machine-learning-bac

August 17, 2023

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import yfinance as yf
```

[3]:
```
datasets = ["BAC"]


for dataset in datasets:
    Ticker = yf.Ticker(dataset)
    data = Ticker.history(start="2023-05-15", end="2023-07-15")
    filename = f"{dataset}_data.csv"
    data.to_csv(filename)
    print(f"Download data for {dataset} and saved as {filename}")
```

```
Download data for BAC and saved as BAC_data.csv
```

[10]:
```
Ticker = 'BAC'
start_date = '2023-05-15'
end_date = '2023-07-15'
data = yf.download(Ticker, start=start_date, end=end_date)['Close']
```

```
[**********100%%**********]  1 of 1 completed
```

[11]:
```
data
```

[11]:
```
Date
2023-05-15    27.650000
2023-05-16    27.360001
2023-05-17    28.570000
2023-05-18    28.469999
2023-05-19    28.110001
2023-05-22    28.340000
2023-05-23    28.580000
2023-05-24    28.100000
2023-05-25    28.170000
2023-05-26    28.309999
2023-05-30    28.260000
```

```
2023-05-31    27.790001
2023-06-01    27.780001
2023-06-02    28.709999
2023-06-05    28.540001
2023-06-06    29.230000
2023-06-07    29.480000
2023-06-08    29.230000
2023-06-09    29.270000
2023-06-12    29.129999
2023-06-13    29.400000
2023-06-14    29.120001
2023-06-15    29.370001
2023-06-16    29.190001
2023-06-20    28.870001
2023-06-21    28.570000
2023-06-22    27.959999
2023-06-23    27.750000
2023-06-26    28.090000
2023-06-27    28.240000
2023-06-28    28.070000
2023-06-29    28.660000
2023-06-30    28.690001
2023-07-03    29.200001
2023-07-05    29.080000
2023-07-06    28.280001
2023-07-07    28.530001
2023-07-10    28.660000
2023-07-11    29.020000
2023-07-12    29.360001
2023-07-13    29.670000
2023-07-14    29.110001
Name: Close, dtype: float64
```

1 Import Data

[12]:
```
data.head()
```

[12]:
```
Date
2023-05-15    27.650000
2023-05-16    27.360001
2023-05-17    28.570000
2023-05-18    28.469999
2023-05-19    28.110001
Name: Close, dtype: float64
```

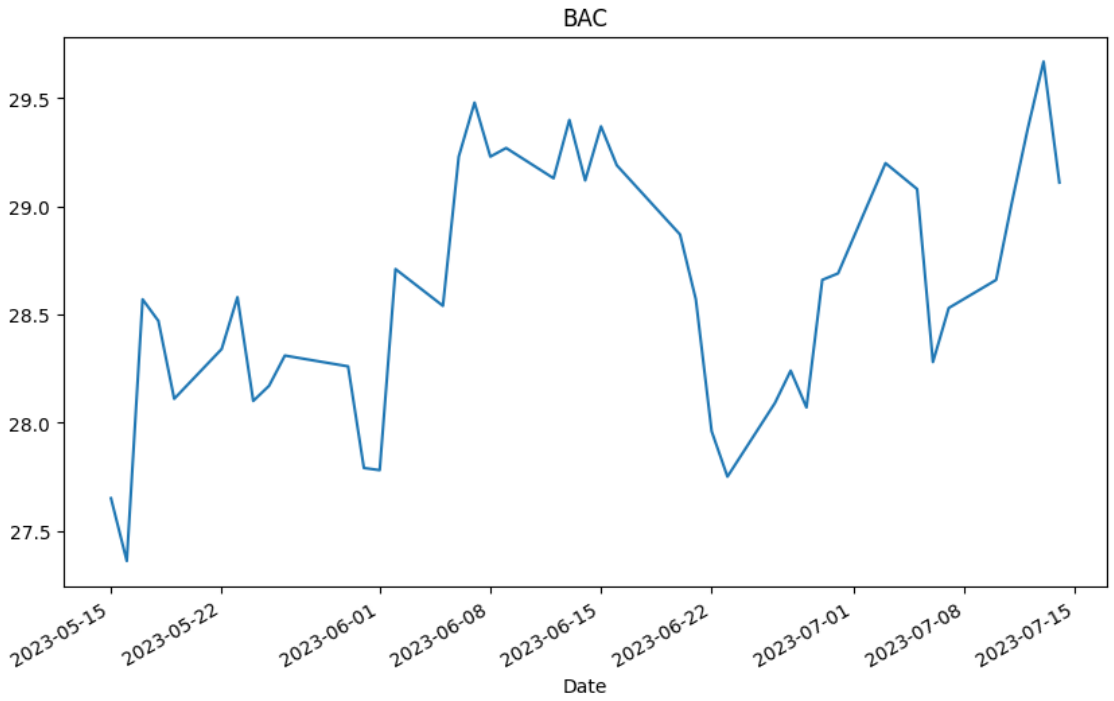
[13]:
```
data.tail()
```

[13]:
```
Date
2023-07-10    28.660000
2023-07-11    29.020000
2023-07-12    29.360001
2023-07-13    29.670000
2023-07-14    29.110001
Name: Close, dtype: float64
```

[15]:
```
l = data.resample('1M').last()
```

[44]:
```
data.plot(figsize=(10, 6), title='BAC')
```

[44]:
```
<Axes: title={'center': 'BAC'}, xlabel='Date'>
```

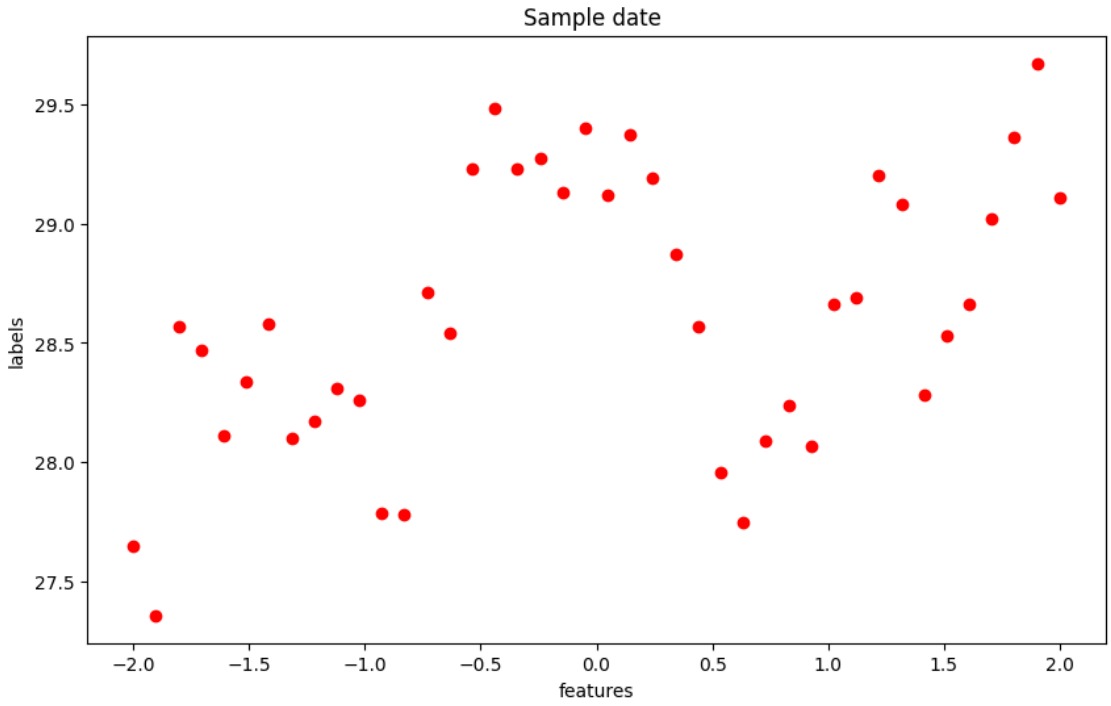


[17]:
```
l = data.values
l_0 = data.mean()
```

[18]:
```
f = np.linspace(-2, 2, len(data))
```

[19]:
```
plt.figure(figsize=(10, 6))
plt.plot(f, l, 'ro')
plt.title('Sample date ')
plt.xlabel('features')
plt.ylabel('labels')
```

[19]: Text(0, 0.5, 'labels')



2 Success

[20]:
```
# The fuction MSE Calculates the mean-squared-error
def MSE(l, p):
    return np.mean((l - p) ** 2)
```

[21]:
```
# The fitting of the OLS Regression model up to and including␣
 ↪fifth-order-monomials
reg = np.polyfit(f, l, deg=5)
```

[22]:
```
reg
```

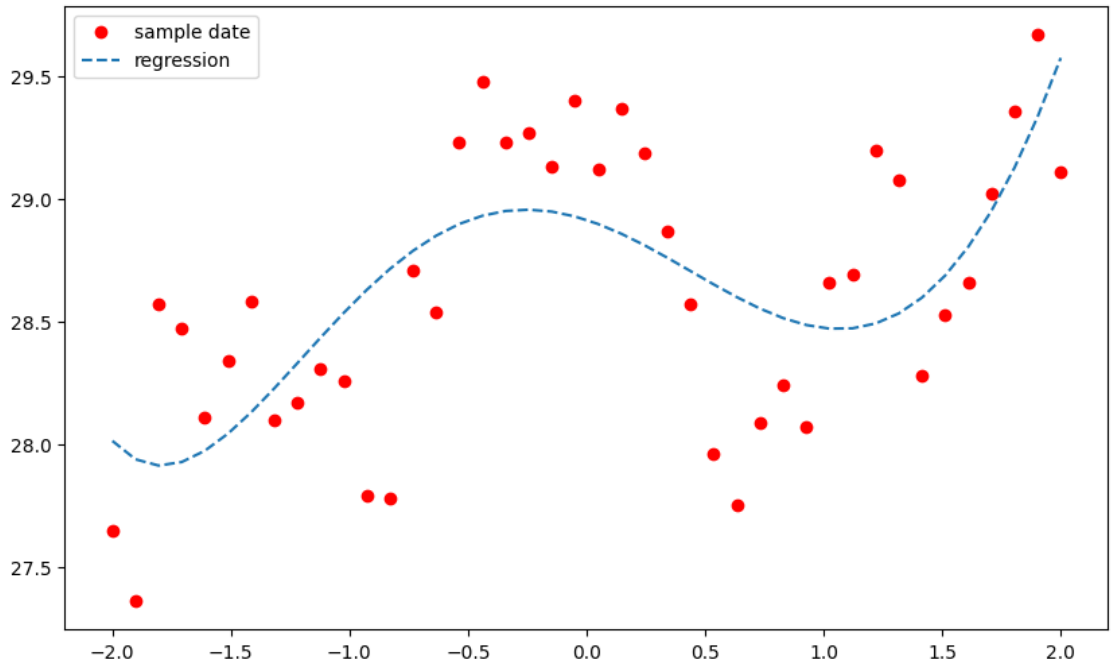
[22]:
```
array([-0.03180353,  0.12267268,  0.30351036, -0.52071558, -0.31470343,
       28.91503064])
```

[23]:
```
# The prediction by the OLS Regression model given the optimal parameters
p = np.polyval(reg, f)
```

[24]:
```
#The MSE value given the prediction value
MSE(l, p)
```

[24]: 0.18387702243048723

[25]:
```
plt.figure(figsize=(10, 6))
plt.plot(f, l, 'ro', label='sample date')
plt.plot(f, p, '--', label='regression')
plt.legend();
```



[26]:
```
import tensorflow as tf
tf.random.set_seed(100)
```

[27]:
```
from keras.layers import Dense
from keras.models import Sequential
```

[28]:
```
model = Sequential()
model.add(Dense(256, activation='relu', input_dim=1))
model.add(Dense(1, activation='linear'))
model.compile(loss='mse', optimizer='rmsprop')
```

[29]:
```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense (Dense)               (None, 256)               512
```

