epoch 83/200
1/1 [==============================] - 0s 3ms/step - loss: 26.8582 -
root_mean_squared_error: 5.1825
Epoch 84/200
1/1 [==============================] - 0s 4ms/step - loss: 26.1256 -
root_mean_squared_error: 5.1113
Epoch 85/200
1/1 [==============================] - 0s 4ms/step - loss: 25.4048 -
root_mean_squared_error: 5.0403
Epoch 86/200
1/1 [==============================] - 0s 3ms/step - loss: 24.6957 -
root_mean_squared_error: 4.9695
Epoch 87/200
1/1 [==============================] - 0s 3ms/step - loss: 23.9983 -
root_mean_squared_error: 4.8988
Epoch 88/200
1/1 [==============================] - 0s 3ms/step - loss: 23.3125 -
root_mean_squared_error: 4.8283
Epoch 89/200
1/1 [==============================] - 0s 3ms/step - loss: 22.6384 -
root_mean_squared_error: 4.7580
Epoch 90/200
1/1 [==============================] - 0s 4ms/step - loss: 21.9758 -
root_mean_squared_error: 4.6878
Epoch 91/200
1/1 [==============================] - 0s 4ms/step - loss: 21.3249 -
```

```
root_mean_squared_error: 4.6179
Epoch 92/200
1/1 [==============================] - 0s 3ms/step - loss: 20.6854 -
root_mean_squared_error: 4.5481
Epoch 93/200
1/1 [==============================] - 0s 4ms/step - loss: 20.0575 -
root_mean_squared_error: 4.4786
Epoch 94/200
1/1 [==============================] - 0s 3ms/step - loss: 19.4410 -
root_mean_squared_error: 4.4092
Epoch 95/200
1/1 [==============================] - 0s 4ms/step - loss: 18.8359 -
root_mean_squared_error: 4.3400
Epoch 96/200
1/1 [==============================] - 0s 3ms/step - loss: 18.2423 -
root_mean_squared_error: 4.2711
Epoch 97/200
1/1 [==============================] - 0s 3ms/step - loss: 17.6600 -
root_mean_squared_error: 4.2024
Epoch 98/200
1/1 [==============================] - 0s 3ms/step - loss: 17.0891 -
root_mean_squared_error: 4.1339
Epoch 99/200
1/1 [==============================] - 0s 3ms/step - loss: 16.5294 -
root_mean_squared_error: 4.0656
Epoch 100/200
1/1 [==============================] - 0s 3ms/step - loss: 15.9810 -
root_mean_squared_error: 3.9976
Epoch 101/200
1/1 [==============================] - 0s 4ms/step - loss: 15.4439 -
root_mean_squared_error: 3.9299
Epoch 102/200
1/1 [==============================] - 0s 3ms/step - loss: 14.9179 -
root_mean_squared_error: 3.8624
Epoch 103/200
1/1 [==============================] - 0s 4ms/step - loss: 14.4031 -
root_mean_squared_error: 3.7951
Epoch 104/200
1/1 [==============================] - 0s 3ms/step - loss: 13.8993 -
root_mean_squared_error: 3.7282
Epoch 105/200
1/1 [==============================] - 0s 3ms/step - loss: 13.4066 -
root_mean_squared_error: 3.6615
Epoch 106/200
1/1 [==============================] - 0s 3ms/step - loss: 12.9250 -
root_mean_squared_error: 3.5951
Epoch 107/200
1/1 [==============================] - 0s 4ms/step - loss: 12.4543 -
```

```
root_mean_squared_error: 3.5291
Epoch 108/200
1/1 [==============================] - 0s 4ms/step - loss: 11.9945 -
root_mean_squared_error: 3.4633
Epoch 109/200
1/1 [==============================] - 0s 4ms/step - loss: 11.5455 -
root_mean_squared_error: 3.3979
Epoch 110/200
1/1 [==============================] - 0s 4ms/step - loss: 11.1075 -
root_mean_squared_error: 3.3328
Epoch 111/200
1/1 [==============================] - 0s 3ms/step - loss: 10.6801 -
root_mean_squared_error: 3.2680
Epoch 112/200
1/1 [==============================] - 0s 3ms/step - loss: 10.2635 -
root_mean_squared_error: 3.2037
Epoch 113/200
1/1 [==============================] - 0s 3ms/step - loss: 9.8576 -
root_mean_squared_error: 3.1397
Epoch 114/200
1/1 [==============================] - 0s 3ms/step - loss: 9.4622 -
root_mean_squared_error: 3.0761
Epoch 115/200
1/1 [==============================] - 0s 3ms/step - loss: 9.0774 -
root_mean_squared_error: 3.0129
Epoch 116/200
1/1 [==============================] - 0s 3ms/step - loss: 8.7031 -
root_mean_squared_error: 2.9501
Epoch 117/200
1/1 [==============================] - 0s 3ms/step - loss: 8.3392 -
root_mean_squared_error: 2.8878
Epoch 118/200
1/1 [==============================] - 0s 3ms/step - loss: 7.9857 -
root_mean_squared_error: 2.8259
Epoch 119/200
1/1 [==============================] - 0s 3ms/step - loss: 7.6424 -
root_mean_squared_error: 2.7645
Epoch 120/200
1/1 [==============================] - 0s 4ms/step - loss: 7.3094 -
root_mean_squared_error: 2.7036
Epoch 121/200
1/1 [==============================] - 0s 3ms/step - loss: 6.9866 -
root_mean_squared_error: 2.6432
Epoch 122/200
1/1 [==============================] - 0s 3ms/step - loss: 6.6738 -
root_mean_squared_error: 2.5834
Epoch 123/200
1/1 [==============================] - 0s 3ms/step - loss: 6.3710 -
```

```
root_mean_squared_error: 2.5241
Epoch 124/200
1/1 [==============================] - 0s 3ms/step - loss: 6.0781 -
root_mean_squared_error: 2.4654
Epoch 125/200
1/1 [==============================] - 0s 3ms/step - loss: 5.7951 -
root_mean_squared_error: 2.4073
Epoch 126/200
1/1 [==============================] - 0s 2ms/step - loss: 5.5218 -
root_mean_squared_error: 2.3498
Epoch 127/200
1/1 [==============================] - 0s 3ms/step - loss: 5.2582 -
root_mean_squared_error: 2.2931
Epoch 128/200
1/1 [==============================] - 0s 4ms/step - loss: 5.0041 -
root_mean_squared_error: 2.2370
Epoch 129/200
1/1 [==============================] - 0s 4ms/step - loss: 4.7595 -
root_mean_squared_error: 2.1816
Epoch 130/200
1/1 [==============================] - 0s 4ms/step - loss: 4.5243 -
root_mean_squared_error: 2.1270
Epoch 131/200
1/1 [==============================] - 0s 3ms/step - loss: 4.2984 -
root_mean_squared_error: 2.0732
Epoch 132/200
1/1 [==============================] - 0s 3ms/step - loss: 4.0816 -
root_mean_squared_error: 2.0203
Epoch 133/200
1/1 [==============================] - 0s 3ms/step - loss: 3.8738 -
root_mean_squared_error: 1.9682
Epoch 134/200
1/1 [==============================] - 0s 3ms/step - loss: 3.6750 -
root_mean_squared_error: 1.9170
Epoch 135/200
1/1 [==============================] - 0s 4ms/step - loss: 3.4850 -
root_mean_squared_error: 1.8668
Epoch 136/200
1/1 [==============================] - 0s 4ms/step - loss: 3.3037 -
root_mean_squared_error: 1.8176
Epoch 137/200
1/1 [==============================] - 0s 3ms/step - loss: 3.1309 -
root_mean_squared_error: 1.7694
Epoch 138/200
1/1 [==============================] - 0s 3ms/step - loss: 2.9666 -
root_mean_squared_error: 1.7224
Epoch 139/200
1/1 [==============================] - 0s 3ms/step - loss: 2.8105 -
```

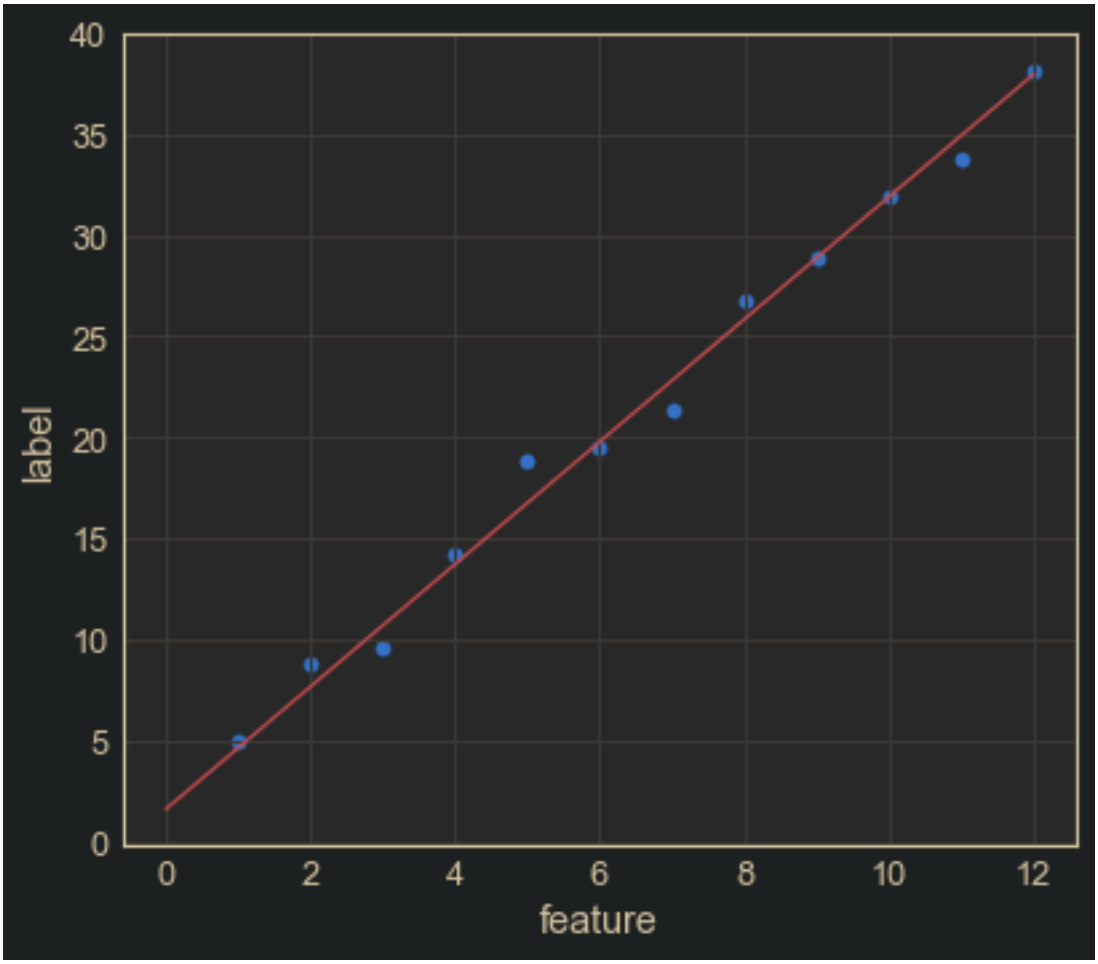
```
root_mean_squared_error: 1.6765
Epoch 140/200
1/1 [==============================] - 0s 2ms/step - loss: 2.6625 -
root_mean_squared_error: 1.6317
Epoch 141/200
1/1 [==============================] - 0s 3ms/step - loss: 2.5226 -
root_mean_squared_error: 1.5883
Epoch 142/200
1/1 [==============================] - 0s 3ms/step - loss: 2.3904 -
root_mean_squared_error: 1.5461
Epoch 143/200
1/1 [==============================] - 0s 3ms/step - loss: 2.2659 -
root_mean_squared_error: 1.5053
Epoch 144/200
1/1 [==============================] - 0s 5ms/step - loss: 2.1488 -
root_mean_squared_error: 1.4659
Epoch 145/200
1/1 [==============================] - 0s 4ms/step - loss: 2.0390 -
root_mean_squared_error: 1.4279
Epoch 146/200
1/1 [==============================] - 0s 3ms/step - loss: 1.9363 -
root_mean_squared_error: 1.3915
Epoch 147/200
1/1 [==============================] - 0s 3ms/step - loss: 1.8405 -
root_mean_squared_error: 1.3567
Epoch 148/200
1/1 [==============================] - 0s 3ms/step - loss: 1.7515 -
root_mean_squared_error: 1.3234
Epoch 149/200
1/1 [==============================] - 0s 4ms/step - loss: 1.6689 -
root_mean_squared_error: 1.2918
Epoch 150/200
1/1 [==============================] - 0s 4ms/step - loss: 1.5925 -
root_mean_squared_error: 1.2620
Epoch 151/200
1/1 [==============================] - 0s 3ms/step - loss: 1.5223 -
root_mean_squared_error: 1.2338
Epoch 152/200
1/1 [==============================] - 0s 4ms/step - loss: 1.4578 -
root_mean_squared_error: 1.2074
Epoch 153/200
1/1 [==============================] - 0s 3ms/step - loss: 1.3989 -
root_mean_squared_error: 1.1827
Epoch 154/200
1/1 [==============================] - 0s 4ms/step - loss: 1.3453 -
root_mean_squared_error: 1.1599
Epoch 155/200
1/1 [==============================] - 0s 3ms/step - loss: 1.2968 -
```

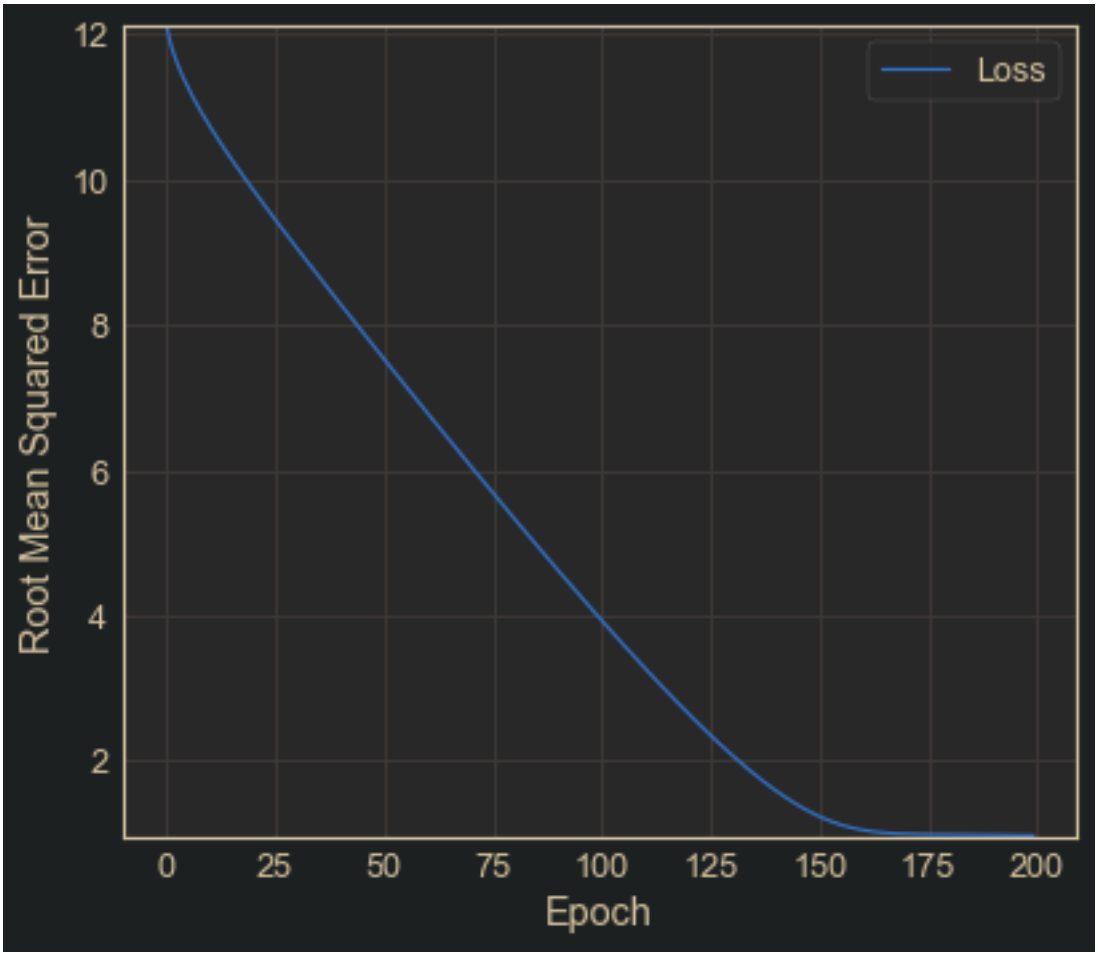
```
root_mean_squared_error: 1.1388
Epoch 156/200
1/1 [==============================] - 0s 4ms/step - loss: 1.2531 -
root_mean_squared_error: 1.1194
Epoch 157/200
1/1 [==============================] - 0s 4ms/step - loss: 1.2139 -
root_mean_squared_error: 1.1018
Epoch 158/200
1/1 [==============================] - 0s 3ms/step - loss: 1.1790 -
root_mean_squared_error: 1.0858
Epoch 159/200
1/1 [==============================] - 0s 4ms/step - loss: 1.1481 -
root_mean_squared_error: 1.0715
Epoch 160/200
1/1 [==============================] - 0s 4ms/step - loss: 1.1209 -
root_mean_squared_error: 1.0587
Epoch 161/200
1/1 [==============================] - 0s 2ms/step - loss: 1.0971 -
root_mean_squared_error: 1.0474
Epoch 162/200
1/1 [==============================] - 0s 3ms/step - loss: 1.0765 -
root_mean_squared_error: 1.0375
Epoch 163/200
1/1 [==============================] - 0s 3ms/step - loss: 1.0587 -
root_mean_squared_error: 1.0289
Epoch 164/200
1/1 [==============================] - 0s 3ms/step - loss: 1.0435 -
root_mean_squared_error: 1.0215
Epoch 165/200
1/1 [==============================] - 0s 3ms/step - loss: 1.0306 -
root_mean_squared_error: 1.0152
Epoch 166/200
1/1 [==============================] - 0s 4ms/step - loss: 1.0198 -
root_mean_squared_error: 1.0099
Epoch 167/200
1/1 [==============================] - 0s 4ms/step - loss: 1.0108 -
root_mean_squared_error: 1.0054
Epoch 168/200
1/1 [==============================] - 0s 3ms/step - loss: 1.0034 -
root_mean_squared_error: 1.0017
Epoch 169/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9973 -
root_mean_squared_error: 0.9986
Epoch 170/200
1/1 [==============================] - 0s 4ms/step - loss: 0.9923 -
root_mean_squared_error: 0.9961
Epoch 171/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9883 -
```

```
root_mean_squared_error: 0.9941
Epoch 172/200
1/1 [==============================] - 0s 1ms/step - loss: 0.9850 -
root_mean_squared_error: 0.9925
Epoch 173/200
1/1 [==============================] - 0s 4ms/step - loss: 0.9823 -
root_mean_squared_error: 0.9911
Epoch 174/200
1/1 [==============================] - 0s 5ms/step - loss: 0.9802 -
root_mean_squared_error: 0.9900
Epoch 175/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9784 -
root_mean_squared_error: 0.9891
Epoch 176/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9768 -
root_mean_squared_error: 0.9883
Epoch 177/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9755 -
root_mean_squared_error: 0.9877
Epoch 178/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9743 -
root_mean_squared_error: 0.9870
Epoch 179/200
1/1 [==============================] - 0s 4ms/step - loss: 0.9731 -
root_mean_squared_error: 0.9865
Epoch 180/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9720 -
root_mean_squared_error: 0.9859
Epoch 181/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9710 -
root_mean_squared_error: 0.9854
Epoch 182/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9699 -
root_mean_squared_error: 0.9848
Epoch 183/200
1/1 [==============================] - 0s 4ms/step - loss: 0.9688 -
root_mean_squared_error: 0.9843
Epoch 184/200
1/1 [==============================] - 0s 4ms/step - loss: 0.9677 -
root_mean_squared_error: 0.9837
Epoch 185/200
1/1 [==============================] - 0s 4ms/step - loss: 0.9665 -
root_mean_squared_error: 0.9831
Epoch 186/200
1/1 [==============================] - 0s 4ms/step - loss: 0.9653 -
root_mean_squared_error: 0.9825
Epoch 187/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9641 -
```

```
root_mean_squared_error: 0.9819
Epoch 188/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9629 -
root_mean_squared_error: 0.9813
Epoch 189/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9616 -
root_mean_squared_error: 0.9806
Epoch 190/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9603 -
root_mean_squared_error: 0.9799
Epoch 191/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9589 -
root_mean_squared_error: 0.9792
Epoch 192/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9575 -
root_mean_squared_error: 0.9785
Epoch 193/200
1/1 [==============================] - 0s 4ms/step - loss: 0.9561 -
root_mean_squared_error: 0.9778
Epoch 194/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9547 -
root_mean_squared_error: 0.9771
Epoch 195/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9532 -
root_mean_squared_error: 0.9763
Epoch 196/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9517 -
root_mean_squared_error: 0.9755
Epoch 197/200
1/1 [==============================] - 0s 4ms/step - loss: 0.9501 -
root_mean_squared_error: 0.9748
Epoch 198/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9486 -
root_mean_squared_error: 0.9740
Epoch 199/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9470 -
root_mean_squared_error: 0.9731
Epoch 200/200
1/1 [==============================] - 0s 3ms/step - loss: 0.9454 -
root_mean_squared_error: 0.9723

C:\Users\Arunabh\anaconda3\envs\mlcc\lib\site-
packages\numpy\core\_asarray.py:136: VisibleDeprecationWarning: Creating an
ndarray from ragged nested sequences (which is a list-or-tuple of lists-or-
tuples-or ndarrays with different lengths or shapes) is deprecated. If you meant
to do this, you must specify 'dtype=object' when creating the ndarray
  return array(a, dtype, copy=False, order=order, subok=True)
```


40
35
30
25
20
15
10
5
0
label
0
2
4
6
8
10
12
feature




```
[ ]: #@title Double-click to view a possible solution
learning_rate=0.01
epochs=450
my_batch_size=12

my_model = build_model(learning_rate)
trained_weight, trained_bias, epochs, rmse = train_model(my_model, my_feature,
                                                         my_label, epochs,
                                                         my_batch_size)
plot_the_model(trained_weight, trained_bias, my_feature, my_label)
plot_the_loss_curve(epochs, rmse)

# The loss curve suggests that the model does converge.
```

1.11 Task 3: Increase the learning rate

In Task 2, you increased the number of epochs to get the model to converge. Sometimes, you can get the model to converge more quickly by increasing the learning rate. However, setting the learning

rate too high often makes it impossible for a model to converge. In Task 3, we've intentionally set the learning rate too high. Run the following code cell and see what happens.

[14]:
```
# Increase the learning rate and decrease the number of epochs.
learning_rate=100
epochs=500

my_model = build_model(learning_rate)
trained_weight, trained_bias, epochs, rmse = train_model(my_model, my_feature,
                                                         my_label, epochs,
                                                         my_batch_size)
plot_the_model(trained_weight, trained_bias, my_feature, my_label)
plot_the_loss_curve(epochs, rmse)
```

```
Epoch 1/500
1/1 [==============================] - 1s 672ms/step - loss: 203.3613 -
root_mean_squared_error: 14.2605
Epoch 2/500
1/1 [==============================] - 0s 4ms/step - loss: 6742572.0000 -
root_mean_squared_error: 2596.6462
Epoch 3/500
1/1 [==============================] - 0s 3ms/step - loss: 202.3578 -
root_mean_squared_error: 14.2253
Epoch 4/500
1/1 [==============================] - 0s 4ms/step - loss: 1.6399 -
root_mean_squared_error: 1.2806
Epoch 5/500
1/1 [==============================] - 0s 4ms/step - loss: 0.9261 -
root_mean_squared_error: 0.9623
Epoch 6/500
1/1 [==============================] - 0s 3ms/step - loss: 0.9140 -
root_mean_squared_error: 0.9560
Epoch 7/500
1/1 [==============================] - 0s 4ms/step - loss: 0.9112 -
root_mean_squared_error: 0.9546
Epoch 8/500
1/1 [==============================] - 0s 3ms/step - loss: 0.9088 -
root_mean_squared_error: 0.9533
Epoch 9/500
1/1 [==============================] - 0s 3ms/step - loss: 0.9064 -
root_mean_squared_error: 0.9520
Epoch 10/500
1/1 [==============================] - 0s 3ms/step - loss: 0.9040 -
root_mean_squared_error: 0.9508
Epoch 11/500
1/1 [==============================] - 0s 3ms/step - loss: 0.9018 -
root_mean_squared_error: 0.9496
Epoch 12/500
```

```
1/1 [==============================] - 0s 4ms/step - loss: 0.8996 -
root_mean_squared_error: 0.9485
Epoch 13/500
1/1 [==============================] - 0s 4ms/step - loss: 0.8974 -
root_mean_squared_error: 0.9473
Epoch 14/500
1/1 [==============================] - 0s 3ms/step - loss: 0.8954 -
root_mean_squared_error: 0.9462
Epoch 15/500
1/1 [==============================] - 0s 4ms/step - loss: 0.8934 -
root_mean_squared_error: 0.9452
Epoch 16/500
1/1 [==============================] - 0s 4ms/step - loss: 0.8916 -
root_mean_squared_error: 0.9442
Epoch 17/500
1/1 [==============================] - 0s 4ms/step - loss: 0.8898 -
root_mean_squared_error: 0.9433
Epoch 18/500
1/1 [==============================] - 0s 4ms/step - loss: 0.8881 -
root_mean_squared_error: 0.9424
Epoch 19/500
1/1 [==============================] - 0s 4ms/step - loss: 0.8866 -
root_mean_squared_error: 0.9416
Epoch 20/500
1/1 [==============================] - 0s 3ms/step - loss: 0.8852 -
root_mean_squared_error: 0.9408
Epoch 21/500
1/1 [==============================] - 0s 3ms/step - loss: 0.8838 -
root_mean_squared_error: 0.9401
Epoch 22/500
1/1 [==============================] - 0s 3ms/step - loss: 0.8826 -
root_mean_squared_error: 0.9395
Epoch 23/500
1/1 [==============================] - 0s 3ms/step - loss: 0.8815 -
root_mean_squared_error: 0.9389
Epoch 24/500
1/1 [==============================] - 0s 3ms/step - loss: 0.8806 -
root_mean_squared_error: 0.9384
Epoch 25/500
1/1 [==============================] - 0s 2ms/step - loss: 0.8797 -
root_mean_squared_error: 0.9379
Epoch 26/500
1/1 [==============================] - 0s 4ms/step - loss: 0.8789 -
root_mean_squared_error: 0.9375
Epoch 27/500
1/1 [==============================] - 0s 3ms/step - loss: 0.8784 -
root_mean_squared_error: 0.9372
Epoch 28/500
```

```
1/1 [==============================] - 0s 5ms/step - loss: 0.8791 -
root_mean_squared_error: 0.9376
Epoch 29/500
1/1 [==============================] - 0s 3ms/step - loss: 0.8900 -
root_mean_squared_error: 0.9434
Epoch 30/500
1/1 [==============================] - 0s 3ms/step - loss: 1.0056 -
root_mean_squared_error: 1.0028
Epoch 31/500
1/1 [==============================] - 0s 3ms/step - loss: 2.3612 -
root_mean_squared_error: 1.5366
Epoch 32/500
1/1 [==============================] - 0s 3ms/step - loss: 20.4718 -
root_mean_squared_error: 4.5246
Epoch 33/500
1/1 [==============================] - 0s 4ms/step - loss: 296.3673 -
root_mean_squared_error: 17.2153
Epoch 34/500
1/1 [==============================] - 0s 4ms/step - loss: 5076.2915 -
root_mean_squared_error: 71.2481
Epoch 35/500
1/1 [==============================] - 0s 3ms/step - loss: 96672.2812 -
root_mean_squared_error: 310.9217
Epoch 36/500
1/1 [==============================] - 0s 3ms/step - loss: 1316451.3750 -
root_mean_squared_error: 1147.3672
Epoch 37/500
1/1 [==============================] - 0s 3ms/step - loss: 1499023.8750 -
root_mean_squared_error: 1224.3463
Epoch 38/500
1/1 [==============================] - 0s 3ms/step - loss: 411650.8438 -
root_mean_squared_error: 641.6002
Epoch 39/500
1/1 [==============================] - 0s 3ms/step - loss: 100559.7109 -
root_mean_squared_error: 317.1115
Epoch 40/500
1/1 [==============================] - 0s 3ms/step - loss: 30091.4902 -
root_mean_squared_error: 173.4690
Epoch 41/500
1/1 [==============================] - 0s 3ms/step - loss: 11613.1885 -
root_mean_squared_error: 107.7645
Epoch 42/500
1/1 [==============================] - 0s 3ms/step - loss: 5767.2251 -
root_mean_squared_error: 75.9422
Epoch 43/500
1/1 [==============================] - 0s 4ms/step - loss: 3640.2197 -
root_mean_squared_error: 60.3342
Epoch 44/500
```

```
1/1 [==============================] - 0s 4ms/step - loss: 2881.6702 -
root_mean_squared_error: 53.6812
Epoch 45/500
1/1 [==============================] - 0s 3ms/step - loss: 2825.7839 -
root_mean_squared_error: 53.1581
Epoch 46/500
1/1 [==============================] - 0s 3ms/step - loss: 3394.2024 -
root_mean_squared_error: 58.2598
Epoch 47/500
1/1 [==============================] - 0s 3ms/step - loss: 4941.9731 -
root_mean_squared_error: 70.2992
Epoch 48/500
1/1 [==============================] - 0s 2ms/step - loss: 8630.0400 -
root_mean_squared_error: 92.8980
Epoch 49/500
1/1 [==============================] - 0s 3ms/step - loss: 17841.4395 -
root_mean_squared_error: 133.5719
Epoch 50/500
1/1 [==============================] - 0s 3ms/step - loss: 42742.2930 -
root_mean_squared_error: 206.7421
Epoch 51/500
1/1 [==============================] - 0s 4ms/step - loss: 113128.1797 -
root_mean_squared_error: 336.3453
Epoch 52/500
1/1 [==============================] - 0s 3ms/step - loss: 292520.5938 -
root_mean_squared_error: 540.8517
Epoch 53/500
1/1 [==============================] - 0s 3ms/step - loss: 564273.7500 -
root_mean_squared_error: 751.1816
Epoch 54/500
1/1 [==============================] - 0s 3ms/step - loss: 609356.1875 -
root_mean_squared_error: 780.6127
Epoch 55/500
1/1 [==============================] - 0s 4ms/step - loss: 398082.2500 -
root_mean_squared_error: 630.9376
Epoch 56/500
1/1 [==============================] - 0s 3ms/step - loss: 212861.7500 -
root_mean_squared_error: 461.3694
Epoch 57/500
1/1 [==============================] - 0s 2ms/step - loss: 115562.7891 -
root_mean_squared_error: 339.9453
Epoch 58/500
1/1 [==============================] - 0s 3ms/step - loss: 70465.5547 -
root_mean_squared_error: 265.4535
Epoch 59/500
1/1 [==============================] - 0s 3ms/step - loss: 50185.5938 -
root_mean_squared_error: 224.0214
Epoch 60/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 42217.3750 -
root_mean_squared_error: 205.4687
Epoch 61/500
1/1 [==============================] - 0s 4ms/step - loss: 41863.9336 -
root_mean_squared_error: 204.6068
Epoch 62/500
1/1 [==============================] - 0s 4ms/step - loss: 48445.7852 -
root_mean_squared_error: 220.1040
Epoch 63/500
1/1 [==============================] - 0s 4ms/step - loss: 64261.8086 -
root_mean_squared_error: 253.4991
Epoch 64/500
1/1 [==============================] - 0s 4ms/step - loss: 94871.3984 -
root_mean_squared_error: 308.0120
Epoch 65/500
1/1 [==============================] - 0s 4ms/step - loss: 148479.9531 -
root_mean_squared_error: 385.3310
Epoch 66/500
1/1 [==============================] - 0s 4ms/step - loss: 228098.0156 -
root_mean_squared_error: 477.5961
Epoch 67/500
1/1 [==============================] - 0s 3ms/step - loss: 310733.3125 -
root_mean_squared_error: 557.4346
Epoch 68/500
1/1 [==============================] - 0s 4ms/step - loss: 344677.4688 -
root_mean_squared_error: 587.0924
Epoch 69/500
1/1 [==============================] - 0s 3ms/step - loss: 308488.6562 -
root_mean_squared_error: 555.4175
Epoch 70/500
1/1 [==============================] - 0s 3ms/step - loss: 238947.6250 -
root_mean_squared_error: 488.8227
Epoch 71/500
1/1 [==============================] - 0s 3ms/step - loss: 175913.7031 -
root_mean_squared_error: 419.4207
Epoch 72/500
1/1 [==============================] - 0s 2ms/step - loss: 132611.5000 -
root_mean_squared_error: 364.1586
Epoch 73/500
1/1 [==============================] - 0s 3ms/step - loss: 107169.2266 -
root_mean_squared_error: 327.3671
Epoch 74/500
1/1 [==============================] - 0s 3ms/step - loss: 94991.8203 -
root_mean_squared_error: 308.2074
Epoch 75/500
1/1 [==============================] - 0s 3ms/step - loss: 92963.6016 -
root_mean_squared_error: 304.8993
Epoch 76/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 99911.7266 -
root_mean_squared_error: 316.0882
Epoch 77/500
1/1 [==============================] - 0s 3ms/step - loss: 116069.3203 -
root_mean_squared_error: 340.6895
Epoch 78/500
1/1 [==============================] - 0s 4ms/step - loss: 141956.3906 -
root_mean_squared_error: 376.7710
Epoch 79/500
1/1 [==============================] - 0s 3ms/step - loss: 176168.6719 -
root_mean_squared_error: 419.7245
Epoch 80/500
1/1 [==============================] - 0s 3ms/step - loss: 212317.3281 -
root_mean_squared_error: 460.7791
Epoch 81/500
1/1 [==============================] - 0s 4ms/step - loss: 238549.8906 -
root_mean_squared_error: 488.4157
Epoch 82/500
1/1 [==============================] - 0s 4ms/step - loss: 244197.9531 -
root_mean_squared_error: 494.1639
Epoch 83/500
1/1 [==============================] - 0s 3ms/step - loss: 228814.9375 -
root_mean_squared_error: 478.3460
Epoch 84/500
1/1 [==============================] - 0s 4ms/step - loss: 201800.3750 -
root_mean_squared_error: 449.2220
Epoch 85/500
1/1 [==============================] - 0s 4ms/step - loss: 173875.8281 -
root_mean_squared_error: 416.9842
Epoch 86/500
1/1 [==============================] - 0s 4ms/step - loss: 151432.3281 -
root_mean_squared_error: 389.1431
Epoch 87/500
1/1 [==============================] - 0s 3ms/step - loss: 136625.0469 -
root_mean_squared_error: 369.6283
Epoch 88/500
1/1 [==============================] - 0s 4ms/step - loss: 129473.7266 -
root_mean_squared_error: 359.8246
Epoch 89/500
1/1 [==============================] - 0s 3ms/step - loss: 129388.6641 -
root_mean_squared_error: 359.7064
Epoch 90/500
1/1 [==============================] - 0s 4ms/step - loss: 135730.1719 -
root_mean_squared_error: 368.4158
Epoch 91/500
1/1 [==============================] - 0s 3ms/step - loss: 147685.3906 -
root_mean_squared_error: 384.2986
Epoch 92/500
```