```
 dense_1 (Dense)             (None, 1)                 257

=================================================================
Total params: 769
Trainable params: 769
Non-trainable params: 0
_________________________________________________________________
```

[30]:
```
%time model.fit(f, l, epochs=1500, verbose=True)
```

```
Epoch 1/1500
2/2 [==============================] - 0s 10ms/step - loss: 817.0469
Epoch 2/1500
2/2 [==============================] - 0s 5ms/step - loss: 808.1884
Epoch 3/1500
2/2 [==============================] - 0s 5ms/step - loss: 801.6991
Epoch 4/1500
2/2 [==============================] - 0s 4ms/step - loss: 796.4325
Epoch 5/1500
2/2 [==============================] - 0s 4ms/step - loss: 791.6453
Epoch 6/1500
2/2 [==============================] - 0s 4ms/step - loss: 786.9604
Epoch 7/1500
2/2 [==============================] - 0s 4ms/step - loss: 782.4695
Epoch 8/1500
2/2 [==============================] - 0s 4ms/step - loss: 778.1050
Epoch 9/1500
2/2 [==============================] - 0s 4ms/step - loss: 773.8954
Epoch 10/1500
2/2 [==============================] - 0s 5ms/step - loss: 769.7902
Epoch 11/1500
2/2 [==============================] - 0s 4ms/step - loss: 765.5968
Epoch 12/1500
2/2 [==============================] - 0s 5ms/step - loss: 761.3173
Epoch 13/1500
2/2 [==============================] - 0s 5ms/step - loss: 757.0302
Epoch 14/1500
2/2 [==============================] - 0s 4ms/step - loss: 752.7767
Epoch 15/1500
2/2 [==============================] - 0s 5ms/step - loss: 748.4166
Epoch 16/1500
2/2 [==============================] - 0s 4ms/step - loss: 744.2622
Epoch 17/1500
2/2 [==============================] - 0s 4ms/step - loss: 739.9661
Epoch 18/1500
2/2 [==============================] - 0s 5ms/step - loss: 735.4926
Epoch 19/1500
```