```
1/1 [==============================] - 0s 4ms/step - loss: 163739.3906 -
root_mean_squared_error: 404.6472
Epoch 93/500
1/1 [==============================] - 0s 4ms/step - loss: 181101.7500 -
root_mean_squared_error: 425.5605
Epoch 94/500
1/1 [==============================] - 0s 3ms/step - loss: 195748.2656 -
root_mean_squared_error: 442.4345
Epoch 95/500
1/1 [==============================] - 0s 4ms/step - loss: 203691.0625 -
root_mean_squared_error: 451.3215
Epoch 96/500
1/1 [==============================] - 0s 3ms/step - loss: 202993.7969 -
root_mean_squared_error: 450.5483
Epoch 97/500
1/1 [==============================] - 0s 4ms/step - loss: 194818.0781 -
root_mean_squared_error: 441.3820
Epoch 98/500
1/1 [==============================] - 0s 4ms/step - loss: 182503.6250 -
root_mean_squared_error: 427.2044
Epoch 99/500
1/1 [==============================] - 0s 3ms/step - loss: 169694.3594 -
root_mean_squared_error: 411.9398
Epoch 100/500
1/1 [==============================] - 0s 4ms/step - loss: 159060.2188 -
root_mean_squared_error: 398.8235
Epoch 101/500
1/1 [==============================] - 0s 3ms/step - loss: 152041.6250 -
root_mean_squared_error: 389.9251
Epoch 102/500
1/1 [==============================] - 0s 3ms/step - loss: 149145.5781 -
root_mean_squared_error: 386.1937
Epoch 103/500
1/1 [==============================] - 0s 3ms/step - loss: 150286.7188 -
root_mean_squared_error: 387.6683
Epoch 104/500
1/1 [==============================] - 0s 3ms/step - loss: 154956.0312 -
root_mean_squared_error: 393.6446
Epoch 105/500
1/1 [==============================] - 0s 2ms/step - loss: 162224.6875 -
root_mean_squared_error: 402.7713
Epoch 106/500
1/1 [==============================] - 0s 3ms/step - loss: 170706.1406 -
root_mean_squared_error: 413.1660
Epoch 107/500
1/1 [==============================] - 0s 3ms/step - loss: 178651.2969 -
root_mean_squared_error: 422.6716
Epoch 108/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 184307.0625 -
root_mean_squared_error: 429.3100
Epoch 109/500
1/1 [==============================] - 0s 4ms/step - loss: 186468.1250 -
root_mean_squared_error: 431.8195
Epoch 110/500
1/1 [==============================] - 0s 4ms/step - loss: 184917.2969 -
root_mean_squared_error: 430.0201
Epoch 111/500
1/1 [==============================] - 0s 3ms/step - loss: 180447.8750 -
root_mean_squared_error: 424.7916
Epoch 112/500
1/1 [==============================] - 0s 3ms/step - loss: 174464.9844 -
root_mean_squared_error: 417.6901
Epoch 113/500
1/1 [==============================] - 0s 2ms/step - loss: 168452.5000 -
root_mean_squared_error: 410.4297
Epoch 114/500
1/1 [==============================] - 0s 3ms/step - loss: 163590.5156 -
root_mean_squared_error: 404.4633
Epoch 115/500
1/1 [==============================] - 0s 3ms/step - loss: 160607.8906 -
root_mean_squared_error: 400.7592
Epoch 116/500
1/1 [==============================] - 0s 3ms/step - loss: 159793.6719 -
root_mean_squared_error: 399.7420
Epoch 117/500
1/1 [==============================] - 0s 3ms/step - loss: 161060.8281 -
root_mean_squared_error: 401.3239
Epoch 118/500
1/1 [==============================] - 0s 4ms/step - loss: 164006.4531 -
root_mean_squared_error: 404.9771
Epoch 119/500
1/1 [==============================] - 0s 4ms/step - loss: 167968.2969 -
root_mean_squared_error: 409.8394
Epoch 120/500
1/1 [==============================] - 0s 3ms/step - loss: 172111.5469 -
root_mean_squared_error: 414.8633
Epoch 121/500
1/1 [==============================] - 0s 4ms/step - loss: 175575.2656 -
root_mean_squared_error: 419.0170
Epoch 122/500
1/1 [==============================] - 0s 3ms/step - loss: 177668.6094 -
root_mean_squared_error: 421.5075
Epoch 123/500
1/1 [==============================] - 0s 4ms/step - loss: 178049.6094 -
root_mean_squared_error: 421.9593
Epoch 124/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 176803.4375 -
root_mean_squared_error: 420.4800
Epoch 125/500
1/1 [==============================] - 0s 3ms/step - loss: 174380.7656 -
root_mean_squared_error: 417.5892
Epoch 126/500
1/1 [==============================] - 0s 3ms/step - loss: 171432.1719 -
root_mean_squared_error: 414.0437
Epoch 127/500
1/1 [==============================] - 0s 4ms/step - loss: 168620.3594 -
root_mean_squared_error: 410.6341
Epoch 128/500
1/1 [==============================] - 0s 3ms/step - loss: 166478.2500 -
root_mean_squared_error: 408.0175
Epoch 129/500
1/1 [==============================] - 0s 3ms/step - loss: 165334.1094 -
root_mean_squared_error: 406.6130
Epoch 130/500
1/1 [==============================] - 0s 4ms/step - loss: 165293.4531 -
root_mean_squared_error: 406.5630
Epoch 131/500
1/1 [==============================] - 0s 2ms/step - loss: 166254.2969 -
root_mean_squared_error: 407.7429
Epoch 132/500
1/1 [==============================] - 0s 4ms/step - loss: 167943.8906 -
root_mean_squared_error: 409.8096
Epoch 133/500
1/1 [==============================] - 0s 3ms/step - loss: 169973.0625 -
root_mean_squared_error: 412.2779
Epoch 134/500
1/1 [==============================] - 0s 3ms/step - loss: 171909.8906 -
root_mean_squared_error: 414.6202
Epoch 135/500
1/1 [==============================] - 0s 3ms/step - loss: 173367.0000 -
root_mean_squared_error: 416.3736
Epoch 136/500
1/1 [==============================] - 0s 3ms/step - loss: 174084.3125 -
root_mean_squared_error: 417.2341
Epoch 137/500
1/1 [==============================] - 0s 4ms/step - loss: 173981.8281 -
root_mean_squared_error: 417.1113
Epoch 138/500
1/1 [==============================] - 0s 3ms/step - loss: 173164.2344 -
root_mean_squared_error: 416.1301
Epoch 139/500
1/1 [==============================] - 0s 2ms/step - loss: 171877.4531 -
root_mean_squared_error: 414.5811
Epoch 140/500
```

```
1/1 [==============================] - 0s 8ms/step - loss: 170435.7656 -
root_mean_squared_error: 412.8387
Epoch 141/500
1/1 [==============================] - 0s 4ms/step - loss: 169144.8281 -
root_mean_squared_error: 411.2722
Epoch 142/500
1/1 [==============================] - 0s 4ms/step - loss: 168241.9531 -
root_mean_squared_error: 410.1731
Epoch 143/500
1/1 [==============================] - 0s 3ms/step - loss: 167861.1094 -
root_mean_squared_error: 409.7086
Epoch 144/500
1/1 [==============================] - 0s 4ms/step - loss: 168022.4531 -
root_mean_squared_error: 409.9054
Epoch 145/500
1/1 [==============================] - 0s 3ms/step - loss: 168641.3594 -
root_mean_squared_error: 410.6597
Epoch 146/500
1/1 [==============================] - 0s 4ms/step - loss: 169553.6875 -
root_mean_squared_error: 411.7690
Epoch 147/500
1/1 [==============================] - 0s 4ms/step - loss: 170552.0312 -
root_mean_squared_error: 412.9795
Epoch 148/500
1/1 [==============================] - 0s 3ms/step - loss: 171428.4375 -
root_mean_squared_error: 414.0392
Epoch 149/500
1/1 [==============================] - 0s 3ms/step - loss: 172016.6094 -
root_mean_squared_error: 414.7488
Epoch 150/500
1/1 [==============================] - 0s 3ms/step - loss: 172223.8281 -
root_mean_squared_error: 414.9986
Epoch 151/500
1/1 [==============================] - 0s 3ms/step - loss: 172045.5000 -
root_mean_squared_error: 414.7837
Epoch 152/500
1/1 [==============================] - 0s 3ms/step - loss: 171557.1875 -
root_mean_squared_error: 414.1946
Epoch 153/500
1/1 [==============================] - 0s 3ms/step - loss: 170890.4531 -
root_mean_squared_error: 413.3890
Epoch 154/500
1/1 [==============================] - 0s 4ms/step - loss: 170198.1406 -
root_mean_squared_error: 412.5508
Epoch 155/500
1/1 [==============================] - 0s 4ms/step - loss: 169621.0000 -
root_mean_squared_error: 411.8507
Epoch 156/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 169261.3594 -
root_mean_squared_error: 411.4138
Epoch 157/500
1/1 [==============================] - 0s 3ms/step - loss: 169167.6094 -
root_mean_squared_error: 411.2999
Epoch 158/500
1/1 [==============================] - 0s 3ms/step - loss: 169331.5781 -
root_mean_squared_error: 411.4992
Epoch 159/500
1/1 [==============================] - 0s 3ms/step - loss: 169695.4531 -
root_mean_squared_error: 411.9411
Epoch 160/500
1/1 [==============================] - 0s 3ms/step - loss: 170167.7812 -
root_mean_squared_error: 412.5140
Epoch 161/500
1/1 [==============================] - 0s 3ms/step - loss: 170644.0781 -
root_mean_squared_error: 413.0909
Epoch 162/500
1/1 [==============================] - 0s 4ms/step - loss: 171028.3281 -
root_mean_squared_error: 413.5557
Epoch 163/500
1/1 [==============================] - 0s 3ms/step - loss: 171252.0156 -
root_mean_squared_error: 413.8261
Epoch 164/500
1/1 [==============================] - 0s 3ms/step - loss: 171285.6719 -
root_mean_squared_error: 413.8667
Epoch 165/500
1/1 [==============================] - 0s 4ms/step - loss: 171141.6094 -
root_mean_squared_error: 413.6927
Epoch 166/500
1/1 [==============================] - 0s 3ms/step - loss: 170866.8438 -
root_mean_squared_error: 413.3604
Epoch 167/500
1/1 [==============================] - 0s 2ms/step - loss: 170530.0625 -
root_mean_squared_error: 412.9529
Epoch 168/500
1/1 [==============================] - 0s 3ms/step - loss: 170205.0312 -
root_mean_squared_error: 412.5591
Epoch 169/500
1/1 [==============================] - 0s 3ms/step - loss: 169955.3750 -
root_mean_squared_error: 412.2564
Epoch 170/500
1/1 [==============================] - 0s 4ms/step - loss: 169822.9688 -
root_mean_squared_error: 412.0958
Epoch 171/500
1/1 [==============================] - 0s 3ms/step - loss: 169822.3906 -
root_mean_squared_error: 412.0951
Epoch 172/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 169940.5781 -
root_mean_squared_error: 412.2385
Epoch 173/500
1/1 [==============================] - 0s 3ms/step - loss: 170142.1406 -
root_mean_squared_error: 412.4829
Epoch 174/500
1/1 [==============================] - 0s 4ms/step - loss: 170378.9531 -
root_mean_squared_error: 412.7699
Epoch 175/500
1/1 [==============================] - 0s 3ms/step - loss: 170600.0000 -
root_mean_squared_error: 413.0375
Epoch 176/500
1/1 [==============================] - 0s 3ms/step - loss: 170762.6406 -
root_mean_squared_error: 413.2344
Epoch 177/500
1/1 [==============================] - 0s 3ms/step - loss: 170839.8750 -
root_mean_squared_error: 413.3278
Epoch 178/500
1/1 [==============================] - 0s 4ms/step - loss: 170824.7969 -
root_mean_squared_error: 413.3096
Epoch 179/500
1/1 [==============================] - 0s 3ms/step - loss: 170729.5156 -
root_mean_squared_error: 413.1943
Epoch 180/500
1/1 [==============================] - 0s 4ms/step - loss: 170581.4219 -
root_mean_squared_error: 413.0150
Epoch 181/500
1/1 [==============================] - 0s 4ms/step - loss: 170415.4062 -
root_mean_squared_error: 412.8140
Epoch 182/500
1/1 [==============================] - 0s 4ms/step - loss: 170266.6094 -
root_mean_squared_error: 412.6338
Epoch 183/500
1/1 [==============================] - 0s 4ms/step - loss: 170162.9531 -
root_mean_squared_error: 412.5081
Epoch 184/500
1/1 [==============================] - 0s 4ms/step - loss: 170120.5781 -
root_mean_squared_error: 412.4568
Epoch 185/500
1/1 [==============================] - 0s 3ms/step - loss: 170141.6562 -
root_mean_squared_error: 412.4823
Epoch 186/500
1/1 [==============================] - 0s 3ms/step - loss: 170215.7344 -
root_mean_squared_error: 412.5721
Epoch 187/500
1/1 [==============================] - 0s 3ms/step - loss: 170322.7344 -
root_mean_squared_error: 412.7018
Epoch 188/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 170438.1094 -
root_mean_squared_error: 412.8415
Epoch 189/500
1/1 [==============================] - 0s 3ms/step - loss: 170537.9375 -
root_mean_squared_error: 412.9624
Epoch 190/500
1/1 [==============================] - 0s 3ms/step - loss: 170603.7344 -
root_mean_squared_error: 413.0421
Epoch 191/500
1/1 [==============================] - 0s 3ms/step - loss: 170625.6719 -
root_mean_squared_error: 413.0686
Epoch 192/500
1/1 [==============================] - 0s 3ms/step - loss: 170603.7812 -
root_mean_squared_error: 413.0421
Epoch 193/500
1/1 [==============================] - 0s 3ms/step - loss: 170546.7969 -
root_mean_squared_error: 412.9731
Epoch 194/500
1/1 [==============================] - 0s 3ms/step - loss: 170469.5781 -
root_mean_squared_error: 412.8796
Epoch 195/500
1/1 [==============================] - 0s 4ms/step - loss: 170389.7500 -
root_mean_squared_error: 412.7829
Epoch 196/500
1/1 [==============================] - 0s 3ms/step - loss: 170323.4375 -
root_mean_squared_error: 412.7026
Epoch 197/500
1/1 [==============================] - 0s 3ms/step - loss: 170282.6250 -
root_mean_squared_error: 412.6532
Epoch 198/500
1/1 [==============================] - 0s 3ms/step - loss: 170272.8594 -
root_mean_squared_error: 412.6413
Epoch 199/500
1/1 [==============================] - 0s 4ms/step - loss: 170292.9531 -
root_mean_squared_error: 412.6657
Epoch 200/500
1/1 [==============================] - 0s 3ms/step - loss: 170336.0625 -
root_mean_squared_error: 412.7179
Epoch 201/500
1/1 [==============================] - 0s 3ms/step - loss: 170391.1094 -
root_mean_squared_error: 412.7846
Epoch 202/500
1/1 [==============================] - 0s 4ms/step - loss: 170445.9062 -
root_mean_squared_error: 412.8510
Epoch 203/500
1/1 [==============================] - 0s 3ms/step - loss: 170489.4688 -
root_mean_squared_error: 412.9037
Epoch 204/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 170514.3594 -
root_mean_squared_error: 412.9338
Epoch 205/500
1/1 [==============================] - 0s 3ms/step - loss: 170517.3906 -
root_mean_squared_error: 412.9375
Epoch 206/500
1/1 [==============================] - 0s 3ms/step - loss: 170500.1562 -
root_mean_squared_error: 412.9167
Epoch 207/500
1/1 [==============================] - 0s 3ms/step - loss: 170468.1250 -
root_mean_squared_error: 412.8779
Epoch 208/500
1/1 [==============================] - 0s 3ms/step - loss: 170429.1562 -
root_mean_squared_error: 412.8307
Epoch 209/500
1/1 [==============================] - 0s 4ms/step - loss: 170391.7344 -
root_mean_squared_error: 412.7853
Epoch 210/500
1/1 [==============================] - 0s 3ms/step - loss: 170363.3281 -
root_mean_squared_error: 412.7509
Epoch 211/500
1/1 [==============================] - 0s 3ms/step - loss: 170348.5781 -
root_mean_squared_error: 412.7331
Epoch 212/500
1/1 [==============================] - 0s 4ms/step - loss: 170349.0781 -
root_mean_squared_error: 412.7337
Epoch 213/500
1/1 [==============================] - 0s 4ms/step - loss: 170363.2031 -
root_mean_squared_error: 412.7508
Epoch 214/500
1/1 [==============================] - 0s 3ms/step - loss: 170386.7656 -
root_mean_squared_error: 412.7793
Epoch 215/500
1/1 [==============================] - 0s 4ms/step - loss: 170414.1406 -
root_mean_squared_error: 412.8125
Epoch 216/500
1/1 [==============================] - 0s 4ms/step - loss: 170439.4531 -
root_mean_squared_error: 412.8431
Epoch 217/500
1/1 [==============================] - 0s 3ms/step - loss: 170457.8906 -
root_mean_squared_error: 412.8654
Epoch 218/500
1/1 [==============================] - 0s 4ms/step - loss: 170466.4062 -
root_mean_squared_error: 412.8758
Epoch 219/500
1/1 [==============================] - 0s 4ms/step - loss: 170464.2344 -
root_mean_squared_error: 412.8731
Epoch 220/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 170452.9844 -
root_mean_squared_error: 412.8595
Epoch 221/500
1/1 [==============================] - 0s 4ms/step - loss: 170435.7344 -
root_mean_squared_error: 412.8386
Epoch 222/500
1/1 [==============================] - 0s 4ms/step - loss: 170416.5781 -
root_mean_squared_error: 412.8154
Epoch 223/500
1/1 [==============================] - 0s 4ms/step - loss: 170399.5469 -
root_mean_squared_error: 412.7948
Epoch 224/500
1/1 [==============================] - 0s 3ms/step - loss: 170387.8750 -
root_mean_squared_error: 412.7807
Epoch 225/500
1/1 [==============================] - 0s 3ms/step - loss: 170383.2344 -
root_mean_squared_error: 412.7751
Epoch 226/500
1/1 [==============================] - 0s 3ms/step - loss: 170385.9688 -
root_mean_squared_error: 412.7784
Epoch 227/500
1/1 [==============================] - 0s 3ms/step - loss: 170394.8281 -
root_mean_squared_error: 412.7891
Epoch 228/500
1/1 [==============================] - 0s 4ms/step - loss: 170407.2969 -
root_mean_squared_error: 412.8042
Epoch 229/500
1/1 [==============================] - 0s 4ms/step - loss: 170420.6250 -
root_mean_squared_error: 412.8203
Epoch 230/500
1/1 [==============================] - 0s 4ms/step - loss: 170431.9375 -
root_mean_squared_error: 412.8340
Epoch 231/500
1/1 [==============================] - 0s 4ms/step - loss: 170439.2656 -
root_mean_squared_error: 412.8429
Epoch 232/500
1/1 [==============================] - 0s 3ms/step - loss: 170441.4531 -
root_mean_squared_error: 412.8456
Epoch 233/500
1/1 [==============================] - 0s 3ms/step - loss: 170438.7031 -
root_mean_squared_error: 412.8422
Epoch 234/500
1/1 [==============================] - 0s 3ms/step - loss: 170431.9844 -
root_mean_squared_error: 412.8341
Epoch 235/500
1/1 [==============================] - 0s 3ms/step - loss: 170423.0312 -
root_mean_squared_error: 412.8232
Epoch 236/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 170413.8906 -
root_mean_squared_error: 412.8122
Epoch 237/500
1/1 [==============================] - 0s 4ms/step - loss: 170406.3281 -
root_mean_squared_error: 412.8030
Epoch 238/500
1/1 [==============================] - 0s 3ms/step - loss: 170401.7969 -
root_mean_squared_error: 412.7975
Epoch 239/500
1/1 [==============================] - 0s 4ms/step - loss: 170400.8594 -
root_mean_squared_error: 412.7964
Epoch 240/500
1/1 [==============================] - 0s 3ms/step - loss: 170403.3125 -
root_mean_squared_error: 412.7993
Epoch 241/500
1/1 [==============================] - 0s 4ms/step - loss: 170408.4062 -
root_mean_squared_error: 412.8055
Epoch 242/500
1/1 [==============================] - 0s 4ms/step - loss: 170414.8281 -
root_mean_squared_error: 412.8133
Epoch 243/500
1/1 [==============================] - 0s 3ms/step - loss: 170421.1406 -
root_mean_squared_error: 412.8210
Epoch 244/500
1/1 [==============================] - 0s 3ms/step - loss: 170426.1406 -
root_mean_squared_error: 412.8270
Epoch 245/500
1/1 [==============================] - 0s 3ms/step - loss: 170428.8594 -
root_mean_squared_error: 412.8303
Epoch 246/500
1/1 [==============================] - 0s 4ms/step - loss: 170429.0625 -
root_mean_squared_error: 412.8305
Epoch 247/500
1/1 [==============================] - 0s 3ms/step - loss: 170427.0000 -
root_mean_squared_error: 412.8281
Epoch 248/500
1/1 [==============================] - 0s 3ms/step - loss: 170423.2500 -
root_mean_squared_error: 412.8235
Epoch 249/500
1/1 [==============================] - 0s 3ms/step - loss: 170418.7031 -
root_mean_squared_error: 412.8180
Epoch 250/500
1/1 [==============================] - 0s 3ms/step - loss: 170414.3594 -
root_mean_squared_error: 412.8127
Epoch 251/500
1/1 [==============================] - 0s 3ms/step - loss: 170411.1406 -
root_mean_squared_error: 412.8088
Epoch 252/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 170409.5625 -
root_mean_squared_error: 412.8069
Epoch 253/500
1/1 [==============================] - 0s 3ms/step - loss: 170409.6094 -
root_mean_squared_error: 412.8070
Epoch 254/500
1/1 [==============================] - 0s 3ms/step - loss: 170411.2344 -
root_mean_squared_error: 412.8090
Epoch 255/500
1/1 [==============================] - 0s 3ms/step - loss: 170414.0781 -
root_mean_squared_error: 412.8124
Epoch 256/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3125 -
root_mean_squared_error: 412.8163
Epoch 257/500
1/1 [==============================] - 0s 3ms/step - loss: 170420.2500 -
root_mean_squared_error: 412.8199
Epoch 258/500
1/1 [==============================] - 0s 3ms/step - loss: 170422.3906 -
root_mean_squared_error: 412.8225
Epoch 259/500
1/1 [==============================] - 0s 3ms/step - loss: 170423.3594 -
root_mean_squared_error: 412.8236
Epoch 260/500
1/1 [==============================] - 0s 3ms/step - loss: 170423.0625 -
root_mean_squared_error: 412.8233
Epoch 261/500
1/1 [==============================] - 0s 4ms/step - loss: 170421.7031 -
root_mean_squared_error: 412.8216
Epoch 262/500
1/1 [==============================] - 0s 3ms/step - loss: 170419.5781 -
root_mean_squared_error: 412.8191
Epoch 263/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.1719 -
root_mean_squared_error: 412.8162
Epoch 264/500
1/1 [==============================] - 0s 4ms/step - loss: 170415.1406 -
root_mean_squared_error: 412.8137
Epoch 265/500
1/1 [==============================] - 0s 3ms/step - loss: 170413.8594 -
root_mean_squared_error: 412.8121
Epoch 266/500
1/1 [==============================] - 0s 3ms/step - loss: 170413.4219 -
root_mean_squared_error: 412.8116
Epoch 267/500
1/1 [==============================] - 0s 4ms/step - loss: 170413.8125 -
root_mean_squared_error: 412.8121
Epoch 268/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 170414.8281 -
root_mean_squared_error: 412.8133
Epoch 269/500
1/1 [==============================] - 0s 3ms/step - loss: 170416.2656 -
root_mean_squared_error: 412.8151
Epoch 270/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.9219 -
root_mean_squared_error: 412.8170
Epoch 271/500
1/1 [==============================] - 0s 3ms/step - loss: 170419.3281 -
root_mean_squared_error: 412.8188
Epoch 272/500
1/1 [==============================] - 0s 3ms/step - loss: 170420.2031 -
root_mean_squared_error: 412.8198
Epoch 273/500
1/1 [==============================] - 0s 3ms/step - loss: 170420.5000 -
root_mean_squared_error: 412.8202
Epoch 274/500
1/1 [==============================] - 0s 4ms/step - loss: 170420.1875 -
root_mean_squared_error: 412.8198
Epoch 275/500
1/1 [==============================] - 0s 3ms/step - loss: 170419.3125 -
root_mean_squared_error: 412.8187
Epoch 276/500
1/1 [==============================] - 0s 3ms/step - loss: 170418.2656 -
root_mean_squared_error: 412.8175
Epoch 277/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.1094 -
root_mean_squared_error: 412.8161
Epoch 278/500
1/1 [==============================] - 0s 3ms/step - loss: 170416.2031 -
root_mean_squared_error: 412.8150
Epoch 279/500
1/1 [==============================] - 0s 4ms/step - loss: 170415.6719 -
root_mean_squared_error: 412.8143
Epoch 280/500
1/1 [==============================] - 0s 2ms/step - loss: 170415.5156 -
root_mean_squared_error: 412.8141
Epoch 281/500
1/1 [==============================] - 0s 3ms/step - loss: 170415.7969 -
root_mean_squared_error: 412.8145
Epoch 282/500
1/1 [==============================] - 0s 3ms/step - loss: 170416.3906 -
root_mean_squared_error: 412.8152
Epoch 283/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.1406 -
root_mean_squared_error: 412.8161
Epoch 284/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 170417.8281 -
root_mean_squared_error: 412.8170
Epoch 285/500
1/1 [==============================] - 0s 4ms/step - loss: 170418.5469 -
root_mean_squared_error: 412.8178
Epoch 286/500
1/1 [==============================] - 0s 4ms/step - loss: 170418.8906 -
root_mean_squared_error: 412.8182
Epoch 287/500
1/1 [==============================] - 0s 3ms/step - loss: 170419.0469 -
root_mean_squared_error: 412.8184
Epoch 288/500
1/1 [==============================] - 0s 3ms/step - loss: 170418.8438 -
root_mean_squared_error: 412.8182
Epoch 289/500
1/1 [==============================] - 0s 3ms/step - loss: 170418.4531 -
root_mean_squared_error: 412.8177
Epoch 290/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.8281 -
root_mean_squared_error: 412.8170
Epoch 291/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.2031 -
root_mean_squared_error: 412.8162
Epoch 292/500
1/1 [==============================] - 0s 3ms/step - loss: 170416.7188 -
root_mean_squared_error: 412.8156
Epoch 293/500
1/1 [==============================] - 0s 3ms/step - loss: 170416.4219 -
root_mean_squared_error: 412.8152
Epoch 294/500
1/1 [==============================] - 0s 4ms/step - loss: 170416.4062 -
root_mean_squared_error: 412.8152
Epoch 295/500
1/1 [==============================] - 0s 3ms/step - loss: 170416.5938 -
root_mean_squared_error: 412.8155
Epoch 296/500
1/1 [==============================] - 0s 3ms/step - loss: 170416.9844 -
root_mean_squared_error: 412.8159
Epoch 297/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3906 -
root_mean_squared_error: 412.8164
Epoch 298/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.7344 -
root_mean_squared_error: 412.8168
Epoch 299/500
1/1 [==============================] - 0s 4ms/step - loss: 170418.0938 -
root_mean_squared_error: 412.8173
Epoch 300/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 170418.3281 -
root_mean_squared_error: 412.8175
Epoch 301/500
1/1 [==============================] - 0s 4ms/step - loss: 170418.3750 -
root_mean_squared_error: 412.8176
Epoch 302/500
1/1 [==============================] - 0s 4ms/step - loss: 170418.2344 -
root_mean_squared_error: 412.8174
Epoch 303/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.9531 -
root_mean_squared_error: 412.8171
Epoch 304/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.6406 -
root_mean_squared_error: 412.8167
Epoch 305/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3906 -
root_mean_squared_error: 412.8164
Epoch 306/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.1250 -
root_mean_squared_error: 412.8161
Epoch 307/500
1/1 [==============================] - 0s 3ms/step - loss: 170416.9844 -
root_mean_squared_error: 412.8159
Epoch 308/500
1/1 [==============================] - 0s 3ms/step - loss: 170416.8906 -
root_mean_squared_error: 412.8158
Epoch 309/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.0781 -
root_mean_squared_error: 412.8160
Epoch 310/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.2344 -
root_mean_squared_error: 412.8162
Epoch 311/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4531 -
root_mean_squared_error: 412.8165
Epoch 312/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6875 -
root_mean_squared_error: 412.8168
Epoch 313/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.8594 -
root_mean_squared_error: 412.8170
Epoch 314/500
1/1 [==============================] - 0s 3ms/step - loss: 170418.0156 -
root_mean_squared_error: 412.8172
Epoch 315/500
1/1 [==============================] - 0s 4ms/step - loss: 170418.0000 -
root_mean_squared_error: 412.8171
Epoch 316/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 170418.0156 -
root_mean_squared_error: 412.8172
Epoch 317/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.8281 -
root_mean_squared_error: 412.8170
Epoch 318/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.6406 -
root_mean_squared_error: 412.8167
Epoch 319/500
1/1 [==============================] - 0s 5ms/step - loss: 170417.4844 -
root_mean_squared_error: 412.8165
Epoch 320/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.3281 -
root_mean_squared_error: 412.8163
Epoch 321/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.1719 -
root_mean_squared_error: 412.8162
Epoch 322/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.1875 -
root_mean_squared_error: 412.8162
Epoch 323/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.1719 -
root_mean_squared_error: 412.8162
Epoch 324/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3125 -
root_mean_squared_error: 412.8163
Epoch 325/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3594 -
root_mean_squared_error: 412.8164
Epoch 326/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5625 -
root_mean_squared_error: 412.8166
Epoch 327/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.7344 -
root_mean_squared_error: 412.8168
Epoch 328/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.9219 -
root_mean_squared_error: 412.8170
Epoch 329/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.9062 -
root_mean_squared_error: 412.8170
Epoch 330/500
1/1 [==============================] - 0s 2ms/step - loss: 170417.8594 -
root_mean_squared_error: 412.8170
Epoch 331/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.7969 -
root_mean_squared_error: 412.8169
Epoch 332/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 170417.7344 -
root_mean_squared_error: 412.8168
Epoch 333/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5781 -
root_mean_squared_error: 412.8167
Epoch 334/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4062 -
root_mean_squared_error: 412.8164
Epoch 335/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3906 -
root_mean_squared_error: 412.8164
Epoch 336/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.2656 -
root_mean_squared_error: 412.8163
Epoch 337/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.2969 -
root_mean_squared_error: 412.8163
Epoch 338/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.3125 -
root_mean_squared_error: 412.8163
Epoch 339/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3594 -
root_mean_squared_error: 412.8164
Epoch 340/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.5156 -
root_mean_squared_error: 412.8166
Epoch 341/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6719 -
root_mean_squared_error: 412.8167
Epoch 342/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.7344 -
root_mean_squared_error: 412.8168
Epoch 343/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.7656 -
root_mean_squared_error: 412.8169
Epoch 344/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.7656 -
root_mean_squared_error: 412.8169
Epoch 345/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.7188 -
root_mean_squared_error: 412.8168
Epoch 346/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6250 -
root_mean_squared_error: 412.8167
Epoch 347/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6094 -
root_mean_squared_error: 412.8167
Epoch 348/500
```