```
2/2 [==============================] - 0s 4ms/step - loss: 731.0334
Epoch 20/1500
2/2 [==============================] - 0s 4ms/step - loss: 726.7067
Epoch 21/1500
2/2 [==============================] - 0s 5ms/step - loss: 722.4056
Epoch 22/1500
2/2 [==============================] - 0s 7ms/step - loss: 717.9847
Epoch 23/1500
2/2 [==============================] - 0s 5ms/step - loss: 713.6735
Epoch 24/1500
2/2 [==============================] - 0s 4ms/step - loss: 709.2811
Epoch 25/1500
2/2 [==============================] - 0s 4ms/step - loss: 704.5774
Epoch 26/1500
2/2 [==============================] - 0s 7ms/step - loss: 699.9096
Epoch 27/1500
2/2 [==============================] - 0s 3ms/step - loss: 695.2585
Epoch 28/1500
2/2 [==============================] - 0s 4ms/step - loss: 690.6822
Epoch 29/1500
2/2 [==============================] - 0s 4ms/step - loss: 686.0197
Epoch 30/1500
2/2 [==============================] - 0s 5ms/step - loss: 681.3222
Epoch 31/1500
2/2 [==============================] - 0s 4ms/step - loss: 676.4915
Epoch 32/1500
2/2 [==============================] - 0s 4ms/step - loss: 671.5068
Epoch 33/1500
2/2 [==============================] - 0s 4ms/step - loss: 666.4354
Epoch 34/1500
2/2 [==============================] - 0s 5ms/step - loss: 661.3600
Epoch 35/1500
2/2 [==============================] - 0s 4ms/step - loss: 656.2183
Epoch 36/1500
2/2 [==============================] - 0s 4ms/step - loss: 651.1930
Epoch 37/1500
2/2 [==============================] - 0s 4ms/step - loss: 645.9583
Epoch 38/1500
2/2 [==============================] - 0s 4ms/step - loss: 640.8068
Epoch 39/1500
2/2 [==============================] - 0s 3ms/step - loss: 635.6376
Epoch 40/1500
2/2 [==============================] - 0s 3ms/step - loss: 630.3317
Epoch 41/1500
2/2 [==============================] - 0s 3ms/step - loss: 624.9743
Epoch 42/1500
2/2 [==============================] - 0s 3ms/step - loss: 619.4843
Epoch 43/1500
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2/2 [==============================] - 0s 3ms/step - loss: 613.9639
Epoch 44/1500
2/2 [==============================] - 0s 3ms/step - loss: 608.5319
Epoch 45/1500
2/2 [==============================] - 0s 3ms/step - loss: 602.9017
Epoch 46/1500
2/2 [==============================] - 0s 4ms/step - loss: 597.2409
Epoch 47/1500
2/2 [==============================] - 0s 4ms/step - loss: 591.6287
Epoch 48/1500
2/2 [==============================] - 0s 4ms/step - loss: 585.9790
Epoch 49/1500
2/2 [==============================] - 0s 3ms/step - loss: 580.1522
Epoch 50/1500
2/2 [==============================] - 0s 4ms/step - loss: 574.5638
Epoch 51/1500
2/2 [==============================] - 0s 3ms/step - loss: 568.8727
Epoch 52/1500
2/2 [==============================] - 0s 3ms/step - loss: 563.0599
Epoch 53/1500
2/2 [==============================] - 0s 3ms/step - loss: 557.2868
Epoch 54/1500
2/2 [==============================] - 0s 3ms/step - loss: 551.4657
Epoch 55/1500
2/2 [==============================] - 0s 3ms/step - loss: 545.6056
Epoch 56/1500
2/2 [==============================] - 0s 3ms/step - loss: 539.6183
Epoch 57/1500
2/2 [==============================] - 0s 3ms/step - loss: 533.5978
Epoch 58/1500
2/2 [==============================] - 0s 3ms/step - loss: 527.6362
Epoch 59/1500
2/2 [==============================] - 0s 3ms/step - loss: 521.6359
Epoch 60/1500
2/2 [==============================] - 0s 3ms/step - loss: 515.4073
Epoch 61/1500
2/2 [==============================] - 0s 3ms/step - loss: 509.3336
Epoch 62/1500
2/2 [==============================] - 0s 3ms/step - loss: 503.2086
Epoch 63/1500
2/2 [==============================] - 0s 5ms/step - loss: 497.0642
Epoch 64/1500
2/2 [==============================] - 0s 3ms/step - loss: 490.8709
Epoch 65/1500
2/2 [==============================] - 0s 3ms/step - loss: 484.7116
Epoch 66/1500
2/2 [==============================] - 0s 3ms/step - loss: 478.5895
Epoch 67/1500
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2/2 [==============================] - 0s 3ms/step - loss: 472.4896
Epoch 68/1500
2/2 [==============================] - 0s 4ms/step - loss: 466.3725
Epoch 69/1500
2/2 [==============================] - 0s 6ms/step - loss: 460.3052
Epoch 70/1500
2/2 [==============================] - 0s 3ms/step - loss: 454.1622
Epoch 71/1500
2/2 [==============================] - 0s 3ms/step - loss: 447.9893
Epoch 72/1500
2/2 [==============================] - 0s 5ms/step - loss: 441.8112
Epoch 73/1500
2/2 [==============================] - 0s 5ms/step - loss: 435.5948
Epoch 74/1500
2/2 [==============================] - 0s 4ms/step - loss: 429.3682
Epoch 75/1500
2/2 [==============================] - 0s 7ms/step - loss: 423.0479
Epoch 76/1500
2/2 [==============================] - 0s 3ms/step - loss: 416.6438
Epoch 77/1500
2/2 [==============================] - 0s 6ms/step - loss: 410.3902
Epoch 78/1500
2/2 [==============================] - 0s 3ms/step - loss: 404.0805
Epoch 79/1500
2/2 [==============================] - 0s 3ms/step - loss: 397.7741
Epoch 80/1500
2/2 [==============================] - 0s 3ms/step - loss: 391.4456
Epoch 81/1500
2/2 [==============================] - 0s 3ms/step - loss: 385.1518
Epoch 82/1500
2/2 [==============================] - 0s 3ms/step - loss: 378.8878
Epoch 83/1500
2/2 [==============================] - 0s 20ms/step - loss: 372.6090
Epoch 84/1500
2/2 [==============================] - 0s 4ms/step - loss: 366.2338
Epoch 85/1500
2/2 [==============================] - 0s 4ms/step - loss: 359.9090
Epoch 86/1500
2/2 [==============================] - 0s 4ms/step - loss: 353.6302
Epoch 87/1500
2/2 [==============================] - 0s 3ms/step - loss: 347.3574
Epoch 88/1500
2/2 [==============================] - 0s 3ms/step - loss: 341.1332
Epoch 89/1500
2/2 [==============================] - 0s 3ms/step - loss: 334.9149
Epoch 90/1500
2/2 [==============================] - 0s 3ms/step - loss: 328.6583
Epoch 91/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 322.4539
Epoch 92/1500
2/2 [==============================] - 0s 3ms/step - loss: 316.2550
Epoch 93/1500
2/2 [==============================] - 0s 3ms/step - loss: 310.1089
Epoch 94/1500
2/2 [==============================] - 0s 3ms/step - loss: 303.9593
Epoch 95/1500
2/2 [==============================] - 0s 3ms/step - loss: 297.8863
Epoch 96/1500
2/2 [==============================] - 0s 3ms/step - loss: 291.7969
Epoch 97/1500
2/2 [==============================] - 0s 7ms/step - loss: 285.6801
Epoch 98/1500
2/2 [==============================] - 0s 3ms/step - loss: 279.6540
Epoch 99/1500
2/2 [==============================] - 0s 3ms/step - loss: 273.6950
Epoch 100/1500
2/2 [==============================] - 0s 3ms/step - loss: 267.7473
Epoch 101/1500
2/2 [==============================] - 0s 3ms/step - loss: 261.9217
Epoch 102/1500
2/2 [==============================] - 0s 3ms/step - loss: 256.0816
Epoch 103/1500
2/2 [==============================] - 0s 3ms/step - loss: 250.2879
Epoch 104/1500
2/2 [==============================] - 0s 3ms/step - loss: 244.5260
Epoch 105/1500
2/2 [==============================] - 0s 3ms/step - loss: 238.7655
Epoch 106/1500
2/2 [==============================] - 0s 3ms/step - loss: 233.0553
Epoch 107/1500
2/2 [==============================] - 0s 3ms/step - loss: 227.3544
Epoch 108/1500
2/2 [==============================] - 0s 3ms/step - loss: 221.6942
Epoch 109/1500
2/2 [==============================] - 0s 3ms/step - loss: 216.0709
Epoch 110/1500
2/2 [==============================] - 0s 3ms/step - loss: 210.4984
Epoch 111/1500
2/2 [==============================] - 0s 3ms/step - loss: 204.9294
Epoch 112/1500
2/2 [==============================] - 0s 3ms/step - loss: 199.4316
Epoch 113/1500
2/2 [==============================] - 0s 3ms/step - loss: 193.9839
Epoch 114/1500
2/2 [==============================] - 0s 3ms/step - loss: 188.6505
Epoch 115/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 183.3022
Epoch 116/1500
2/2 [==============================] - 0s 3ms/step - loss: 178.0905
Epoch 117/1500
2/2 [==============================] - 0s 3ms/step - loss: 172.9640
Epoch 118/1500
2/2 [==============================] - 0s 3ms/step - loss: 167.8369
Epoch 119/1500
2/2 [==============================] - 0s 3ms/step - loss: 162.8287
Epoch 120/1500
2/2 [==============================] - 0s 3ms/step - loss: 157.8267
Epoch 121/1500
2/2 [==============================] - 0s 3ms/step - loss: 152.9768
Epoch 122/1500
2/2 [==============================] - 0s 5ms/step - loss: 148.1431
Epoch 123/1500
2/2 [==============================] - 0s 3ms/step - loss: 143.4888
Epoch 124/1500
2/2 [==============================] - 0s 3ms/step - loss: 138.8778
Epoch 125/1500
2/2 [==============================] - 0s 3ms/step - loss: 134.3485
Epoch 126/1500
2/2 [==============================] - 0s 2ms/step - loss: 129.8899
Epoch 127/1500
2/2 [==============================] - 0s 3ms/step - loss: 125.4250
Epoch 128/1500
2/2 [==============================] - 0s 3ms/step - loss: 121.0722
Epoch 129/1500
2/2 [==============================] - 0s 2ms/step - loss: 116.8925
Epoch 130/1500
2/2 [==============================] - 0s 3ms/step - loss: 112.8659
Epoch 131/1500
2/2 [==============================] - 0s 3ms/step - loss: 108.8121
Epoch 132/1500
2/2 [==============================] - 0s 3ms/step - loss: 104.9139
Epoch 133/1500
2/2 [==============================] - 0s 3ms/step - loss: 101.0775
Epoch 134/1500
2/2 [==============================] - 0s 3ms/step - loss: 97.2684
Epoch 135/1500
2/2 [==============================] - 0s 4ms/step - loss: 93.5301
Epoch 136/1500
2/2 [==============================] - 0s 8ms/step - loss: 89.9341
Epoch 137/1500
2/2 [==============================] - 0s 4ms/step - loss: 86.4054
Epoch 138/1500
2/2 [==============================] - 0s 3ms/step - loss: 82.9828
Epoch 139/1500
```

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2/2 [==============================] - 0s 4ms/step - loss: 79.8064
Epoch 140/1500
2/2 [==============================] - 0s 3ms/step - loss: 76.3077
Epoch 141/1500
2/2 [==============================] - 0s 8ms/step - loss: 73.0943
Epoch 142/1500
2/2 [==============================] - 0s 3ms/step - loss: 70.1918
Epoch 143/1500
2/2 [==============================] - 0s 4ms/step - loss: 67.4222
Epoch 144/1500
2/2 [==============================] - 0s 3ms/step - loss: 64.7306
Epoch 145/1500
2/2 [==============================] - 0s 3ms/step - loss: 62.0686
Epoch 146/1500
2/2 [==============================] - 0s 4ms/step - loss: 59.2605
Epoch 147/1500
2/2 [==============================] - 0s 3ms/step - loss: 56.8181
Epoch 148/1500
2/2 [==============================] - 0s 3ms/step - loss: 54.4012
Epoch 149/1500
2/2 [==============================] - 0s 3ms/step - loss: 52.2152
Epoch 150/1500
2/2 [==============================] - 0s 3ms/step - loss: 50.0944
Epoch 151/1500
2/2 [==============================] - 0s 3ms/step - loss: 47.9654
Epoch 152/1500
2/2 [==============================] - 0s 3ms/step - loss: 45.9356
Epoch 153/1500
2/2 [==============================] - 0s 3ms/step - loss: 44.0396
Epoch 154/1500
2/2 [==============================] - 0s 4ms/step - loss: 42.1471
Epoch 155/1500
2/2 [==============================] - 0s 3ms/step - loss: 40.4287
Epoch 156/1500
2/2 [==============================] - 0s 3ms/step - loss: 38.6794
Epoch 157/1500
2/2 [==============================] - 0s 3ms/step - loss: 37.0164
Epoch 158/1500
2/2 [==============================] - 0s 3ms/step - loss: 35.4047
Epoch 159/1500
2/2 [==============================] - 0s 3ms/step - loss: 34.0805
Epoch 160/1500
2/2 [==============================] - 0s 3ms/step - loss: 32.6151
Epoch 161/1500
2/2 [==============================] - 0s 6ms/step - loss: 31.3110
Epoch 162/1500
2/2 [==============================] - 0s 3ms/step - loss: 30.1777
Epoch 163/1500
```

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2/2 [==============================] - 0s 3ms/step - loss: 28.9997
Epoch 164/1500
2/2 [==============================] - 0s 4ms/step - loss: 27.7902
Epoch 165/1500
2/2 [==============================] - 0s 3ms/step - loss: 26.7158
Epoch 166/1500
2/2 [==============================] - 0s 3ms/step - loss: 25.7411
Epoch 167/1500
2/2 [==============================] - 0s 3ms/step - loss: 24.6605
Epoch 168/1500
2/2 [==============================] - 0s 6ms/step - loss: 23.6146
Epoch 169/1500
2/2 [==============================] - 0s 4ms/step - loss: 22.7428
Epoch 170/1500
2/2 [==============================] - 0s 4ms/step - loss: 21.7056
Epoch 171/1500
2/2 [==============================] - 0s 3ms/step - loss: 20.9084
Epoch 172/1500
2/2 [==============================] - 0s 4ms/step - loss: 20.1311
Epoch 173/1500
2/2 [==============================] - 0s 3ms/step - loss: 19.2487
Epoch 174/1500
2/2 [==============================] - 0s 5ms/step - loss: 18.5967
Epoch 175/1500
2/2 [==============================] - 0s 3ms/step - loss: 17.7995
Epoch 176/1500
2/2 [==============================] - 0s 4ms/step - loss: 17.0556
Epoch 177/1500
2/2 [==============================] - 0s 4ms/step - loss: 16.3602
Epoch 178/1500
2/2 [==============================] - 0s 4ms/step - loss: 15.6313
Epoch 179/1500
2/2 [==============================] - 0s 4ms/step - loss: 14.8754
Epoch 180/1500
2/2 [==============================] - 0s 4ms/step - loss: 14.2956
Epoch 181/1500
2/2 [==============================] - 0s 4ms/step - loss: 13.8223
Epoch 182/1500
2/2 [==============================] - 0s 6ms/step - loss: 13.3243
Epoch 183/1500
2/2 [==============================] - 0s 4ms/step - loss: 12.8582
Epoch 184/1500
2/2 [==============================] - 0s 22ms/step - loss: 12.3469
Epoch 185/1500
2/2 [==============================] - 0s 5ms/step - loss: 11.8418
Epoch 186/1500
2/2 [==============================] - 0s 6ms/step - loss: 11.3904
Epoch 187/1500
```

```
2/2 [==============================] - 0s 8ms/step - loss: 10.9486
Epoch 188/1500
2/2 [==============================] - 0s 4ms/step - loss: 10.5243
Epoch 189/1500
2/2 [==============================] - 0s 4ms/step - loss: 10.1197
Epoch 190/1500
2/2 [==============================] - 0s 3ms/step - loss: 9.7518
Epoch 191/1500
2/2 [==============================] - 0s 4ms/step - loss: 9.3854
Epoch 192/1500
2/2 [==============================] - 0s 3ms/step - loss: 8.9669
Epoch 193/1500
2/2 [==============================] - 0s 3ms/step - loss: 8.5652
Epoch 194/1500
2/2 [==============================] - 0s 5ms/step - loss: 8.2525
Epoch 195/1500
2/2 [==============================] - 0s 3ms/step - loss: 7.9933
Epoch 196/1500
2/2 [==============================] - 0s 3ms/step - loss: 7.6411
Epoch 197/1500
2/2 [==============================] - 0s 3ms/step - loss: 7.3197
Epoch 198/1500
2/2 [==============================] - 0s 3ms/step - loss: 7.0336
Epoch 199/1500
2/2 [==============================] - 0s 3ms/step - loss: 6.7368
Epoch 200/1500
2/2 [==============================] - 0s 3ms/step - loss: 6.4759
Epoch 201/1500
2/2 [==============================] - 0s 3ms/step - loss: 6.1737
Epoch 202/1500
2/2 [==============================] - 0s 3ms/step - loss: 5.9096
Epoch 203/1500
2/2 [==============================] - 0s 3ms/step - loss: 5.6270
Epoch 204/1500
2/2 [==============================] - 0s 3ms/step - loss: 5.3670
Epoch 205/1500
2/2 [==============================] - 0s 3ms/step - loss: 5.1283
Epoch 206/1500
2/2 [==============================] - 0s 3ms/step - loss: 4.8791
Epoch 207/1500
2/2 [==============================] - 0s 3ms/step - loss: 4.6623
Epoch 208/1500
2/2 [==============================] - 0s 3ms/step - loss: 4.4776
Epoch 209/1500
2/2 [==============================] - 0s 3ms/step - loss: 4.2080
Epoch 210/1500
2/2 [==============================] - 0s 3ms/step - loss: 3.9942
Epoch 211/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 3.8201
Epoch 212/1500
2/2 [==============================] - 0s 3ms/step - loss: 3.6453
Epoch 213/1500
2/2 [==============================] - 0s 3ms/step - loss: 3.4678
Epoch 214/1500
2/2 [==============================] - 0s 3ms/step - loss: 3.2883
Epoch 215/1500
2/2 [==============================] - 0s 3ms/step - loss: 3.1324
Epoch 216/1500
2/2 [==============================] - 0s 2ms/step - loss: 2.9909
Epoch 217/1500
2/2 [==============================] - 0s 2ms/step - loss: 2.8819
Epoch 218/1500
2/2 [==============================] - 0s 3ms/step - loss: 2.7464
Epoch 219/1500
2/2 [==============================] - 0s 3ms/step - loss: 2.6125
Epoch 220/1500
2/2 [==============================] - 0s 3ms/step - loss: 2.4554
Epoch 221/1500
2/2 [==============================] - 0s 3ms/step - loss: 2.3331
Epoch 222/1500
2/2 [==============================] - 0s 3ms/step - loss: 2.2765
Epoch 223/1500
2/2 [==============================] - 0s 3ms/step - loss: 2.1474
Epoch 224/1500
2/2 [==============================] - 0s 3ms/step - loss: 2.0722
Epoch 225/1500
2/2 [==============================] - 0s 3ms/step - loss: 1.9683
Epoch 226/1500
2/2 [==============================] - 0s 8ms/step - loss: 1.8854
Epoch 227/1500
2/2 [==============================] - 0s 3ms/step - loss: 1.7870
Epoch 228/1500
2/2 [==============================] - 0s 4ms/step - loss: 1.6959
Epoch 229/1500
2/2 [==============================] - 0s 3ms/step - loss: 1.6100
Epoch 230/1500
2/2 [==============================] - 0s 3ms/step - loss: 1.5521
Epoch 231/1500
2/2 [==============================] - 0s 3ms/step - loss: 1.5169
Epoch 232/1500
2/2 [==============================] - 0s 3ms/step - loss: 1.4526
Epoch 233/1500
2/2 [==============================] - 0s 3ms/step - loss: 1.3872
Epoch 234/1500
2/2 [==============================] - 0s 3ms/step - loss: 1.2897
Epoch 235/1500
```

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2/2 [==============================] - 0s 3ms/step - loss: 1.2565
Epoch 236/1500
2/2 [==============================] - 0s 3ms/step - loss: 1.2127
Epoch 237/1500
2/2 [==============================] - 0s 2ms/step - loss: 1.1349
Epoch 238/1500
2/2 [==============================] - 0s 3ms/step - loss: 1.1038
Epoch 239/1500
2/2 [==============================] - 0s 3ms/step - loss: 1.0596
Epoch 240/1500
2/2 [==============================] - 0s 3ms/step - loss: 1.0412
Epoch 241/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.9851
Epoch 242/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.9199
Epoch 243/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.8836
Epoch 244/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.8323
Epoch 245/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.7824
Epoch 246/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.7395
Epoch 247/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.7339
Epoch 248/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.7082
Epoch 249/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.6608
Epoch 250/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.6447
Epoch 251/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.6408
Epoch 252/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.6104
Epoch 253/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.5767
Epoch 254/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.5656
Epoch 255/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.5550
Epoch 256/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.5332
Epoch 257/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.5005
Epoch 258/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.4821
Epoch 259/1500
```