```
1/1 [==============================] - 0s 4ms/step - loss: 170417.5469 -
root_mean_squared_error: 412.8166
Epoch 349/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4844 -
root_mean_squared_error: 412.8165
Epoch 350/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.4219 -
root_mean_squared_error: 412.8164
Epoch 351/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.3125 -
root_mean_squared_error: 412.8163
Epoch 352/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.2812 -
root_mean_squared_error: 412.8163
Epoch 353/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.2969 -
root_mean_squared_error: 412.8163
Epoch 354/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3125 -
root_mean_squared_error: 412.8163
Epoch 355/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3906 -
root_mean_squared_error: 412.8164
Epoch 356/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.5625 -
root_mean_squared_error: 412.8166
Epoch 357/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6719 -
root_mean_squared_error: 412.8167
Epoch 358/500
1/1 [==============================] - 0s 5ms/step - loss: 170417.6875 -
root_mean_squared_error: 412.8168
Epoch 359/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.8125 -
root_mean_squared_error: 412.8169
Epoch 360/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.8281 -
root_mean_squared_error: 412.8170
Epoch 361/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.7188 -
root_mean_squared_error: 412.8168
Epoch 362/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.6250 -
root_mean_squared_error: 412.8167
Epoch 363/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6094 -
root_mean_squared_error: 412.8167
Epoch 364/500
```

```
1/1 [==============================] - 0s 4ms/step - loss: 170417.4844 -
root_mean_squared_error: 412.8165
Epoch 365/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4375 -
root_mean_squared_error: 412.8165
Epoch 366/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.3906 -
root_mean_squared_error: 412.8164
Epoch 367/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.4844 -
root_mean_squared_error: 412.8165
Epoch 368/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.4531 -
root_mean_squared_error: 412.8165
Epoch 369/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4688 -
root_mean_squared_error: 412.8165
Epoch 370/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.4531 -
root_mean_squared_error: 412.8165
Epoch 371/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4844 -
root_mean_squared_error: 412.8165
Epoch 372/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.4531 -
root_mean_squared_error: 412.8165
Epoch 373/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.5156 -
root_mean_squared_error: 412.8166
Epoch 374/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.6094 -
root_mean_squared_error: 412.8167
Epoch 375/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.7188 -
root_mean_squared_error: 412.8168
Epoch 376/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.6875 -
root_mean_squared_error: 412.8168
Epoch 377/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.6406 -
root_mean_squared_error: 412.8167
Epoch 378/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.5469 -
root_mean_squared_error: 412.8166
Epoch 379/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6094 -
root_mean_squared_error: 412.8167
Epoch 380/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 170417.6719 -
root_mean_squared_error: 412.8167
Epoch 381/500
1/1 [==============================] - 0s 2ms/step - loss: 170417.6094 -
root_mean_squared_error: 412.8167
Epoch 382/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6094 -
root_mean_squared_error: 412.8167
Epoch 383/500
1/1 [==============================] - 0s 2ms/step - loss: 170417.6250 -
root_mean_squared_error: 412.8167
Epoch 384/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5156 -
root_mean_squared_error: 412.8166
Epoch 385/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.4062 -
root_mean_squared_error: 412.8164
Epoch 386/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3125 -
root_mean_squared_error: 412.8163
Epoch 387/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3906 -
root_mean_squared_error: 412.8164
Epoch 388/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4219 -
root_mean_squared_error: 412.8164
Epoch 389/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.4844 -
root_mean_squared_error: 412.8165
Epoch 390/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5156 -
root_mean_squared_error: 412.8166
Epoch 391/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5156 -
root_mean_squared_error: 412.8166
Epoch 392/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5156 -
root_mean_squared_error: 412.8166
Epoch 393/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.6094 -
root_mean_squared_error: 412.8167
Epoch 394/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6719 -
root_mean_squared_error: 412.8167
Epoch 395/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6250 -
root_mean_squared_error: 412.8167
Epoch 396/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 170417.6562 -
root_mean_squared_error: 412.8167
Epoch 397/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6250 -
root_mean_squared_error: 412.8167
Epoch 398/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5625 -
root_mean_squared_error: 412.8166
Epoch 399/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.6875 -
root_mean_squared_error: 412.8168
Epoch 400/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6406 -
root_mean_squared_error: 412.8167
Epoch 401/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5781 -
root_mean_squared_error: 412.8167
Epoch 402/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5000 -
root_mean_squared_error: 412.8166
Epoch 403/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4219 -
root_mean_squared_error: 412.8164
Epoch 404/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3906 -
root_mean_squared_error: 412.8164
Epoch 405/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.4844 -
root_mean_squared_error: 412.8165
Epoch 406/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.4844 -
root_mean_squared_error: 412.8165
Epoch 407/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5000 -
root_mean_squared_error: 412.8166
Epoch 408/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.4375 -
root_mean_squared_error: 412.8165
Epoch 409/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.4062 -
root_mean_squared_error: 412.8164
Epoch 410/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4219 -
root_mean_squared_error: 412.8164
Epoch 411/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.4844 -
root_mean_squared_error: 412.8165
Epoch 412/500
```