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2/2 [==============================] - 0s 3ms/step - loss: 0.4755
Epoch 260/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.4655
Epoch 261/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.4489
Epoch 262/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.4452
Epoch 263/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.4151
Epoch 264/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.4088
Epoch 265/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.4059
Epoch 266/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3925
Epoch 267/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.3901
Epoch 268/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3791
Epoch 269/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3563
Epoch 270/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3531
Epoch 271/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3514
Epoch 272/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3575
Epoch 273/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3365
Epoch 274/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3189
Epoch 275/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3163
Epoch 276/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3198
Epoch 277/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3140
Epoch 278/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3014
Epoch 279/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3003
Epoch 280/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3268
Epoch 281/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2900
Epoch 282/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3087
Epoch 283/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.3403
Epoch 284/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3181
Epoch 285/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3064
Epoch 286/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3000
Epoch 287/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2924
Epoch 288/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2953
Epoch 289/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3055
Epoch 290/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2779
Epoch 291/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2748
Epoch 292/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2806
Epoch 293/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2823
Epoch 294/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2700
Epoch 295/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2828
Epoch 296/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2803
Epoch 297/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2964
Epoch 298/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2986
Epoch 299/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2781
Epoch 300/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2796
Epoch 301/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2734
Epoch 302/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2664
Epoch 303/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2873
Epoch 304/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2840
Epoch 305/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2996
Epoch 306/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2654
Epoch 307/1500
```

```
2/2 [==============================] - 0s 5ms/step - loss: 0.2730
Epoch 308/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2867
Epoch 309/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2772
Epoch 310/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2851
Epoch 311/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2644
Epoch 312/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2632
Epoch 313/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2800
Epoch 314/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2684
Epoch 315/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2672
Epoch 316/1500
2/2 [==============================] - 0s 8ms/step - loss: 0.2648
Epoch 317/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2588
Epoch 318/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2592
Epoch 319/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2690
Epoch 320/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2964
Epoch 321/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2617
Epoch 322/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3114
Epoch 323/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2892
Epoch 324/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2626
Epoch 325/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2865
Epoch 326/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2641
Epoch 327/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2774
Epoch 328/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2970
Epoch 329/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2688
Epoch 330/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2715
Epoch 331/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2691
Epoch 332/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2709
Epoch 333/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2697
Epoch 334/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2928
Epoch 335/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2731
Epoch 336/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2725
Epoch 337/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2850
Epoch 338/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2850
Epoch 339/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3018
Epoch 340/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2668
Epoch 341/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2682
Epoch 342/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2657
Epoch 343/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2751
Epoch 344/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2590
Epoch 345/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2889
Epoch 346/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2725
Epoch 347/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2739
Epoch 348/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2604
Epoch 349/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2587
Epoch 350/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2607
Epoch 351/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2915
Epoch 352/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2898
Epoch 353/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2914
Epoch 354/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2821
Epoch 355/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2719
Epoch 356/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2622
Epoch 357/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2714
Epoch 358/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2672
Epoch 359/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2635
Epoch 360/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2782
Epoch 361/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2999
Epoch 362/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2707
Epoch 363/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2632
Epoch 364/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2632
Epoch 365/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2753
Epoch 366/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2803
Epoch 367/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2850
Epoch 368/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2583
Epoch 369/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2686
Epoch 370/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2872
Epoch 371/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2756
Epoch 372/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2652
Epoch 373/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2667
Epoch 374/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2840
Epoch 375/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2712
Epoch 376/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2620
Epoch 377/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2762
Epoch 378/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2609
Epoch 379/1500
```

```
2/2 [==============================] - 0s 4ms/step - loss: 0.2601
Epoch 380/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2660
Epoch 381/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2904
Epoch 382/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2933
Epoch 383/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2605
Epoch 384/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2621
Epoch 385/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2660
Epoch 386/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2871
Epoch 387/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2735
Epoch 388/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2688
Epoch 389/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2574
Epoch 390/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2651
Epoch 391/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2707
Epoch 392/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2786
Epoch 393/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2616
Epoch 394/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2818
Epoch 395/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2627
Epoch 396/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2732
Epoch 397/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2776
Epoch 398/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2731
Epoch 399/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3008
Epoch 400/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2616
Epoch 401/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2631
Epoch 402/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2581
Epoch 403/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2583
Epoch 404/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2606
Epoch 405/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2789
Epoch 406/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2983
Epoch 407/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3049
Epoch 408/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2756
Epoch 409/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2739
Epoch 410/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2605
Epoch 411/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2692
Epoch 412/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2707
Epoch 413/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2621
Epoch 414/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2709
Epoch 415/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2632
Epoch 416/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2772
Epoch 417/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2985
Epoch 418/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2950
Epoch 419/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2631
Epoch 420/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2757
Epoch 421/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2633
Epoch 422/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2888
Epoch 423/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3008
Epoch 424/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2611
Epoch 425/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2653
Epoch 426/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2621
Epoch 427/1500
```

```
2/2 [==============================] - 0s 85ms/step - loss: 0.2601
Epoch 428/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2564
Epoch 429/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2671
Epoch 430/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2900
Epoch 431/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2615
Epoch 432/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2591
Epoch 433/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2973
Epoch 434/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2684
Epoch 435/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2574
Epoch 436/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2610
Epoch 437/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2755
Epoch 438/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2750
Epoch 439/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3053
Epoch 440/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2714
Epoch 441/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2743
Epoch 442/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2670
Epoch 443/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2637
Epoch 444/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2777
Epoch 445/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2599
Epoch 446/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2608
Epoch 447/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2746
Epoch 448/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2583
Epoch 449/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3011
Epoch 450/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2705
Epoch 451/1500
```

```
2/2 [==============================] - 0s 4ms/step - loss: 0.2699
Epoch 452/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2672
Epoch 453/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2788
Epoch 454/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2754
Epoch 455/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2716
Epoch 456/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2590
Epoch 457/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2623
Epoch 458/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2888
Epoch 459/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2618
Epoch 460/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3011
Epoch 461/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2857
Epoch 462/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2591
Epoch 463/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2775
Epoch 464/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2657
Epoch 465/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2762
Epoch 466/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2843
Epoch 467/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2594
Epoch 468/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2626
Epoch 469/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2869
Epoch 470/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2781
Epoch 471/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2644
Epoch 472/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2712
Epoch 473/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2797
Epoch 474/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2719
Epoch 475/1500
```

```
2/2 [==============================] - 0s 4ms/step - loss: 0.2675
Epoch 476/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2644
Epoch 477/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2695
Epoch 478/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2652
Epoch 479/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2746
Epoch 480/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2755
Epoch 481/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2588
Epoch 482/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2688
Epoch 483/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2733
Epoch 484/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2570
Epoch 485/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2812
Epoch 486/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2876
Epoch 487/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2684
Epoch 488/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3181
Epoch 489/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2970
Epoch 490/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2689
Epoch 491/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2771
Epoch 492/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2692
Epoch 493/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2814
Epoch 494/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2619
Epoch 495/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2556
Epoch 496/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2599
Epoch 497/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2689
Epoch 498/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2711
Epoch 499/1500
```

```
2/2 [==============================] - 0s 5ms/step - loss: 0.2773
Epoch 500/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2898
Epoch 501/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2585
Epoch 502/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2693
Epoch 503/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2557
Epoch 504/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2626
Epoch 505/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2849
Epoch 506/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2735
Epoch 507/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2629
Epoch 508/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2604
Epoch 509/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2787
Epoch 510/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.3009
Epoch 511/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2631
Epoch 512/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2602
Epoch 513/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2662
Epoch 514/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2780
Epoch 515/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2844
Epoch 516/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2711
Epoch 517/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2671
Epoch 518/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2604
Epoch 519/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2610
Epoch 520/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2994
Epoch 521/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2887
Epoch 522/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2964
Epoch 523/1500
```

```
2/2 [==============================] - 0s 5ms/step - loss: 0.2666
Epoch 524/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2679
Epoch 525/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3012
Epoch 526/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2738
Epoch 527/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2753
Epoch 528/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2663
Epoch 529/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2615
Epoch 530/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2677
Epoch 531/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2709
Epoch 532/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2990
Epoch 533/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3132
Epoch 534/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2665
Epoch 535/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2758
Epoch 536/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2649
Epoch 537/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2601
Epoch 538/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2956
Epoch 539/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3030
Epoch 540/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2845
Epoch 541/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2798
Epoch 542/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2602
Epoch 543/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2760
Epoch 544/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2647
Epoch 545/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2558
Epoch 546/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2649
Epoch 547/1500
```

```
2/2 [==============================] - 0s 4ms/step - loss: 0.2625
Epoch 548/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2952
Epoch 549/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2830
Epoch 550/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2705
Epoch 551/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2663
Epoch 552/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2870
Epoch 553/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2864
Epoch 554/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2588
Epoch 555/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2674
Epoch 556/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2653
Epoch 557/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2586
Epoch 558/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2680
Epoch 559/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2610
Epoch 560/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2606
Epoch 561/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2685
Epoch 562/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2631
Epoch 563/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2903
Epoch 564/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2719
Epoch 565/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2892
Epoch 566/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2622
Epoch 567/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2639
Epoch 568/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2570
Epoch 569/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2655
Epoch 570/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2661
Epoch 571/1500
```

```
2/2 [==============================] - 0s 5ms/step - loss: 0.2712
Epoch 572/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2731
Epoch 573/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2840
Epoch 574/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2715
Epoch 575/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2650
Epoch 576/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2623
Epoch 577/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2859
Epoch 578/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2585
Epoch 579/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2590
Epoch 580/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2825
Epoch 581/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2675
Epoch 582/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2892
Epoch 583/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2683
Epoch 584/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2952
Epoch 585/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2678
Epoch 586/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2603
Epoch 587/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2604
Epoch 588/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2639
Epoch 589/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2667
Epoch 590/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2737
Epoch 591/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3088
Epoch 592/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2563
Epoch 593/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2573
Epoch 594/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2562
Epoch 595/1500
```

```
2/2 [==============================] - 0s 4ms/step - loss: 0.2694
Epoch 596/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2863
Epoch 597/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2937
Epoch 598/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3026
Epoch 599/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2713
Epoch 600/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2623
Epoch 601/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2584
Epoch 602/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2973
Epoch 603/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2864
Epoch 604/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2647
Epoch 605/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2631
Epoch 606/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2616
Epoch 607/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2855
Epoch 608/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2687
Epoch 609/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2747
Epoch 610/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2875
Epoch 611/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2727
Epoch 612/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2778
Epoch 613/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3157
Epoch 614/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2872
Epoch 615/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2751
Epoch 616/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2603
Epoch 617/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2717
Epoch 618/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2631
Epoch 619/1500
```

```
2/2 [==============================] - 0s 5ms/step - loss: 0.2754
Epoch 620/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2619
Epoch 621/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2586
Epoch 622/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2707
Epoch 623/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2681
Epoch 624/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2666
Epoch 625/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2708
Epoch 626/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2667
Epoch 627/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2850
Epoch 628/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2619
Epoch 629/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2929
Epoch 630/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2640
Epoch 631/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2673
Epoch 632/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2675
Epoch 633/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2680
Epoch 634/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2607
Epoch 635/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2572
Epoch 636/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2739
Epoch 637/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2633
Epoch 638/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2667
Epoch 639/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2794
Epoch 640/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2898
Epoch 641/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2865
Epoch 642/1500
2/2 [==============================] - 0s 9ms/step - loss: 0.2738
Epoch 643/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2690
Epoch 644/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2732
Epoch 645/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2631
Epoch 646/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2842
Epoch 647/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2597
Epoch 648/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2751
Epoch 649/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2703
Epoch 650/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2963
Epoch 651/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2779
Epoch 652/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2816
Epoch 653/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2607
Epoch 654/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2674
Epoch 655/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2605
Epoch 656/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2916
Epoch 657/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2803
Epoch 658/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2655
Epoch 659/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2567
Epoch 660/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2905
Epoch 661/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2981
Epoch 662/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2736
Epoch 663/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2849
Epoch 664/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3025
Epoch 665/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2584
Epoch 666/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2689
Epoch 667/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2605
Epoch 668/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2708
Epoch 669/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2886
Epoch 670/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2695
Epoch 671/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2747
Epoch 672/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2736
Epoch 673/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2705
Epoch 674/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2735
Epoch 675/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2595
Epoch 676/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2651
Epoch 677/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2889
Epoch 678/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2625
Epoch 679/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2740
Epoch 680/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2698
Epoch 681/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2667
Epoch 682/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2901
Epoch 683/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2783
Epoch 684/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2718
Epoch 685/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2850
Epoch 686/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2857
Epoch 687/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2824
Epoch 688/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2812
Epoch 689/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2861
Epoch 690/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2921
Epoch 691/1500
```

```
2/2 [==============================] - 0s 4ms/step - loss: 0.2765
Epoch 692/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2859
Epoch 693/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2806
Epoch 694/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2621
Epoch 695/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2685
Epoch 696/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2884
Epoch 697/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2644
Epoch 698/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2608
Epoch 699/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2629
Epoch 700/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2707
Epoch 701/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2806
Epoch 702/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2600
Epoch 703/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2727
Epoch 704/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2565
Epoch 705/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2638
Epoch 706/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2898
Epoch 707/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2706
Epoch 708/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2690
Epoch 709/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2774
Epoch 710/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2790
Epoch 711/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2701
Epoch 712/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2615
Epoch 713/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2701
Epoch 714/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2815
Epoch 715/1500
```

```
2/2 [==============================] - 0s 4ms/step - loss: 0.2752
Epoch 716/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2605
Epoch 717/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2678
Epoch 718/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2603
Epoch 719/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2571
Epoch 720/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2556
Epoch 721/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2707
Epoch 722/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2850
Epoch 723/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2937
Epoch 724/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.3006
Epoch 725/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2639
Epoch 726/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2986
Epoch 727/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2873
Epoch 728/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2682
Epoch 729/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2742
Epoch 730/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2693
Epoch 731/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2858
Epoch 732/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2617
Epoch 733/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2656
Epoch 734/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2663
Epoch 735/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2667
Epoch 736/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2637
Epoch 737/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2624
Epoch 738/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2617
Epoch 739/1500
```

```
2/2 [==============================] - 0s 5ms/step - loss: 0.2711
Epoch 740/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2683
Epoch 741/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2690
Epoch 742/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2694
Epoch 743/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2635
Epoch 744/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2976
Epoch 745/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2699
Epoch 746/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2707
Epoch 747/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2741
Epoch 748/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2885
Epoch 749/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2609
Epoch 750/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2703
Epoch 751/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2739
Epoch 752/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2788
Epoch 753/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2787
Epoch 754/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2577
Epoch 755/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2659
Epoch 756/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2816
Epoch 757/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2603
Epoch 758/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2803
Epoch 759/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2730
Epoch 760/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2564
Epoch 761/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2817
Epoch 762/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2729
Epoch 763/1500
```

```
2/2 [==============================] - 0s 2ms/step - loss: 0.3050
Epoch 764/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2662
Epoch 765/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2779
Epoch 766/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2598
Epoch 767/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2574
Epoch 768/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2655
Epoch 769/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2752
Epoch 770/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2598
Epoch 771/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2614
Epoch 772/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2621
Epoch 773/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2728
Epoch 774/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2864
Epoch 775/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3072
Epoch 776/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2657
Epoch 777/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2658
Epoch 778/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2683
Epoch 779/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3074
Epoch 780/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2726
Epoch 781/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2600
Epoch 782/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2803
Epoch 783/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2651
Epoch 784/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2640
Epoch 785/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2770
Epoch 786/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2658
Epoch 787/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2724
Epoch 788/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2588
Epoch 789/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2759
Epoch 790/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2896
Epoch 791/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2659
Epoch 792/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2764
Epoch 793/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2564
Epoch 794/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2701
Epoch 795/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2761
Epoch 796/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2729
Epoch 797/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2922
Epoch 798/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2589
Epoch 799/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2854
Epoch 800/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2726
Epoch 801/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2912
Epoch 802/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2575
Epoch 803/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2772
Epoch 804/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2682
Epoch 805/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2657
Epoch 806/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2705
Epoch 807/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2676
Epoch 808/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2938
Epoch 809/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2800
Epoch 810/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2578
Epoch 811/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2658
Epoch 812/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2562
Epoch 813/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2613
Epoch 814/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2594
Epoch 815/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2770
Epoch 816/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2870
Epoch 817/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2904
Epoch 818/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2650
Epoch 819/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2647
Epoch 820/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2845
Epoch 821/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2606
Epoch 822/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2698
Epoch 823/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2687
Epoch 824/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2577
Epoch 825/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2792
Epoch 826/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2603
Epoch 827/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2891
Epoch 828/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2599
Epoch 829/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2774
Epoch 830/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2604
Epoch 831/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2956
Epoch 832/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2671
Epoch 833/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2886
Epoch 834/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2633
Epoch 835/1500
```