```
1/1 [==============================] - 0s 4ms/step - loss: 170417.5469 -
root_mean_squared_error: 412.8166
Epoch 413/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.6094 -
root_mean_squared_error: 412.8167
Epoch 414/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.5938 -
root_mean_squared_error: 412.8167
Epoch 415/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.6875 -
root_mean_squared_error: 412.8168
Epoch 416/500
1/1 [==============================] - 0s 5ms/step - loss: 170417.6094 -
root_mean_squared_error: 412.8167
Epoch 417/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.5781 -
root_mean_squared_error: 412.8167
Epoch 418/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.5000 -
root_mean_squared_error: 412.8166
Epoch 419/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.5781 -
root_mean_squared_error: 412.8167
Epoch 420/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5469 -
root_mean_squared_error: 412.8166
Epoch 421/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5469 -
root_mean_squared_error: 412.8166
Epoch 422/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5469 -
root_mean_squared_error: 412.8166
Epoch 423/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.5469 -
root_mean_squared_error: 412.8166
Epoch 424/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4531 -
root_mean_squared_error: 412.8165
Epoch 425/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5469 -
root_mean_squared_error: 412.8166
Epoch 426/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4531 -
root_mean_squared_error: 412.8165
Epoch 427/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4531 -
root_mean_squared_error: 412.8165
Epoch 428/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 170417.4531 -
root_mean_squared_error: 412.8165
Epoch 429/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.4844 -
root_mean_squared_error: 412.8165
Epoch 430/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5469 -
root_mean_squared_error: 412.8166
Epoch 431/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.5781 -
root_mean_squared_error: 412.8167
Epoch 432/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.6875 -
root_mean_squared_error: 412.8168
Epoch 433/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6094 -
root_mean_squared_error: 412.8167
Epoch 434/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5781 -
root_mean_squared_error: 412.8167
Epoch 435/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5625 -
root_mean_squared_error: 412.8166
Epoch 436/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.5000 -
root_mean_squared_error: 412.8166
Epoch 437/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4531 -
root_mean_squared_error: 412.8165
Epoch 438/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4531 -
root_mean_squared_error: 412.8165
Epoch 439/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4531 -
root_mean_squared_error: 412.8165
Epoch 440/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5000 -
root_mean_squared_error: 412.8166
Epoch 441/500
1/1 [==============================] - 0s 2ms/step - loss: 170417.5156 -
root_mean_squared_error: 412.8166
Epoch 442/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5156 -
root_mean_squared_error: 412.8166
Epoch 443/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6094 -
root_mean_squared_error: 412.8167
Epoch 444/500
```

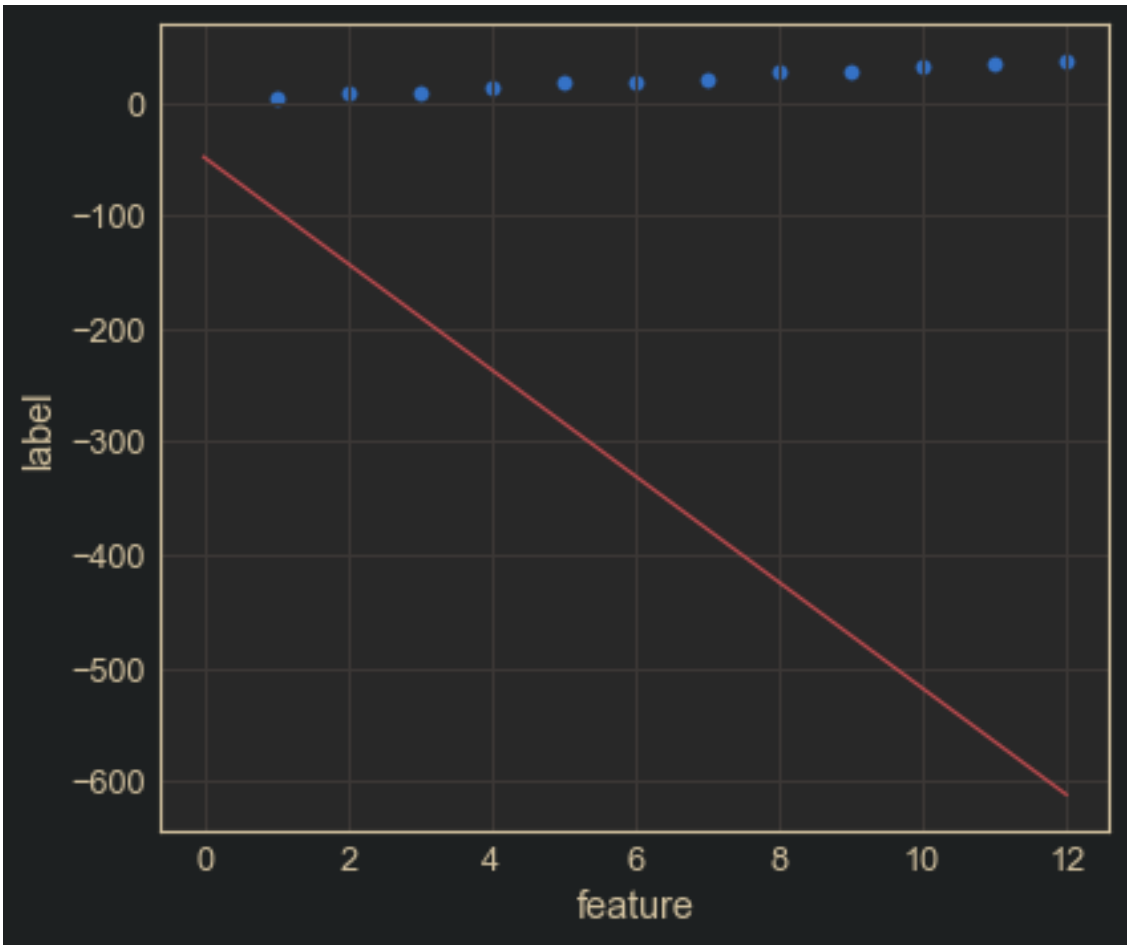
```
1/1 [==============================] - 0s 3ms/step - loss: 170417.7344 -
root_mean_squared_error: 412.8168
Epoch 445/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.7656 -
root_mean_squared_error: 412.8169
Epoch 446/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6875 -
root_mean_squared_error: 412.8168
Epoch 447/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6094 -
root_mean_squared_error: 412.8167
Epoch 448/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6406 -
root_mean_squared_error: 412.8167
Epoch 449/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.6094 -
root_mean_squared_error: 412.8167
Epoch 450/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.5156 -
root_mean_squared_error: 412.8166
Epoch 451/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.5000 -
root_mean_squared_error: 412.8166
Epoch 452/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.3594 -
root_mean_squared_error: 412.8164
Epoch 453/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.2969 -
root_mean_squared_error: 412.8163
Epoch 454/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.2812 -
root_mean_squared_error: 412.8163
Epoch 455/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.3594 -
root_mean_squared_error: 412.8164
Epoch 456/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5156 -
root_mean_squared_error: 412.8166
Epoch 457/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6562 -
root_mean_squared_error: 412.8167
Epoch 458/500
1/1 [==============================] - 0s 2ms/step - loss: 170417.7344 -
root_mean_squared_error: 412.8168
Epoch 459/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.7969 -
root_mean_squared_error: 412.8169
Epoch 460/500
```

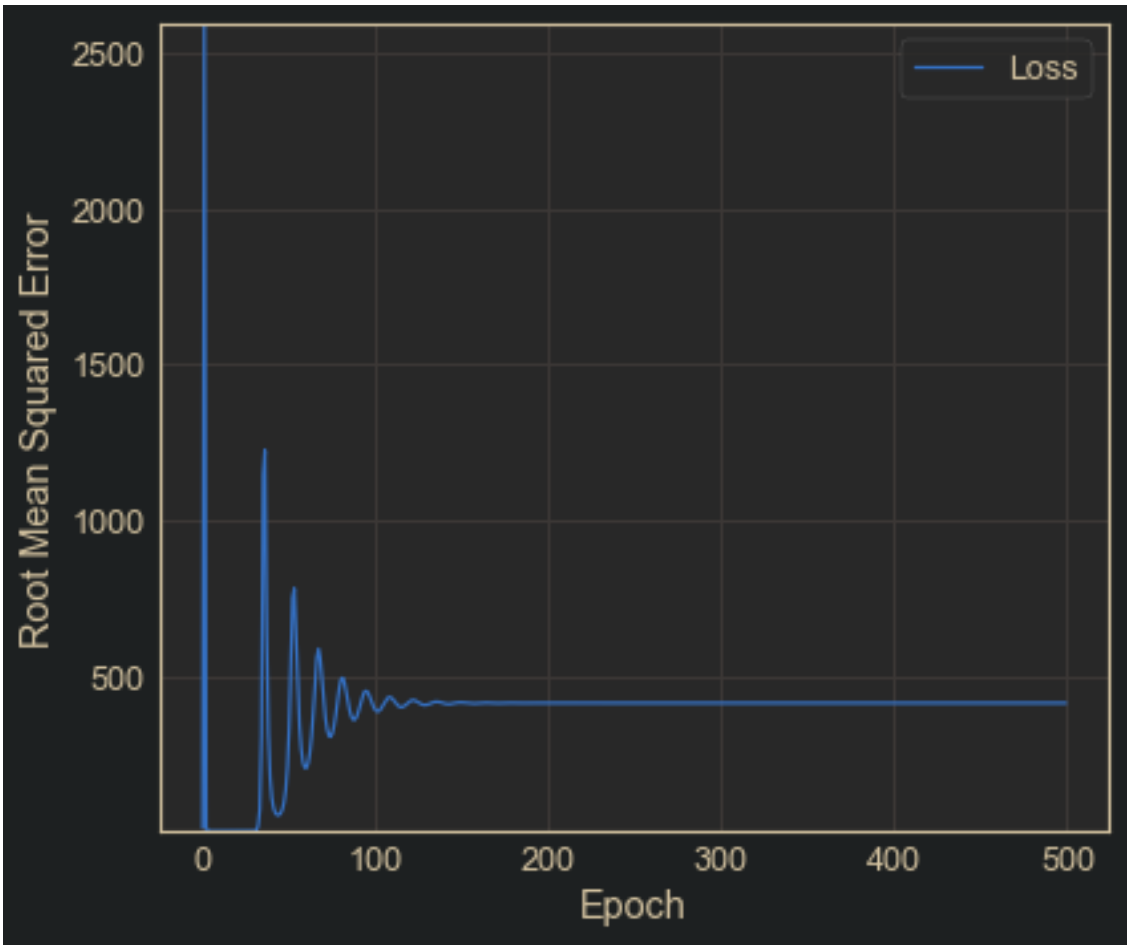
```
1/1 [==============================] - 0s 3ms/step - loss: 170417.8750 -
root_mean_squared_error: 412.8170
Epoch 461/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.8125 -
root_mean_squared_error: 412.8169
Epoch 462/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.7344 -
root_mean_squared_error: 412.8168
Epoch 463/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5156 -
root_mean_squared_error: 412.8166
Epoch 464/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.3594 -
root_mean_squared_error: 412.8164
Epoch 465/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.2969 -
root_mean_squared_error: 412.8163
Epoch 466/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.2188 -
root_mean_squared_error: 412.8162
Epoch 467/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3125 -
root_mean_squared_error: 412.8163
Epoch 468/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3281 -
root_mean_squared_error: 412.8163
Epoch 469/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.4844 -
root_mean_squared_error: 412.8165
Epoch 470/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5781 -
root_mean_squared_error: 412.8167
Epoch 471/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.7656 -
root_mean_squared_error: 412.8169
Epoch 472/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.7969 -
root_mean_squared_error: 412.8169
Epoch 473/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.7188 -
root_mean_squared_error: 412.8168
Epoch 474/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.7344 -
root_mean_squared_error: 412.8168
Epoch 475/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.7031 -
root_mean_squared_error: 412.8168
Epoch 476/500
```

```
1/1 [==============================] - 0s 4ms/step - loss: 170417.6875 -
root_mean_squared_error: 412.8168
Epoch 477/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5469 -
root_mean_squared_error: 412.8166
Epoch 478/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3594 -
root_mean_squared_error: 412.8164
Epoch 479/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.2500 -
root_mean_squared_error: 412.8163
Epoch 480/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.2656 -
root_mean_squared_error: 412.8163
Epoch 481/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.2969 -
root_mean_squared_error: 412.8163
Epoch 482/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.3125 -
root_mean_squared_error: 412.8163
Epoch 483/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3906 -
root_mean_squared_error: 412.8164
Epoch 484/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.4531 -
root_mean_squared_error: 412.8165
Epoch 485/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6875 -
root_mean_squared_error: 412.8168
Epoch 486/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.7344 -
root_mean_squared_error: 412.8168
Epoch 487/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.8281 -
root_mean_squared_error: 412.8170
Epoch 488/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.8281 -
root_mean_squared_error: 412.8170
Epoch 489/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.7344 -
root_mean_squared_error: 412.8168
Epoch 490/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6875 -
root_mean_squared_error: 412.8168
Epoch 491/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.5469 -
root_mean_squared_error: 412.8166
Epoch 492/500
```

```
1/1 [==============================] - 0s 3ms/step - loss: 170417.4219 -
root_mean_squared_error: 412.8164
Epoch 493/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3906 -
root_mean_squared_error: 412.8164
Epoch 494/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.3125 -
root_mean_squared_error: 412.8163
Epoch 495/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.2500 -
root_mean_squared_error: 412.8163
Epoch 496/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.3125 -
root_mean_squared_error: 412.8163
Epoch 497/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.4531 -
root_mean_squared_error: 412.8165
Epoch 498/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.5781 -
root_mean_squared_error: 412.8167
Epoch 499/500
1/1 [==============================] - 0s 4ms/step - loss: 170417.5781 -
root_mean_squared_error: 412.8167
Epoch 500/500
1/1 [==============================] - 0s 3ms/step - loss: 170417.6875 -
root_mean_squared_error: 412.8168

C:\Users\Arunabh\anaconda3\envs\mlcc\lib\site-
packages\numpy\core\_asarray.py:136: VisibleDeprecationWarning: Creating an
ndarray from ragged nested sequences (which is a list-or-tuple of lists-or-
tuples-or ndarrays with different lengths or shapes) is deprecated. If you meant
to do this, you must specify 'dtype=object' when creating the ndarray
  return array(a, dtype, copy=False, order=order, subok=True)
```


0
−100
−200
−300
−400
−500
−600
label
0
2
4
6
8
10
12
feature



The resulting model is terrible; the red line doesn't align with the blue dots. Furthermore, the loss curve oscillates like a roller coaster. An oscillating loss curve strongly suggests that the learning rate is too high.

1.12 Task 4: Find the ideal combination of epochs and learning rate

Assign values to the following two hyperparameters to make training converge as efficiently as possible:

- learning_rate
- epochs

[20]:
```
# Set the learning rate and number of epochs
learning_rate= 0.14  # Replace ? with a floating-point number
epochs= 70   # Replace ? with an integer

my_model = build_model(learning_rate)
trained_weight, trained_bias, epochs, rmse = train_model(my_model, my_feature,
                                                         my_label, epochs,
```

```
                                                          my_batch_size)
plot_the_model(trained_weight, trained_bias, my_feature, my_label)
plot_the_loss_curve(epochs, rmse)
```

```
Epoch 1/70
1/1 [==============================] - 0s 211ms/step - loss: 708.2417 -
root_mean_squared_error: 26.6128
Epoch 2/70
1/1 [==============================] - 0s 4ms/step - loss: 527.2039 -
root_mean_squared_error: 22.9609
Epoch 3/70
1/1 [==============================] - 0s 3ms/step - loss: 420.4508 -
root_mean_squared_error: 20.5049
Epoch 4/70
1/1 [==============================] - 0s 4ms/step - loss: 344.1979 -
root_mean_squared_error: 18.5526
Epoch 5/70
1/1 [==============================] - 0s 3ms/step - loss: 285.4361 -
root_mean_squared_error: 16.8949
Epoch 6/70
1/1 [==============================] - 0s 4ms/step - loss: 238.3073 -
root_mean_squared_error: 15.4372
Epoch 7/70
1/1 [==============================] - 0s 4ms/step - loss: 199.5995 -
root_mean_squared_error: 14.1280
Epoch 8/70
1/1 [==============================] - 0s 4ms/step - loss: 167.3302 -
root_mean_squared_error: 12.9356
Epoch 9/70
1/1 [==============================] - 0s 4ms/step - loss: 140.1724 -
root_mean_squared_error: 11.8394
Epoch 10/70
1/1 [==============================] - 0s 4ms/step - loss: 117.1843 -
root_mean_squared_error: 10.8252
Epoch 11/70
1/1 [==============================] - 0s 3ms/step - loss: 97.6656 -
root_mean_squared_error: 9.8826
Epoch 12/70
1/1 [==============================] - 0s 3ms/step - loss: 81.0761 -
root_mean_squared_error: 9.0042
Epoch 13/70
1/1 [==============================] - 0s 3ms/step - loss: 66.9861 -
root_mean_squared_error: 8.1845
Epoch 14/70
1/1 [==============================] - 0s 4ms/step - loss: 55.0445 -
root_mean_squared_error: 7.4192
Epoch 15/70
1/1 [==============================] - 0s 4ms/step - loss: 44.9586 -
```

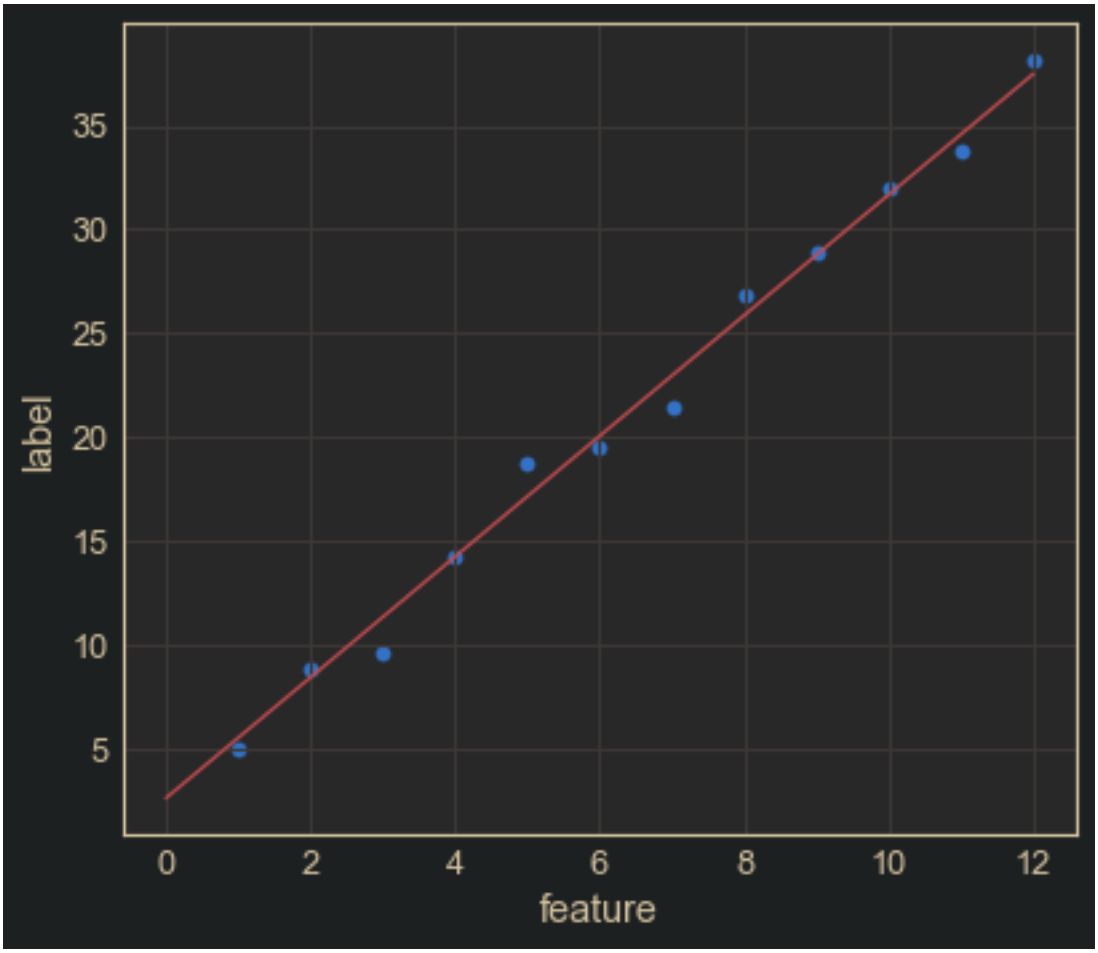
```
root_mean_squared_error: 6.7051
Epoch 16/70
1/1 [==============================] - 0s 3ms/step - loss: 36.4793 -
root_mean_squared_error: 6.0398
Epoch 17/70
1/1 [==============================] - 0s 3ms/step - loss: 29.3917 -
root_mean_squared_error: 5.4214
Epoch 18/70
1/1 [==============================] - 0s 4ms/step - loss: 23.5079 -
root_mean_squared_error: 4.8485
Epoch 19/70
1/1 [==============================] - 0s 4ms/step - loss: 18.6622 -
root_mean_squared_error: 4.3200
Epoch 20/70
1/1 [==============================] - 0s 4ms/step - loss: 14.7075 -
root_mean_squared_error: 3.8350
Epoch 21/70
1/1 [==============================] - 0s 4ms/step - loss: 11.5127 -
root_mean_squared_error: 3.3930
Epoch 22/70
1/1 [==============================] - 0s 3ms/step - loss: 8.9610 -
root_mean_squared_error: 2.9935
Epoch 23/70
1/1 [==============================] - 0s 3ms/step - loss: 6.9482 -
root_mean_squared_error: 2.6359
Epoch 24/70
1/1 [==============================] - 0s 3ms/step - loss: 5.3823 -
root_mean_squared_error: 2.3200
Epoch 25/70
1/1 [==============================] - 0s 3ms/step - loss: 4.1823 -
root_mean_squared_error: 2.0451
Epoch 26/70
1/1 [==============================] - 0s 3ms/step - loss: 3.2775 -
root_mean_squared_error: 1.8104
Epoch 27/70
1/1 [==============================] - 0s 4ms/step - loss: 2.6072 -
root_mean_squared_error: 1.6147
Epoch 28/70
1/1 [==============================] - 0s 3ms/step - loss: 2.1201 -
root_mean_squared_error: 1.4561
Epoch 29/70
1/1 [==============================] - 0s 4ms/step - loss: 1.7732 -
root_mean_squared_error: 1.3316
Epoch 30/70
1/1 [==============================] - 0s 3ms/step - loss: 1.5314 -
root_mean_squared_error: 1.2375
Epoch 31/70
1/1 [==============================] - 0s 4ms/step - loss: 1.3666 -
```

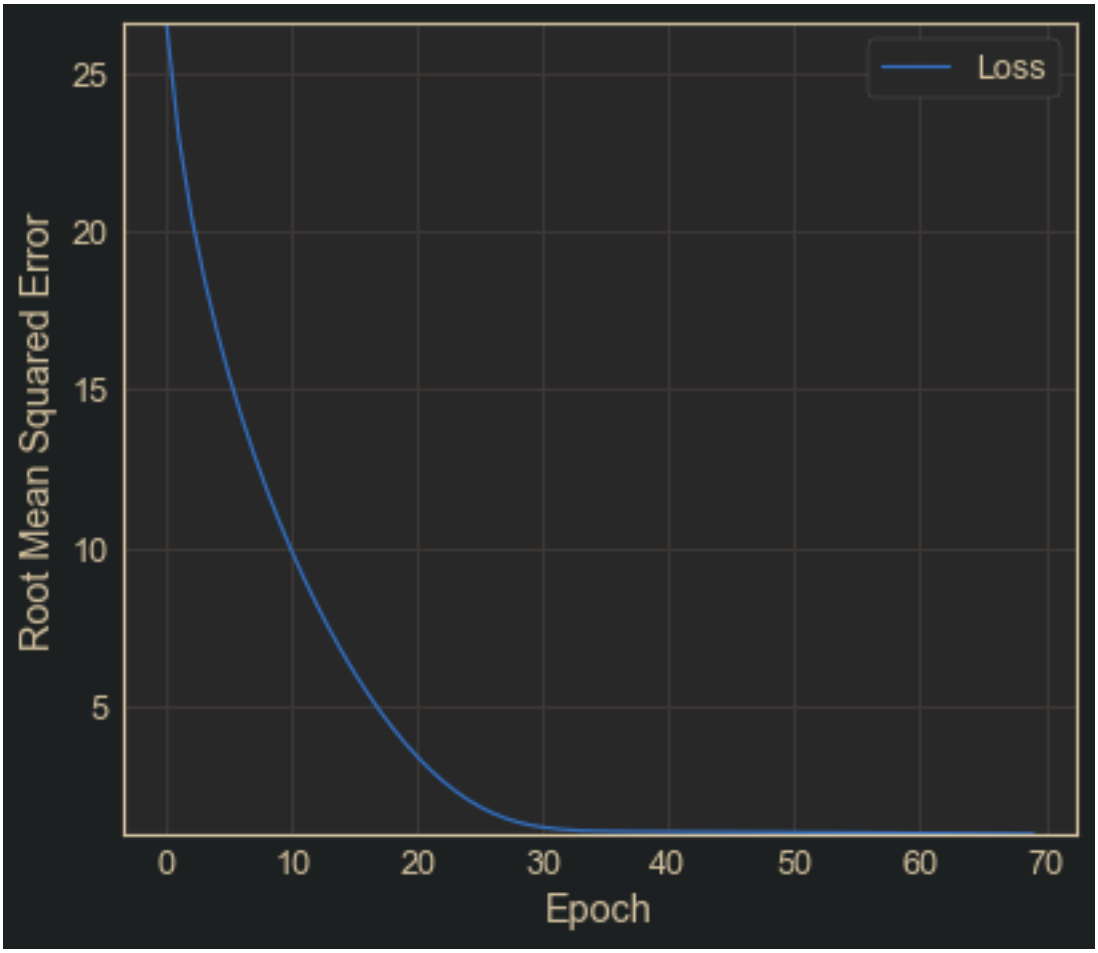
```
root_mean_squared_error: 1.1690
Epoch 32/70
1/1 [==============================] - 0s 4ms/step - loss: 1.2568 -
root_mean_squared_error: 1.1211
Epoch 33/70
1/1 [==============================] - 0s 3ms/step - loss: 1.1853 -
root_mean_squared_error: 1.0887
Epoch 34/70
1/1 [==============================] - 0s 3ms/step - loss: 1.1397 -
root_mean_squared_error: 1.0676
Epoch 35/70
1/1 [==============================] - 0s 3ms/step - loss: 1.1111 -
root_mean_squared_error: 1.0541
Epoch 36/70
1/1 [==============================] - 0s 4ms/step - loss: 1.0931 -
root_mean_squared_error: 1.0455
Epoch 37/70
1/1 [==============================] - 0s 3ms/step - loss: 1.0816 -
root_mean_squared_error: 1.0400
Epoch 38/70
1/1 [==============================] - 0s 3ms/step - loss: 1.0739 -
root_mean_squared_error: 1.0363
Epoch 39/70
1/1 [==============================] - 0s 4ms/step - loss: 1.0683 -
root_mean_squared_error: 1.0336
Epoch 40/70
1/1 [==============================] - 0s 3ms/step - loss: 1.0638 -
root_mean_squared_error: 1.0314
Epoch 41/70
1/1 [==============================] - 0s 3ms/step - loss: 1.0598 -
root_mean_squared_error: 1.0294
Epoch 42/70
1/1 [==============================] - 0s 3ms/step - loss: 1.0559 -
root_mean_squared_error: 1.0276
Epoch 43/70
1/1 [==============================] - 0s 4ms/step - loss: 1.0521 -
root_mean_squared_error: 1.0257
Epoch 44/70
1/1 [==============================] - 0s 5ms/step - loss: 1.0482 -
root_mean_squared_error: 1.0238
Epoch 45/70
1/1 [==============================] - 0s 3ms/step - loss: 1.0443 -
root_mean_squared_error: 1.0219
Epoch 46/70
1/1 [==============================] - 0s 3ms/step - loss: 1.0402 -
root_mean_squared_error: 1.0199
Epoch 47/70
1/1 [==============================] - 0s 3ms/step - loss: 1.0360 -
```