```
2/2 [==============================] - 0s 6ms/step - loss: 0.2798
Epoch 836/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2763
Epoch 837/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2672
Epoch 838/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2760
Epoch 839/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2772
Epoch 840/1500
2/2 [==============================] - 0s 14ms/step - loss: 0.2842
Epoch 841/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2703
Epoch 842/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2712
Epoch 843/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2838
Epoch 844/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3002
Epoch 845/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2861
Epoch 846/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2685
Epoch 847/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2599
Epoch 848/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2594
Epoch 849/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2757
Epoch 850/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2589
Epoch 851/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2737
Epoch 852/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2822
Epoch 853/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2590
Epoch 854/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2728
Epoch 855/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2589
Epoch 856/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2668
Epoch 857/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2808
Epoch 858/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2735
Epoch 859/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.3162
Epoch 860/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2843
Epoch 861/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2629
Epoch 862/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2556
Epoch 863/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2579
Epoch 864/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2658
Epoch 865/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2811
Epoch 866/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2919
Epoch 867/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2666
Epoch 868/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2542
Epoch 869/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2554
Epoch 870/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2643
Epoch 871/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2639
Epoch 872/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2845
Epoch 873/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.3131
Epoch 874/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2790
Epoch 875/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2719
Epoch 876/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2835
Epoch 877/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2615
Epoch 878/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2674
Epoch 879/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2612
Epoch 880/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2751
Epoch 881/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2637
Epoch 882/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2693
Epoch 883/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2884
Epoch 884/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2862
Epoch 885/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2776
Epoch 886/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2620
Epoch 887/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2636
Epoch 888/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2758
Epoch 889/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2691
Epoch 890/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2643
Epoch 891/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2635
Epoch 892/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2584
Epoch 893/1500
2/2 [==============================] - 0s 8ms/step - loss: 0.2734
Epoch 894/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2659
Epoch 895/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2775
Epoch 896/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2793
Epoch 897/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.3073
Epoch 898/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2957
Epoch 899/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2668
Epoch 900/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2578
Epoch 901/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2634
Epoch 902/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2689
Epoch 903/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2769
Epoch 904/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2681
Epoch 905/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2743
Epoch 906/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2676
Epoch 907/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2689
Epoch 908/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2593
Epoch 909/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2870
Epoch 910/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2646
Epoch 911/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2580
Epoch 912/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2740
Epoch 913/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3006
Epoch 914/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2724
Epoch 915/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2707
Epoch 916/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2598
Epoch 917/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2749
Epoch 918/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2649
Epoch 919/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2585
Epoch 920/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2887
Epoch 921/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2750
Epoch 922/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2722
Epoch 923/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2699
Epoch 924/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2668
Epoch 925/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2945
Epoch 926/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2938
Epoch 927/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2852
Epoch 928/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2653
Epoch 929/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2796
Epoch 930/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2634
Epoch 931/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2996
Epoch 932/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2795
Epoch 933/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2630
Epoch 934/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2689
Epoch 935/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2652
Epoch 936/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2739
Epoch 937/1500
2/2 [==============================] - 0s 8ms/step - loss: 0.2715
Epoch 938/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2591
Epoch 939/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2763
Epoch 940/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2860
Epoch 941/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2910
Epoch 942/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2658
Epoch 943/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2850
Epoch 944/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2626
Epoch 945/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2914
Epoch 946/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2780
Epoch 947/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2816
Epoch 948/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2672
Epoch 949/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2585
Epoch 950/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2671
Epoch 951/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2651
Epoch 952/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2674
Epoch 953/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2770
Epoch 954/1500
2/2 [==============================] - 0s 26ms/step - loss: 0.2620
Epoch 955/1500
```

```
2/2 [==============================] - 0s 4ms/step - loss: 0.2635
Epoch 956/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2827
Epoch 957/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2667
Epoch 958/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2736
Epoch 959/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2785
Epoch 960/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2952
Epoch 961/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3027
Epoch 962/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2734
Epoch 963/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2621
Epoch 964/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2745
Epoch 965/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2589
Epoch 966/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2648
Epoch 967/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2645
Epoch 968/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2742
Epoch 969/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2889
Epoch 970/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2662
Epoch 971/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2742
Epoch 972/1500
2/2 [==============================] - 0s 8ms/step - loss: 0.2594
Epoch 973/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2721
Epoch 974/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2658
Epoch 975/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2661
Epoch 976/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2780
Epoch 977/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2653
Epoch 978/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2894
Epoch 979/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2822
Epoch 980/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2587
Epoch 981/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2565
Epoch 982/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2634
Epoch 983/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2575
Epoch 984/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2874
Epoch 985/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2904
Epoch 986/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2592
Epoch 987/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2561
Epoch 988/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2583
Epoch 989/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2693
Epoch 990/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2726
Epoch 991/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2967
Epoch 992/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2792
Epoch 993/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2878
Epoch 994/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2629
Epoch 995/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2789
Epoch 996/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2676
Epoch 997/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2745
Epoch 998/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2787
Epoch 999/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2897
Epoch 1000/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2810
Epoch 1001/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2807
Epoch 1002/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3021
Epoch 1003/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2727
Epoch 1004/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2711
Epoch 1005/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2647
Epoch 1006/1500
2/2 [==============================] - 0s 12ms/step - loss: 0.2568
Epoch 1007/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2598
Epoch 1008/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2545
Epoch 1009/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2672
Epoch 1010/1500
2/2 [==============================] - 0s 8ms/step - loss: 0.2717
Epoch 1011/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2683
Epoch 1012/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2888
Epoch 1013/1500
2/2 [==============================] - 0s 14ms/step - loss: 0.2764
Epoch 1014/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2927
Epoch 1015/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2744
Epoch 1016/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2634
Epoch 1017/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2617
Epoch 1018/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2684
Epoch 1019/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2836
Epoch 1020/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2881
Epoch 1021/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2567
Epoch 1022/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2571
Epoch 1023/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2724
Epoch 1024/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2681
Epoch 1025/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2619
Epoch 1026/1500
2/2 [==============================] - 0s 9ms/step - loss: 0.2777
Epoch 1027/1500
```

```
2/2 [==============================] - 0s 7ms/step - loss: 0.2733
Epoch 1028/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2618
Epoch 1029/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2711
Epoch 1030/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2833
Epoch 1031/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2793
Epoch 1032/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2814
Epoch 1033/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2757
Epoch 1034/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2836
Epoch 1035/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2568
Epoch 1036/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2550
Epoch 1037/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2662
Epoch 1038/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2895
Epoch 1039/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2839
Epoch 1040/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2714
Epoch 1041/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2771
Epoch 1042/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2635
Epoch 1043/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2685
Epoch 1044/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2733
Epoch 1045/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2699
Epoch 1046/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2629
Epoch 1047/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2760
Epoch 1048/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2654
Epoch 1049/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.3263
Epoch 1050/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.3022
Epoch 1051/1500
```

```
2/2 [==============================] - 0s 4ms/step - loss: 0.2761
Epoch 1052/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2640
Epoch 1053/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2587
Epoch 1054/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2587
Epoch 1055/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2573
Epoch 1056/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2688
Epoch 1057/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2722
Epoch 1058/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2556
Epoch 1059/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2554
Epoch 1060/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2569
Epoch 1061/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2622
Epoch 1062/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2768
Epoch 1063/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2584
Epoch 1064/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3003
Epoch 1065/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2842
Epoch 1066/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2768
Epoch 1067/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2706
Epoch 1068/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2726
Epoch 1069/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2626
Epoch 1070/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2641
Epoch 1071/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2655
Epoch 1072/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2748
Epoch 1073/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2680
Epoch 1074/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2867
Epoch 1075/1500
```

```
2/2 [==============================] - 0s 4ms/step - loss: 0.2729
Epoch 1076/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2791
Epoch 1077/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2616
Epoch 1078/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2562
Epoch 1079/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2627
Epoch 1080/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2787
Epoch 1081/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2747
Epoch 1082/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3010
Epoch 1083/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2853
Epoch 1084/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2810
Epoch 1085/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2762
Epoch 1086/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2692
Epoch 1087/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2594
Epoch 1088/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2912
Epoch 1089/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2676
Epoch 1090/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2653
Epoch 1091/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3204
Epoch 1092/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3297
Epoch 1093/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2929
Epoch 1094/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2548
Epoch 1095/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2559
Epoch 1096/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2618
Epoch 1097/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2563
Epoch 1098/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2565
Epoch 1099/1500
```

```
2/2 [==============================] - 0s 5ms/step - loss: 0.2587
Epoch 1100/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2713
Epoch 1101/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2619
Epoch 1102/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2558
Epoch 1103/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2675
Epoch 1104/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2700
Epoch 1105/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2854
Epoch 1106/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2645
Epoch 1107/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2968
Epoch 1108/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2948
Epoch 1109/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2680
Epoch 1110/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2564
Epoch 1111/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2590
Epoch 1112/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2553
Epoch 1113/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2570
Epoch 1114/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2587
Epoch 1115/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2664
Epoch 1116/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2675
Epoch 1117/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2864
Epoch 1118/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2835
Epoch 1119/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2576
Epoch 1120/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2600
Epoch 1121/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2753
Epoch 1122/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3099
Epoch 1123/1500
```