```
root_mean_squared_error: 1.0178
Epoch 48/70
1/1 [==============================] - 0s 3ms/step - loss: 1.0317 -
root_mean_squared_error: 1.0157
Epoch 49/70
1/1 [==============================] - 0s 2ms/step - loss: 1.0273 -
root_mean_squared_error: 1.0135
Epoch 50/70
1/1 [==============================] - 0s 3ms/step - loss: 1.0228 -
root_mean_squared_error: 1.0113
Epoch 51/70
1/1 [==============================] - 0s 2ms/step - loss: 1.0182 -
root_mean_squared_error: 1.0090
Epoch 52/70
1/1 [==============================] - 0s 3ms/step - loss: 1.0134 -
root_mean_squared_error: 1.0067
Epoch 53/70
1/1 [==============================] - 0s 3ms/step - loss: 1.0087 -
root_mean_squared_error: 1.0043
Epoch 54/70
1/1 [==============================] - 0s 4ms/step - loss: 1.0038 -
root_mean_squared_error: 1.0019
Epoch 55/70
1/1 [==============================] - 0s 4ms/step - loss: 0.9988 -
root_mean_squared_error: 0.9994
Epoch 56/70
1/1 [==============================] - 0s 5ms/step - loss: 0.9938 -
root_mean_squared_error: 0.9969
Epoch 57/70
1/1 [==============================] - 0s 3ms/step - loss: 0.9888 -
root_mean_squared_error: 0.9944
Epoch 58/70
1/1 [==============================] - 0s 2ms/step - loss: 0.9837 -
root_mean_squared_error: 0.9918
Epoch 59/70
1/1 [==============================] - 0s 3ms/step - loss: 0.9786 -
root_mean_squared_error: 0.9892
Epoch 60/70
1/1 [==============================] - 0s 3ms/step - loss: 0.9734 -
root_mean_squared_error: 0.9866
Epoch 61/70
1/1 [==============================] - 0s 3ms/step - loss: 0.9683 -
root_mean_squared_error: 0.9840
Epoch 62/70
1/1 [==============================] - 0s 2ms/step - loss: 0.9631 -
root_mean_squared_error: 0.9814
Epoch 63/70
1/1 [==============================] - 0s 4ms/step - loss: 0.9580 -
```

```
root_mean_squared_error: 0.9788
Epoch 64/70
1/1 [==============================] - 0s 3ms/step - loss: 0.9530 -
root_mean_squared_error: 0.9762
Epoch 65/70
1/1 [==============================] - 0s 4ms/step - loss: 0.9480 -
root_mean_squared_error: 0.9736
Epoch 66/70
1/1 [==============================] - 0s 3ms/step - loss: 0.9431 -
root_mean_squared_error: 0.9711
Epoch 67/70
1/1 [==============================] - 0s 3ms/step - loss: 0.9382 -
root_mean_squared_error: 0.9686
Epoch 68/70
1/1 [==============================] - 0s 3ms/step - loss: 0.9335 -
root_mean_squared_error: 0.9662
Epoch 69/70
1/1 [==============================] - 0s 3ms/step - loss: 0.9289 -
root_mean_squared_error: 0.9638
Epoch 70/70
1/1 [==============================] - 0s 3ms/step - loss: 0.9245 -
root_mean_squared_error: 0.9615

C:\Users\Arunabh\anaconda3\envs\mlcc\lib\site-
packages\numpy\core\_asarray.py:136: VisibleDeprecationWarning: Creating an
ndarray from ragged nested sequences (which is a list-or-tuple of lists-or-
tuples-or ndarrays with different lengths or shapes) is deprecated. If you meant
to do this, you must specify 'dtype=object' when creating the ndarray
  return array(a, dtype, copy=False, order=order, subok=True)
```


35
30
25
20
15
10
5
label
0
2
4
6
8
10
12
feature



[ ]:
```
#@title Double-click to view a possible solution

learning_rate=0.14
epochs=70
my_batch_size=12

my_model = build_model(learning_rate)
trained_weight, trained_bias, epochs, rmse = train_model(my_model, my_feature,
                                                         my_label, epochs,
                                                         my_batch_size)
plot_the_model(trained_weight, trained_bias, my_feature, my_label)
plot_the_loss_curve(epochs, rmse)
```

1.13 Task 5: Adjust the batch size

The system recalculates the model's loss value and adjusts the model's weights and bias after each **iteration**. Each iteration is the span in which the system processes one batch. For example, if the **batch size** is 6, then the system recalculates the model's loss value and adjusts the model's

weights and bias after processing every 6 examples.

One **epoch** spans sufficient iterations to process every example in the dataset. For example, if the batch size is 12, then each epoch lasts one iteration. However, if the batch size is 6, then each epoch consumes two iterations.

It is tempting to simply set the batch size to the number of examples in the dataset (12, in this case). However, the model might actually train faster on smaller batches. Conversely, very small batches might not contain enough information to help the model converge.

Experiment with `batch_size` in the following code cell. What's the smallest integer you can set for `batch_size` and still have the model converge in a hundred epochs?

[26]:
```
learning_rate=0.05
epochs=100
my_batch_size=6  # Replace ? with an integer.

my_model = build_model(learning_rate)
trained_weight, trained_bias, epochs, rmse = train_model(my_model, my_feature,
                                                         my_label, epochs,
                                                         my_batch_size)
plot_the_model(trained_weight, trained_bias, my_feature, my_label)
plot_the_loss_curve(epochs, rmse)
```

```
Epoch 1/100
1/1 [==============================] - 0s 229ms/step - loss: 795.3948 -
root_mean_squared_error: 28.2027
Epoch 2/100
1/1 [==============================] - 0s 4ms/step - loss: 723.5212 -
root_mean_squared_error: 26.8983
Epoch 3/100
1/1 [==============================] - 0s 3ms/step - loss: 674.6304 -
root_mean_squared_error: 25.9736
Epoch 4/100
1/1 [==============================] - 0s 3ms/step - loss: 635.5685 -
root_mean_squared_error: 25.2105
Epoch 5/100
1/1 [==============================] - 0s 3ms/step - loss: 602.2419 -
root_mean_squared_error: 24.5406
Epoch 6/100
1/1 [==============================] - 0s 3ms/step - loss: 572.7701 -
root_mean_squared_error: 23.9326
Epoch 7/100
1/1 [==============================] - 0s 3ms/step - loss: 546.1123 -
root_mean_squared_error: 23.3690
Epoch 8/100
1/1 [==============================] - 0s 4ms/step - loss: 521.6245 -
root_mean_squared_error: 22.8391
Epoch 9/100
1/1 [==============================] - 0s 4ms/step - loss: 498.8773 -
```

```
root_mean_squared_error: 22.3356
Epoch 10/100
1/1 [==============================] - 0s 4ms/step - loss: 477.5688 -
root_mean_squared_error: 21.8533
Epoch 11/100
1/1 [==============================] - 0s 3ms/step - loss: 457.4775 -
root_mean_squared_error: 21.3887
Epoch 12/100
1/1 [==============================] - 0s 3ms/step - loss: 438.4364 -
root_mean_squared_error: 20.9389
Epoch 13/100
1/1 [==============================] - 0s 3ms/step - loss: 420.3159 -
root_mean_squared_error: 20.5016
Epoch 14/100
1/1 [==============================] - 0s 4ms/step - loss: 403.0135 -
root_mean_squared_error: 20.0752
Epoch 15/100
1/1 [==============================] - 0s 3ms/step - loss: 386.4466 -
root_mean_squared_error: 19.6582
Epoch 16/100
1/1 [==============================] - 0s 4ms/step - loss: 370.5479 -
root_mean_squared_error: 19.2496
Epoch 17/100
1/1 [==============================] - 0s 4ms/step - loss: 355.2617 -
root_mean_squared_error: 18.8484
Epoch 18/100
1/1 [==============================] - 0s 3ms/step - loss: 340.5414 -
root_mean_squared_error: 18.4538
Epoch 19/100
1/1 [==============================] - 0s 4ms/step - loss: 326.3479 -
root_mean_squared_error: 18.0651
Epoch 20/100
1/1 [==============================] - 0s 3ms/step - loss: 312.6476 -
root_mean_squared_error: 17.6818
Epoch 21/100
1/1 [==============================] - 0s 3ms/step - loss: 299.4120 -
root_mean_squared_error: 17.3035
Epoch 22/100
1/1 [==============================] - 0s 3ms/step - loss: 286.6165 -
root_mean_squared_error: 16.9298
Epoch 23/100
1/1 [==============================] - 0s 3ms/step - loss: 274.2394 -
root_mean_squared_error: 16.5602
Epoch 24/100
1/1 [==============================] - 0s 3ms/step - loss: 262.2621 -
root_mean_squared_error: 16.1945
Epoch 25/100
1/1 [==============================] - 0s 3ms/step - loss: 250.6681 -
```

```
root_mean_squared_error: 15.8325
Epoch 26/100
1/1 [==============================] - 0s 3ms/step - loss: 239.4428 -
root_mean_squared_error: 15.4739
Epoch 27/100
1/1 [==============================] - 0s 3ms/step - loss: 228.5734 -
root_mean_squared_error: 15.1186
Epoch 28/100
1/1 [==============================] - 0s 4ms/step - loss: 218.0483 -
root_mean_squared_error: 14.7665
Epoch 29/100
1/1 [==============================] - 0s 3ms/step - loss: 207.8571 -
root_mean_squared_error: 14.4173
Epoch 30/100
1/1 [==============================] - 0s 5ms/step - loss: 197.9906 -
root_mean_squared_error: 14.0709
Epoch 31/100
1/1 [==============================] - 0s 4ms/step - loss: 188.4402 -
root_mean_squared_error: 13.7274
Epoch 32/100
1/1 [==============================] - 0s 3ms/step - loss: 179.1983 -
root_mean_squared_error: 13.3865
Epoch 33/100
1/1 [==============================] - 0s 3ms/step - loss: 170.2579 -
root_mean_squared_error: 13.0483
Epoch 34/100
1/1 [==============================] - 0s 3ms/step - loss: 161.6122 -
root_mean_squared_error: 12.7127
Epoch 35/100
1/1 [==============================] - 0s 4ms/step - loss: 153.2555 -
root_mean_squared_error: 12.3796
Epoch 36/100
1/1 [==============================] - 0s 4ms/step - loss: 145.1821 -
root_mean_squared_error: 12.0492
Epoch 37/100
1/1 [==============================] - 0s 3ms/step - loss: 137.3866 -
root_mean_squared_error: 11.7212
Epoch 38/100
1/1 [==============================] - 0s 3ms/step - loss: 129.8641 -
root_mean_squared_error: 11.3958
Epoch 39/100
1/1 [==============================] - 0s 3ms/step - loss: 122.6098 -
root_mean_squared_error: 11.0729
Epoch 40/100
1/1 [==============================] - 0s 3ms/step - loss: 115.6194 -
root_mean_squared_error: 10.7526
Epoch 41/100
1/1 [==============================] - 0s 3ms/step - loss: 108.8883 -
```

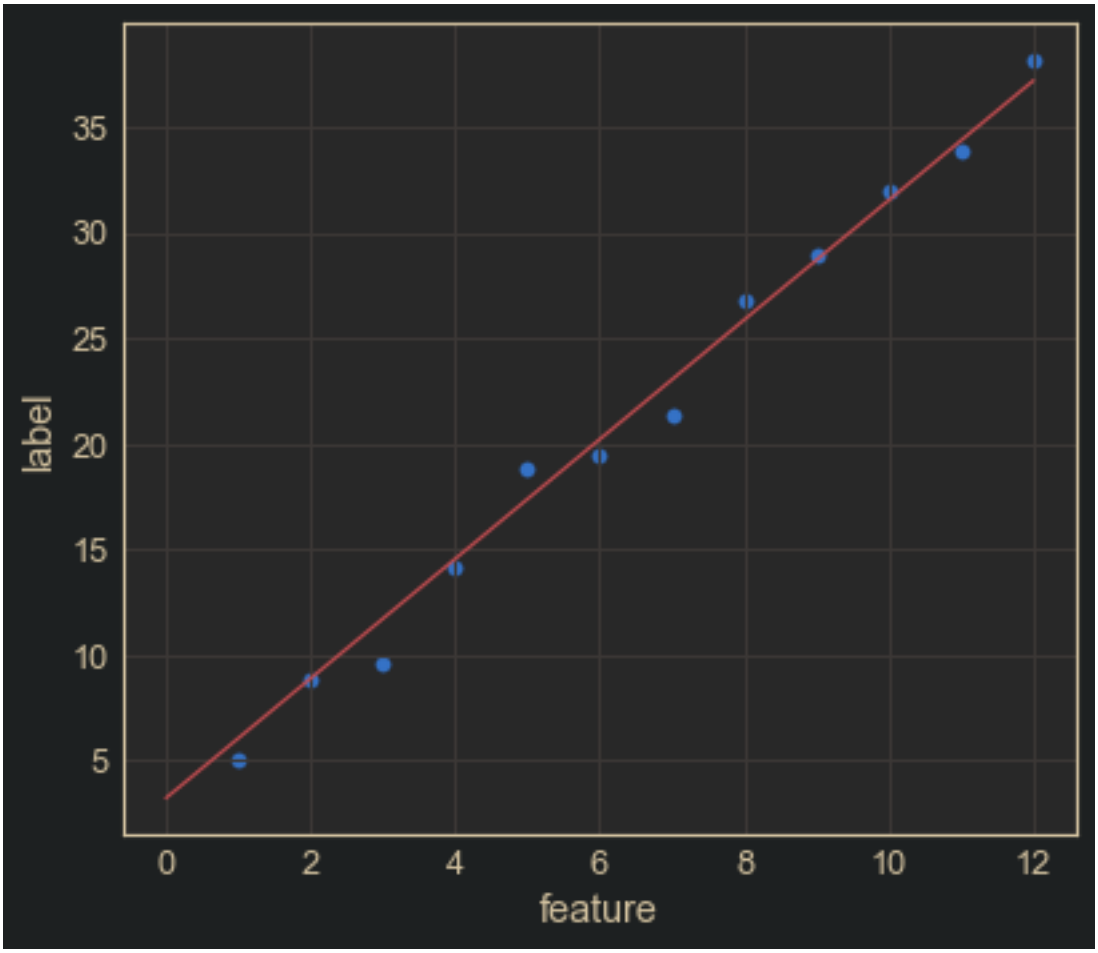
```
root_mean_squared_error: 10.4350
Epoch 42/100
1/1 [==============================] - 0s 3ms/step - loss: 102.4125 -
root_mean_squared_error: 10.1199
Epoch 43/100
1/1 [==============================] - 0s 3ms/step - loss: 96.1879 -
root_mean_squared_error: 9.8075
Epoch 44/100
1/1 [==============================] - 0s 3ms/step - loss: 90.2104 -
root_mean_squared_error: 9.4979
Epoch 45/100
1/1 [==============================] - 0s 2ms/step - loss: 84.4760 -
root_mean_squared_error: 9.1911
Epoch 46/100
1/1 [==============================] - 0s 3ms/step - loss: 78.9810 -
root_mean_squared_error: 8.8871
Epoch 47/100
1/1 [==============================] - 0s 3ms/step - loss: 73.7214 -
root_mean_squared_error: 8.5861
Epoch 48/100
1/1 [==============================] - 0s 3ms/step - loss: 68.6933 -
root_mean_squared_error: 8.2881
Epoch 49/100
1/1 [==============================] - 0s 4ms/step - loss: 63.8928 -
root_mean_squared_error: 7.9933
Epoch 50/100
1/1 [==============================] - 0s 5ms/step - loss: 59.3160 -
root_mean_squared_error: 7.7017
Epoch 51/100
1/1 [==============================] - 0s 4ms/step - loss: 54.9590 -
root_mean_squared_error: 7.4134
Epoch 52/100
1/1 [==============================] - 0s 4ms/step - loss: 50.8176 -
root_mean_squared_error: 7.1286
Epoch 53/100
1/1 [==============================] - 0s 3ms/step - loss: 46.8877 -
root_mean_squared_error: 6.8475
Epoch 54/100
1/1 [==============================] - 0s 3ms/step - loss: 43.1652 -
root_mean_squared_error: 6.5700
Epoch 55/100
1/1 [==============================] - 0s 3ms/step - loss: 39.6457 -
root_mean_squared_error: 6.2965
Epoch 56/100
1/1 [==============================] - 0s 3ms/step - loss: 36.3249 -
root_mean_squared_error: 6.0270
Epoch 57/100
1/1 [==============================] - 0s 5ms/step - loss: 33.1981 -
```

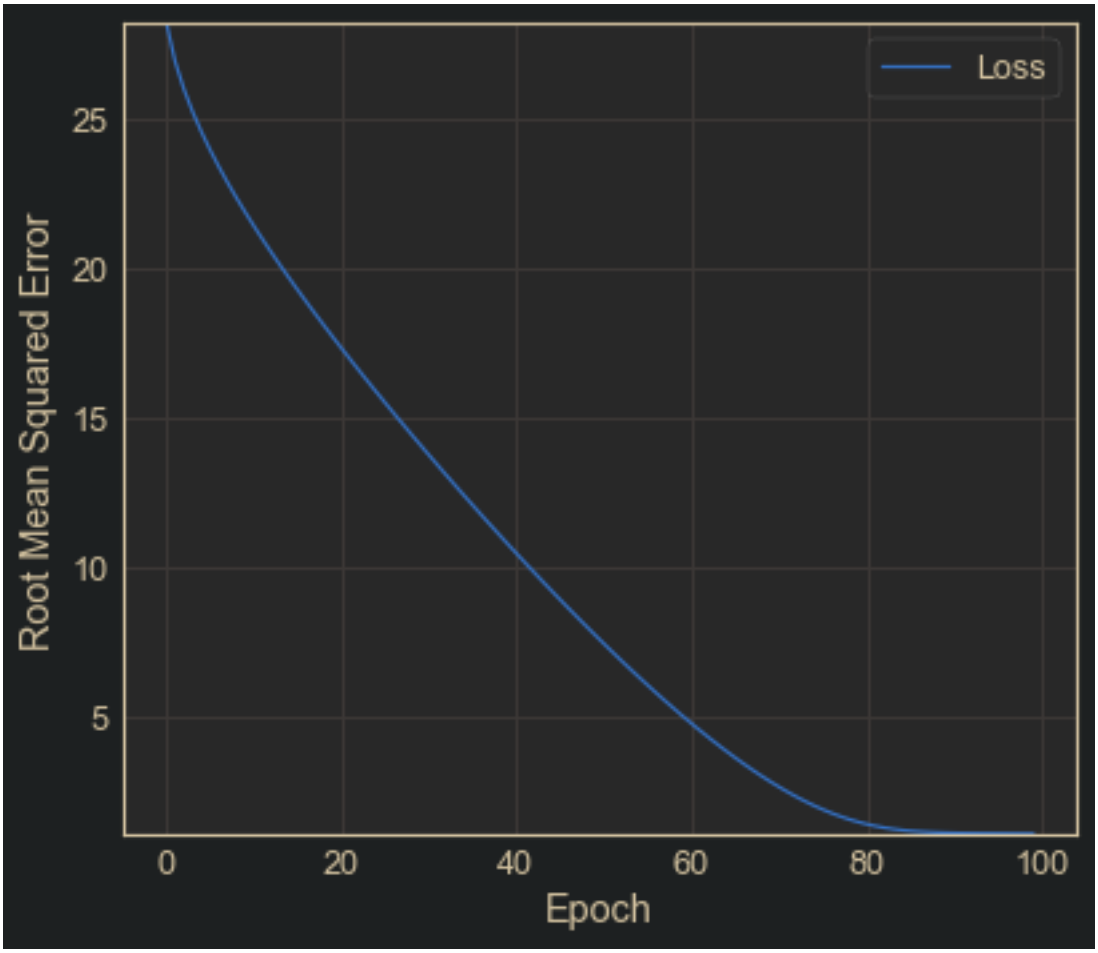
```
root_mean_squared_error: 5.7618
Epoch 58/100
1/1 [==============================] - 0s 4ms/step - loss: 30.2607 -
root_mean_squared_error: 5.5010
Epoch 59/100
1/1 [==============================] - 0s 4ms/step - loss: 27.5079 -
root_mean_squared_error: 5.2448
Epoch 60/100
1/1 [==============================] - 0s 3ms/step - loss: 24.9347 -
root_mean_squared_error: 4.9935
Epoch 61/100
1/1 [==============================] - 0s 4ms/step - loss: 22.5360 -
root_mean_squared_error: 4.7472
Epoch 62/100
1/1 [==============================] - 0s 4ms/step - loss: 20.3065 -
root_mean_squared_error: 4.5063
Epoch 63/100
1/1 [==============================] - 0s 3ms/step - loss: 18.2408 -
root_mean_squared_error: 4.2709
Epoch 64/100
1/1 [==============================] - 0s 3ms/step - loss: 16.3332 -
root_mean_squared_error: 4.0414
Epoch 65/100
1/1 [==============================] - 0s 3ms/step - loss: 14.5780 -
root_mean_squared_error: 3.8181
Epoch 66/100
1/1 [==============================] - 0s 3ms/step - loss: 12.9691 -
root_mean_squared_error: 3.6013
Epoch 67/100
1/1 [==============================] - 0s 3ms/step - loss: 11.5004 -
root_mean_squared_error: 3.3912
Epoch 68/100
1/1 [==============================] - 0s 3ms/step - loss: 10.1657 -
root_mean_squared_error: 3.1884
Epoch 69/100
1/1 [==============================] - 0s 3ms/step - loss: 8.9584 -
root_mean_squared_error: 2.9931
Epoch 70/100
1/1 [==============================] - 0s 3ms/step - loss: 7.8719 -
root_mean_squared_error: 2.8057
Epoch 71/100
1/1 [==============================] - 0s 3ms/step - loss: 6.8995 -
root_mean_squared_error: 2.6267
Epoch 72/100
1/1 [==============================] - 0s 3ms/step - loss: 6.0342 -
root_mean_squared_error: 2.4565
Epoch 73/100
1/1 [==============================] - 0s 3ms/step - loss: 5.2692 -
```

```
root_mean_squared_error: 2.2955
Epoch 74/100
1/1 [==============================] - 0s 3ms/step - loss: 4.5974 -
root_mean_squared_error: 2.1442
Epoch 75/100
1/1 [==============================] - 0s 4ms/step - loss: 4.0117 -
root_mean_squared_error: 2.0029
Epoch 76/100
1/1 [==============================] - 0s 3ms/step - loss: 3.5052 -
root_mean_squared_error: 1.8722
Epoch 77/100
1/1 [==============================] - 0s 3ms/step - loss: 3.0707 -
root_mean_squared_error: 1.7523
Epoch 78/100
1/1 [==============================] - 0s 4ms/step - loss: 2.7014 -
root_mean_squared_error: 1.6436
Epoch 79/100
1/1 [==============================] - 0s 3ms/step - loss: 2.3906 -
root_mean_squared_error: 1.5462
Epoch 80/100
1/1 [==============================] - 0s 3ms/step - loss: 2.1317 -
root_mean_squared_error: 1.4600
Epoch 81/100
1/1 [==============================] - 0s 4ms/step - loss: 1.9184 -
root_mean_squared_error: 1.3851
Epoch 82/100
1/1 [==============================] - 0s 3ms/step - loss: 1.7447 -
root_mean_squared_error: 1.3209
Epoch 83/100
1/1 [==============================] - 0s 4ms/step - loss: 1.6051 -
root_mean_squared_error: 1.2669
Epoch 84/100
1/1 [==============================] - 0s 4ms/step - loss: 1.4943 -
root_mean_squared_error: 1.2224
Epoch 85/100
1/1 [==============================] - 0s 4ms/step - loss: 1.4075 -
root_mean_squared_error: 1.1864
Epoch 86/100
1/1 [==============================] - 0s 4ms/step - loss: 1.3405 -
root_mean_squared_error: 1.1578
Epoch 87/100
1/1 [==============================] - 0s 3ms/step - loss: 1.2894 -
root_mean_squared_error: 1.1355
Epoch 88/100
1/1 [==============================] - 0s 4ms/step - loss: 1.2509 -
root_mean_squared_error: 1.1184
Epoch 89/100
1/1 [==============================] - 0s 3ms/step - loss: 1.2222 -
```

```
root_mean_squared_error: 1.1055
Epoch 90/100
1/1 [==============================] - 0s 3ms/step - loss: 1.2010 -
root_mean_squared_error: 1.0959
Epoch 91/100
1/1 [==============================] - 0s 3ms/step - loss: 1.1853 -
root_mean_squared_error: 1.0887
Epoch 92/100
1/1 [==============================] - 0s 4ms/step - loss: 1.1735 -
root_mean_squared_error: 1.0833
Epoch 93/100
1/1 [==============================] - 0s 3ms/step - loss: 1.1645 -
root_mean_squared_error: 1.0791
Epoch 94/100
1/1 [==============================] - 0s 3ms/step - loss: 1.1574 -
root_mean_squared_error: 1.0758
Epoch 95/100
1/1 [==============================] - 0s 3ms/step - loss: 1.1515 -
root_mean_squared_error: 1.0731
Epoch 96/100
1/1 [==============================] - 0s 4ms/step - loss: 1.1463 -
root_mean_squared_error: 1.0706
Epoch 97/100
1/1 [==============================] - 0s 4ms/step - loss: 1.1415 -
root_mean_squared_error: 1.0684
Epoch 98/100
1/1 [==============================] - 0s 4ms/step - loss: 1.1368 -
root_mean_squared_error: 1.0662
Epoch 99/100
1/1 [==============================] - 0s 4ms/step - loss: 1.1323 -
root_mean_squared_error: 1.0641
Epoch 100/100
1/1 [==============================] - 0s 4ms/step - loss: 1.1276 -
root_mean_squared_error: 1.0619

C:\Users\Arunabh\anaconda3\envs\mlcc\lib\site-
packages\numpy\core\_asarray.py:136: VisibleDeprecationWarning: Creating an
ndarray from ragged nested sequences (which is a list-or-tuple of lists-or-
tuples-or ndarrays with different lengths or shapes) is deprecated. If you meant
to do this, you must specify 'dtype=object' when creating the ndarray
  return array(a, dtype, copy=False, order=order, subok=True)
```


label
feature
35
30
25
20
15
10
5
0
2
4
6
8
10
12



[27]:
```
#@title Double-click to view a possible solution

learning_rate=0.05
epochs=125
my_batch_size=1 # Wow, a batch size of 1 works!

my_model = build_model(learning_rate)
trained_weight, trained_bias, epochs, rmse = train_model(my_model, my_feature,
                                                         my_label, epochs,
                                                         my_batch_size)
plot_the_model(trained_weight, trained_bias, my_feature, my_label)
plot_the_loss_curve(epochs, rmse)
```

```
Epoch 1/125
1/1 [==============================] - 0s 211ms/step - loss: 886.1603 -
root_mean_squared_error: 29.7684
Epoch 2/125
1/1 [==============================] - 0s 4ms/step - loss: 810.2009 -
```

```
root_mean_squared_error: 28.4640
Epoch 3/125
1/1 [==============================] - 0s 4ms/step - loss: 758.3486 -
root_mean_squared_error: 27.5381
Epoch 4/125
1/1 [==============================] - 0s 3ms/step - loss: 716.8121 -
root_mean_squared_error: 26.7733
Epoch 5/125
1/1 [==============================] - 0s 4ms/step - loss: 681.2937 -
root_mean_squared_error: 26.1016
Epoch 6/125
1/1 [==============================] - 0s 3ms/step - loss: 649.8185 -
root_mean_squared_error: 25.4915
Epoch 7/125
1/1 [==============================] - 0s 3ms/step - loss: 621.2928 -
root_mean_squared_error: 24.9257
Epoch 8/125
1/1 [==============================] - 0s 4ms/step - loss: 595.0396 -
root_mean_squared_error: 24.3934
Epoch 9/125
1/1 [==============================] - 0s 3ms/step - loss: 570.6077 -
root_mean_squared_error: 23.8874
Epoch 10/125
1/1 [==============================] - 0s 3ms/step - loss: 547.6794 -
root_mean_squared_error: 23.4026
Epoch 11/125
1/1 [==============================] - 0s 4ms/step - loss: 526.0222 -
root_mean_squared_error: 22.9352
Epoch 12/125
1/1 [==============================] - 0s 4ms/step - loss: 505.4603 -
root_mean_squared_error: 22.4824
Epoch 13/125
1/1 [==============================] - 0s 3ms/step - loss: 485.8574 -
root_mean_squared_error: 22.0422
Epoch 14/125
1/1 [==============================] - 0s 4ms/step - loss: 467.1057 -
root_mean_squared_error: 21.6126
Epoch 15/125
1/1 [==============================] - 0s 4ms/step - loss: 449.1187 -
root_mean_squared_error: 21.1924
Epoch 16/125
1/1 [==============================] - 0s 3ms/step - loss: 431.8253 -
root_mean_squared_error: 20.7804
Epoch 17/125
1/1 [==============================] - 0s 4ms/step - loss: 415.1673 -
root_mean_squared_error: 20.3757
Epoch 18/125
1/1 [==============================] - 0s 3ms/step - loss: 399.0956 -
```

```
root_mean_squared_error: 19.9774
Epoch 19/125
1/1 [==============================] - 0s 3ms/step - loss: 383.5691 -
root_mean_squared_error: 19.5849
Epoch 20/125
1/1 [==============================] - 0s 4ms/step - loss: 368.5528 -
root_mean_squared_error: 19.1977
Epoch 21/125
1/1 [==============================] - 0s 3ms/step - loss: 354.0167 -
root_mean_squared_error: 18.8153
Epoch 22/125
1/1 [==============================] - 0s 4ms/step - loss: 339.9350 -
root_mean_squared_error: 18.4373
Epoch 23/125
1/1 [==============================] - 0s 4ms/step - loss: 326.2852 -
root_mean_squared_error: 18.0634
Epoch 24/125
1/1 [==============================] - 0s 3ms/step - loss: 313.0478 -
root_mean_squared_error: 17.6932
Epoch 25/125
1/1 [==============================] - 0s 4ms/step - loss: 300.2056 -
root_mean_squared_error: 17.3264
Epoch 26/125
1/1 [==============================] - 0s 3ms/step - loss: 287.7436 -
root_mean_squared_error: 16.9630
Epoch 27/125
1/1 [==============================] - 0s 4ms/step - loss: 275.6482 -
root_mean_squared_error: 16.6027
Epoch 28/125
1/1 [==============================] - 0s 3ms/step - loss: 263.9077 -
root_mean_squared_error: 16.2452
Epoch 29/125
1/1 [==============================] - 0s 4ms/step - loss: 252.5113 -
root_mean_squared_error: 15.8906
Epoch 30/125
1/1 [==============================] - 0s 3ms/step - loss: 241.4495 -
root_mean_squared_error: 15.5386
Epoch 31/125
1/1 [==============================] - 0s 4ms/step - loss: 230.7136 -
root_mean_squared_error: 15.1893
Epoch 32/125
1/1 [==============================] - 0s 3ms/step - loss: 220.2959 -
root_mean_squared_error: 14.8424
Epoch 33/125
1/1 [==============================] - 0s 3ms/step - loss: 210.1891 -
root_mean_squared_error: 14.4979
Epoch 34/125
1/1 [==============================] - 0s 3ms/step - loss: 200.3868 -
```

```
root_mean_squared_error: 14.1558
Epoch 35/125
1/1 [==============================] - 0s 3ms/step - loss: 190.8828 -
root_mean_squared_error: 13.8160
Epoch 36/125
1/1 [==============================] - 0s 3ms/step - loss: 181.6718 -
root_mean_squared_error: 13.4786
Epoch 37/125
1/1 [==============================] - 0s 4ms/step - loss: 172.7483 -
root_mean_squared_error: 13.1434
Epoch 38/125
1/1 [==============================] - 0s 4ms/step - loss: 164.1077 -
root_mean_squared_error: 12.8105
Epoch 39/125
1/1 [==============================] - 0s 4ms/step - loss: 155.7452 -
root_mean_squared_error: 12.4798
Epoch 40/125
1/1 [==============================] - 0s 4ms/step - loss: 147.6566 -
root_mean_squared_error: 12.1514
Epoch 41/125
1/1 [==============================] - 0s 4ms/step - loss: 139.8378 -
root_mean_squared_error: 11.8253
Epoch 42/125
1/1 [==============================] - 0s 5ms/step - loss: 132.2847 -
root_mean_squared_error: 11.5015
Epoch 43/125
1/1 [==============================] - 0s 4ms/step - loss: 124.9936 -
root_mean_squared_error: 11.1801
Epoch 44/125
1/1 [==============================] - 0s 4ms/step - loss: 117.9608 -
root_mean_squared_error: 10.8610
Epoch 45/125
1/1 [==============================] - 0s 3ms/step - loss: 111.1825 -
root_mean_squared_error: 10.5443
Epoch 46/125
1/1 [==============================] - 0s 4ms/step - loss: 104.6553 -
root_mean_squared_error: 10.2301
Epoch 47/125
1/1 [==============================] - 0s 4ms/step - loss: 98.3757 -
root_mean_squared_error: 9.9185
Epoch 48/125
1/1 [==============================] - 0s 3ms/step - loss: 92.3401 -
root_mean_squared_error: 9.6094
Epoch 49/125
1/1 [==============================] - 0s 3ms/step - loss: 86.5451 -
root_mean_squared_error: 9.3030
Epoch 50/125
1/1 [==============================] - 0s 4ms/step - loss: 80.9873 -
```

```
root_mean_squared_error: 8.9993
Epoch 51/125
1/1 [==============================] - 0s 5ms/step - loss: 75.6630 -
root_mean_squared_error: 8.6984
Epoch 52/125
1/1 [==============================] - 0s 3ms/step - loss: 70.5688 -
root_mean_squared_error: 8.4005
Epoch 53/125
1/1 [==============================] - 0s 4ms/step - loss: 65.7011 -
root_mean_squared_error: 8.1056
Epoch 54/125
1/1 [==============================] - 0s 3ms/step - loss: 61.0563 -
root_mean_squared_error: 7.8139
Epoch 55/125
1/1 [==============================] - 0s 3ms/step - loss: 56.6307 -
root_mean_squared_error: 7.5253
Epoch 56/125
1/1 [==============================] - 0s 3ms/step - loss: 52.4203 -
root_mean_squared_error: 7.2402
Epoch 57/125
1/1 [==============================] - 0s 3ms/step - loss: 48.4215 -
root_mean_squared_error: 6.9586
Epoch 58/125
1/1 [==============================] - 0s 3ms/step - loss: 44.6301 -
root_mean_squared_error: 6.6806
Epoch 59/125
1/1 [==============================] - 0s 4ms/step - loss: 41.0420 -
root_mean_squared_error: 6.4064
Epoch 60/125
1/1 [==============================] - 0s 4ms/step - loss: 37.6531 -
root_mean_squared_error: 6.1362
Epoch 61/125
1/1 [==============================] - 0s 4ms/step - loss: 34.4590 -
root_mean_squared_error: 5.8702
Epoch 62/125
1/1 [==============================] - 0s 4ms/step - loss: 31.4551 -
root_mean_squared_error: 5.6085
Epoch 63/125
1/1 [==============================] - 0s 4ms/step - loss: 28.6368 -
root_mean_squared_error: 5.3513
Epoch 64/125
1/1 [==============================] - 0s 4ms/step - loss: 25.9993 -
root_mean_squared_error: 5.0990
Epoch 65/125
1/1 [==============================] - 0s 3ms/step - loss: 23.5377 -
root_mean_squared_error: 4.8516
Epoch 66/125
1/1 [==============================] - 0s 3ms/step - loss: 21.2467 -
```

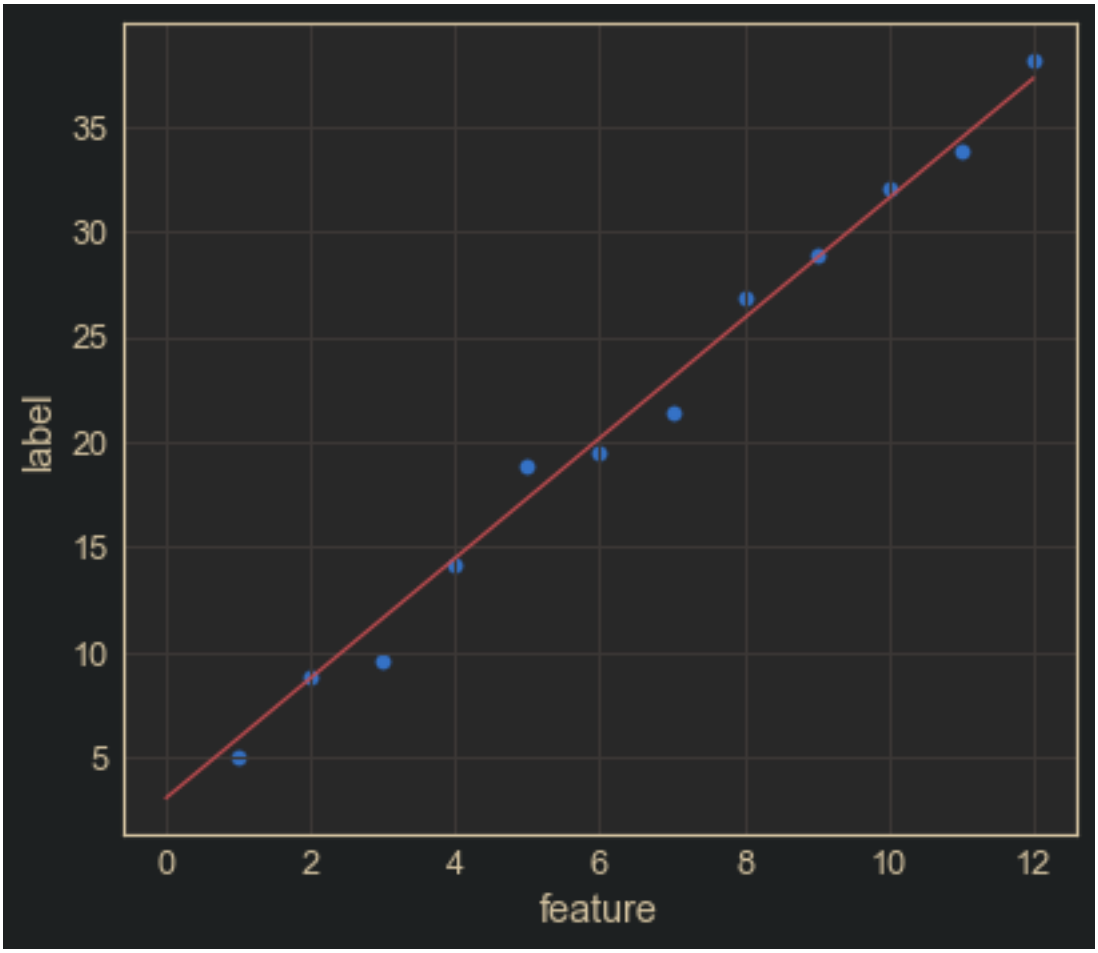
```
root_mean_squared_error: 4.6094
Epoch 67/125
1/1 [==============================] - 0s 3ms/step - loss: 19.1210 -
root_mean_squared_error: 4.3728
Epoch 68/125
1/1 [==============================] - 0s 3ms/step - loss: 17.1552 -
root_mean_squared_error: 4.1419
Epoch 69/125
1/1 [==============================] - 0s 3ms/step - loss: 15.3436 -
root_mean_squared_error: 3.9171
Epoch 70/125
1/1 [==============================] - 0s 3ms/step - loss: 13.6803 -
root_mean_squared_error: 3.6987
Epoch 71/125
1/1 [==============================] - 0s 3ms/step - loss: 12.1593 -
root_mean_squared_error: 3.4870
Epoch 72/125
1/1 [==============================] - 0s 3ms/step - loss: 10.7744 -
root_mean_squared_error: 3.2824
Epoch 73/125
1/1 [==============================] - 0s 3ms/step - loss: 9.5192 -
root_mean_squared_error: 3.0853
Epoch 74/125
1/1 [==============================] - 0s 3ms/step - loss: 8.3871 -
root_mean_squared_error: 2.8960
Epoch 75/125
1/1 [==============================] - 0s 3ms/step - loss: 7.3715 -
root_mean_squared_error: 2.7151
Epoch 76/125
1/1 [==============================] - 0s 3ms/step - loss: 6.4657 -
root_mean_squared_error: 2.5428
Epoch 77/125
1/1 [==============================] - 0s 3ms/step - loss: 5.6626 -
root_mean_squared_error: 2.3796
Epoch 78/125
1/1 [==============================] - 0s 4ms/step - loss: 4.9553 -
root_mean_squared_error: 2.2260
Epoch 79/125
1/1 [==============================] - 0s 4ms/step - loss: 4.3368 -
root_mean_squared_error: 2.0825
Epoch 80/125
1/1 [==============================] - 0s 3ms/step - loss: 3.8000 -
root_mean_squared_error: 1.9494
Epoch 81/125
1/1 [==============================] - 0s 4ms/step - loss: 3.3379 -
root_mean_squared_error: 1.8270
Epoch 82/125
1/1 [==============================] - 0s 4ms/step - loss: 2.9436 -
```

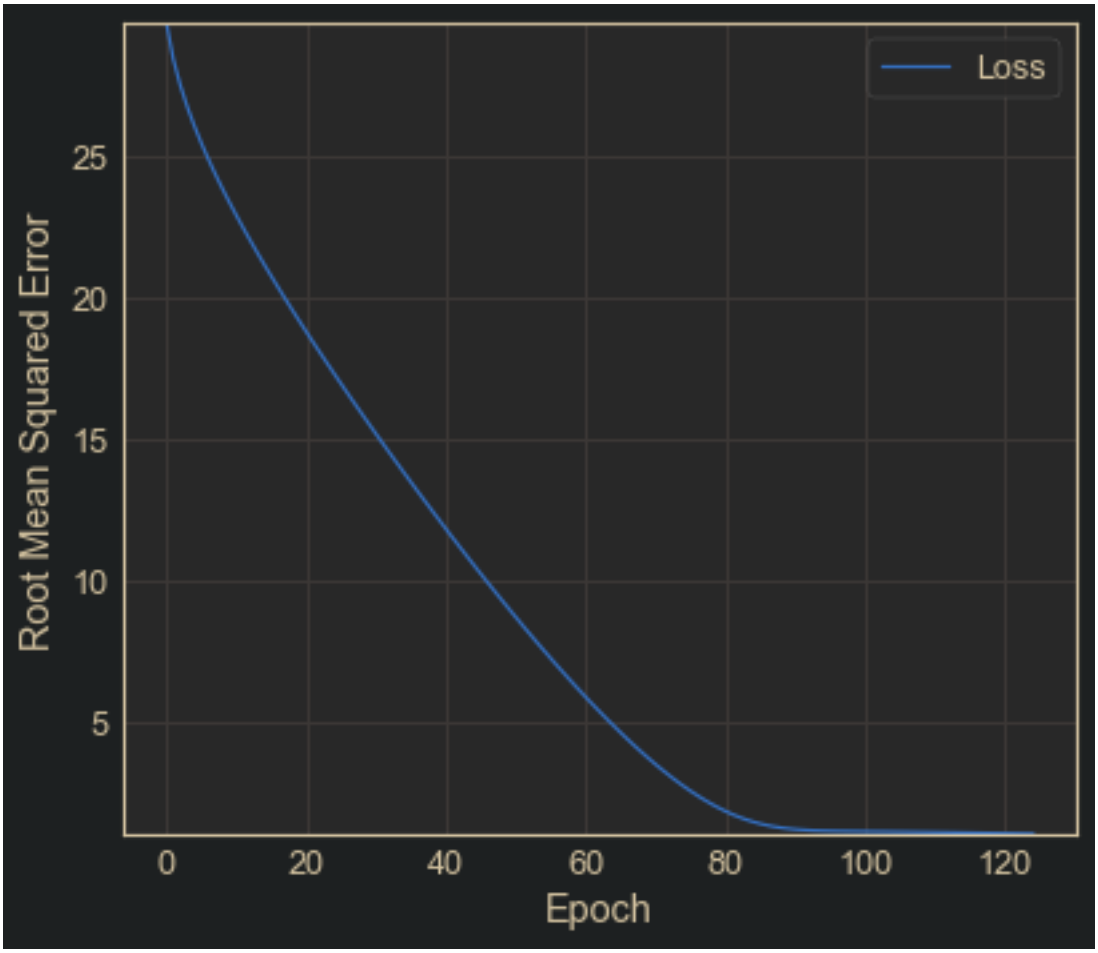
```
root_mean_squared_error: 1.7157
Epoch 83/125
1/1 [==============================] - 0s 4ms/step - loss: 2.6103 -
root_mean_squared_error: 1.6156
Epoch 84/125
1/1 [==============================] - 0s 4ms/step - loss: 2.3314 -
root_mean_squared_error: 1.5269
Epoch 85/125
1/1 [==============================] - 0s 4ms/step - loss: 2.1004 -
root_mean_squared_error: 1.4493
Epoch 86/125
1/1 [==============================] - 0s 3ms/step - loss: 1.9113 -
root_mean_squared_error: 1.3825
Epoch 87/125
1/1 [==============================] - 0s 3ms/step - loss: 1.7583 -
root_mean_squared_error: 1.3260
Epoch 88/125
1/1 [==============================] - 0s 3ms/step - loss: 1.6361 -
root_mean_squared_error: 1.2791
Epoch 89/125
1/1 [==============================] - 0s 3ms/step - loss: 1.5397 -
root_mean_squared_error: 1.2408
Epoch 90/125
1/1 [==============================] - 0s 3ms/step - loss: 1.4645 -
root_mean_squared_error: 1.2102
Epoch 91/125
1/1 [==============================] - 0s 4ms/step - loss: 1.4067 -
root_mean_squared_error: 1.1861
Epoch 92/125
1/1 [==============================] - 0s 3ms/step - loss: 1.3628 -
root_mean_squared_error: 1.1674
Epoch 93/125
1/1 [==============================] - 0s 3ms/step - loss: 1.3296 -
root_mean_squared_error: 1.1531
Epoch 94/125
1/1 [==============================] - 0s 3ms/step - loss: 1.3047 -
root_mean_squared_error: 1.1422
Epoch 95/125
1/1 [==============================] - 0s 3ms/step - loss: 1.2859 -
root_mean_squared_error: 1.1340
Epoch 96/125
1/1 [==============================] - 0s 3ms/step - loss: 1.2716 -
root_mean_squared_error: 1.1277
Epoch 97/125
1/1 [==============================] - 0s 3ms/step - loss: 1.2605 -
root_mean_squared_error: 1.1227
Epoch 98/125
1/1 [==============================] - 0s 3ms/step - loss: 1.2515 -
```

```
root_mean_squared_error: 1.1187
Epoch 99/125
1/1 [==============================] - 0s 4ms/step - loss: 1.2440 -
root_mean_squared_error: 1.1153
Epoch 100/125
1/1 [==============================] - 0s 3ms/step - loss: 1.2372 -
root_mean_squared_error: 1.1123
Epoch 101/125
1/1 [==============================] - 0s 3ms/step - loss: 1.2309 -
root_mean_squared_error: 1.1095
Epoch 102/125
1/1 [==============================] - 0s 4ms/step - loss: 1.2249 -
root_mean_squared_error: 1.1067
Epoch 103/125
1/1 [==============================] - 0s 4ms/step - loss: 1.2188 -
root_mean_squared_error: 1.1040
Epoch 104/125
1/1 [==============================] - 0s 5ms/step - loss: 1.2127 -
root_mean_squared_error: 1.1012
Epoch 105/125
1/1 [==============================] - 0s 3ms/step - loss: 1.2065 -
root_mean_squared_error: 1.0984
Epoch 106/125
1/1 [==============================] - 0s 3ms/step - loss: 1.2001 -
root_mean_squared_error: 1.0955
Epoch 107/125
1/1 [==============================] - 0s 4ms/step - loss: 1.1936 -
root_mean_squared_error: 1.0925
Epoch 108/125
1/1 [==============================] - 0s 3ms/step - loss: 1.1868 -
root_mean_squared_error: 1.0894
Epoch 109/125
1/1 [==============================] - 0s 3ms/step - loss: 1.1799 -
root_mean_squared_error: 1.0862
Epoch 110/125
1/1 [==============================] - 0s 3ms/step - loss: 1.1728 -
root_mean_squared_error: 1.0829
Epoch 111/125
1/1 [==============================] - 0s 4ms/step - loss: 1.1655 -
root_mean_squared_error: 1.0796
Epoch 112/125
1/1 [==============================] - 0s 3ms/step - loss: 1.1580 -
root_mean_squared_error: 1.0761
Epoch 113/125
1/1 [==============================] - 0s 4ms/step - loss: 1.1503 -
root_mean_squared_error: 1.0725
Epoch 114/125
1/1 [==============================] - 0s 3ms/step - loss: 1.1425 -
```

```
root_mean_squared_error: 1.0689
Epoch 115/125
1/1 [==============================] - 0s 3ms/step - loss: 1.1346 -
root_mean_squared_error: 1.0652
Epoch 116/125
1/1 [==============================] - 0s 4ms/step - loss: 1.1265 -
root_mean_squared_error: 1.0614
Epoch 117/125
1/1 [==============================] - 0s 4ms/step - loss: 1.1183 -
root_mean_squared_error: 1.0575
Epoch 118/125
1/1 [==============================] - 0s 4ms/step - loss: 1.1100 -
root_mean_squared_error: 1.0536
Epoch 119/125
1/1 [==============================] - 0s 4ms/step - loss: 1.1016 -
root_mean_squared_error: 1.0496
Epoch 120/125
1/1 [==============================] - 0s 4ms/step - loss: 1.0931 -
root_mean_squared_error: 1.0455
Epoch 121/125
1/1 [==============================] - 0s 4ms/step - loss: 1.0846 -
root_mean_squared_error: 1.0414
Epoch 122/125
1/1 [==============================] - 0s 4ms/step - loss: 1.0760 -
root_mean_squared_error: 1.0373
Epoch 123/125
1/1 [==============================] - 0s 3ms/step - loss: 1.0674 -
root_mean_squared_error: 1.0331
Epoch 124/125
1/1 [==============================] - 0s 3ms/step - loss: 1.0587 -
root_mean_squared_error: 1.0290
Epoch 125/125
1/1 [==============================] - 0s 3ms/step - loss: 1.0501 -
root_mean_squared_error: 1.0248

C:\Users\Arunabh\anaconda3\envs\mlcc\lib\site-
packages\numpy\core\_asarray.py:136: VisibleDeprecationWarning: Creating an
ndarray from ragged nested sequences (which is a list-or-tuple of lists-or-
tuples-or ndarrays with different lengths or shapes) is deprecated. If you meant
to do this, you must specify 'dtype=object' when creating the ndarray
  return array(a, dtype, copy=False, order=order, subok=True)
```


label
feature
35
30
25
20
15
10
5
0
2
4
6
8
10
12



1.14 Summary of hyperparameter tuning

Most machine learning problems require a lot of hyperparameter tuning. Unfortunately, we can't provide concrete tuning rules for every model. Lowering the learning rate can help one model converge efficiently but make another model converge much too slowly. You must experiment to find the best set of hyperparameters for your dataset. That said, here are a few rules of thumb:

- Training loss should steadily decrease, steeply at first, and then more slowly until the slope of the curve reaches or approaches zero.
- If the training loss does not converge, train for more epochs.
- If the training loss decreases too slowly, increase the learning rate. Note that setting the training loss too high may also prevent training loss from converging.
- If the training loss varies wildly (that is, the training loss jumps around), decrease the learning rate.
- Lowering the learning rate while increasing the number of epochs or the batch size is often a good combination.
- Setting the batch size to a *very* small batch number can also cause instability. First, try large batch size values. Then, decrease the batch size until you see degradation.
- For real-world datasets consisting of a very large number of examples, the entire dataset might

not fit into memory. In such cases, you'll need to reduce the batch size to enable a batch to fit into memory.

Remember: the ideal combination of hyperparameters is data dependent, so you must always experiment and verify.