```
2/2 [==============================] - 0s 5ms/step - loss: 0.3004
Epoch 1124/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2547
Epoch 1125/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2602
Epoch 1126/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2701
Epoch 1127/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2691
Epoch 1128/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2613
Epoch 1129/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2929
Epoch 1130/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2871
Epoch 1131/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2749
Epoch 1132/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2570
Epoch 1133/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2583
Epoch 1134/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2836
Epoch 1135/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2622
Epoch 1136/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2568
Epoch 1137/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2879
Epoch 1138/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2830
Epoch 1139/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2586
Epoch 1140/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2630
Epoch 1141/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2764
Epoch 1142/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2757
Epoch 1143/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2806
Epoch 1144/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2816
Epoch 1145/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2961
Epoch 1146/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2602
Epoch 1147/1500
```

```
2/2 [==============================] - 0s 2ms/step - loss: 0.2793
Epoch 1148/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2665
Epoch 1149/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2724
Epoch 1150/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2732
Epoch 1151/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2609
Epoch 1152/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2702
Epoch 1153/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2685
Epoch 1154/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2724
Epoch 1155/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2665
Epoch 1156/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2654
Epoch 1157/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2830
Epoch 1158/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2848
Epoch 1159/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2574
Epoch 1160/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2652
Epoch 1161/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2823
Epoch 1162/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2726
Epoch 1163/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2708
Epoch 1164/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2613
Epoch 1165/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2739
Epoch 1166/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2562
Epoch 1167/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2669
Epoch 1168/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2594
Epoch 1169/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2797
Epoch 1170/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2577
Epoch 1171/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2721
Epoch 1172/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2596
Epoch 1173/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2584
Epoch 1174/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2641
Epoch 1175/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3320
Epoch 1176/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2912
Epoch 1177/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2910
Epoch 1178/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2738
Epoch 1179/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2797
Epoch 1180/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2634
Epoch 1181/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2668
Epoch 1182/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2545
Epoch 1183/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2604
Epoch 1184/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2855
Epoch 1185/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2641
Epoch 1186/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2691
Epoch 1187/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2779
Epoch 1188/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2661
Epoch 1189/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2549
Epoch 1190/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2622
Epoch 1191/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3000
Epoch 1192/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2768
Epoch 1193/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2638
Epoch 1194/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2586
Epoch 1195/1500
```

```
2/2 [==============================] - 0s 2ms/step - loss: 0.2631
Epoch 1196/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2574
Epoch 1197/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2621
Epoch 1198/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2655
Epoch 1199/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2892
Epoch 1200/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2800
Epoch 1201/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2711
Epoch 1202/1500
2/2 [==============================] - 0s 8ms/step - loss: 0.2745
Epoch 1203/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2634
Epoch 1204/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2694
Epoch 1205/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2778
Epoch 1206/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2703
Epoch 1207/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2638
Epoch 1208/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2630
Epoch 1209/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2719
Epoch 1210/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2658
Epoch 1211/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2571
Epoch 1212/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2943
Epoch 1213/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3142
Epoch 1214/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2793
Epoch 1215/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2620
Epoch 1216/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2574
Epoch 1217/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2844
Epoch 1218/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3089
Epoch 1219/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2709
Epoch 1220/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2769
Epoch 1221/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2559
Epoch 1222/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2603
Epoch 1223/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2639
Epoch 1224/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2793
Epoch 1225/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2664
Epoch 1226/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2647
Epoch 1227/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2752
Epoch 1228/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2543
Epoch 1229/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2641
Epoch 1230/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2716
Epoch 1231/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2658
Epoch 1232/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2567
Epoch 1233/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2575
Epoch 1234/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2791
Epoch 1235/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2602
Epoch 1236/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2742
Epoch 1237/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2776
Epoch 1238/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2851
Epoch 1239/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2664
Epoch 1240/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2764
Epoch 1241/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2704
Epoch 1242/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2870
Epoch 1243/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.3017
Epoch 1244/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2701
Epoch 1245/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2673
Epoch 1246/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2665
Epoch 1247/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2658
Epoch 1248/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2813
Epoch 1249/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2630
Epoch 1250/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2693
Epoch 1251/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2679
Epoch 1252/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2722
Epoch 1253/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2842
Epoch 1254/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2782
Epoch 1255/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2739
Epoch 1256/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2621
Epoch 1257/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2745
Epoch 1258/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2904
Epoch 1259/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2675
Epoch 1260/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2809
Epoch 1261/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2673
Epoch 1262/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2861
Epoch 1263/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2964
Epoch 1264/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2884
Epoch 1265/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2611
Epoch 1266/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2959
Epoch 1267/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.3004
Epoch 1268/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2860
Epoch 1269/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2997
Epoch 1270/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2752
Epoch 1271/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2567
Epoch 1272/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2572
Epoch 1273/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2596
Epoch 1274/1500
2/2 [==============================] - 0s 8ms/step - loss: 0.2564
Epoch 1275/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2615
Epoch 1276/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2596
Epoch 1277/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2598
Epoch 1278/1500
2/2 [==============================] - 0s 8ms/step - loss: 0.2864
Epoch 1279/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2629
Epoch 1280/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2709
Epoch 1281/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2733
Epoch 1282/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2703
Epoch 1283/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2665
Epoch 1284/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2671
Epoch 1285/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2695
Epoch 1286/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2832
Epoch 1287/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2677
Epoch 1288/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2914
Epoch 1289/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2713
Epoch 1290/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2585
Epoch 1291/1500
```

```
2/2 [==============================] - 0s 4ms/step - loss: 0.2728
Epoch 1292/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2640
Epoch 1293/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2623
Epoch 1294/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2702
Epoch 1295/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2809
Epoch 1296/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2636
Epoch 1297/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2802
Epoch 1298/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2822
Epoch 1299/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2646
Epoch 1300/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2624
Epoch 1301/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2657
Epoch 1302/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2687
Epoch 1303/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2808
Epoch 1304/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2873
Epoch 1305/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2733
Epoch 1306/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2628
Epoch 1307/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2784
Epoch 1308/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2761
Epoch 1309/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2908
Epoch 1310/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2677
Epoch 1311/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2700
Epoch 1312/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2566
Epoch 1313/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2812
Epoch 1314/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2911
Epoch 1315/1500
```

```
2/2 [==============================] - 0s 4ms/step - loss: 0.2900
Epoch 1316/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2722
Epoch 1317/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2742
Epoch 1318/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2744
Epoch 1319/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2662
Epoch 1320/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2564
Epoch 1321/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2752
Epoch 1322/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2905
Epoch 1323/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2597
Epoch 1324/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2572
Epoch 1325/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2590
Epoch 1326/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2830
Epoch 1327/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2684
Epoch 1328/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2635
Epoch 1329/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2589
Epoch 1330/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2700
Epoch 1331/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2558
Epoch 1332/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2675
Epoch 1333/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2611
Epoch 1334/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2572
Epoch 1335/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3267
Epoch 1336/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2918
Epoch 1337/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2675
Epoch 1338/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2642
Epoch 1339/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2715
Epoch 1340/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2609
Epoch 1341/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2857
Epoch 1342/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2845
Epoch 1343/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2987
Epoch 1344/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2702
Epoch 1345/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2539
Epoch 1346/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2647
Epoch 1347/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2770
Epoch 1348/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2799
Epoch 1349/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2841
Epoch 1350/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2779
Epoch 1351/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2696
Epoch 1352/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2727
Epoch 1353/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2630
Epoch 1354/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2705
Epoch 1355/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2543
Epoch 1356/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2567
Epoch 1357/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2590
Epoch 1358/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2746
Epoch 1359/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2672
Epoch 1360/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2797
Epoch 1361/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2564
Epoch 1362/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2868
Epoch 1363/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2971
Epoch 1364/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2608
Epoch 1365/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2658
Epoch 1366/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2740
Epoch 1367/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2552
Epoch 1368/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2547
Epoch 1369/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2577
Epoch 1370/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2607
Epoch 1371/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2597
Epoch 1372/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3065
Epoch 1373/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3034
Epoch 1374/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2703
Epoch 1375/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2706
Epoch 1376/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2712
Epoch 1377/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2904
Epoch 1378/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2676
Epoch 1379/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2575
Epoch 1380/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2588
Epoch 1381/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2808
Epoch 1382/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2578
Epoch 1383/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2677
Epoch 1384/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3150
Epoch 1385/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2808
Epoch 1386/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2583
Epoch 1387/1500
```

```
2/2 [==============================] - 0s 5ms/step - loss: 0.2768
Epoch 1388/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2694
Epoch 1389/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2782
Epoch 1390/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2597
Epoch 1391/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2674
Epoch 1392/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2811
Epoch 1393/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2718
Epoch 1394/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2667
Epoch 1395/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2741
Epoch 1396/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2900
Epoch 1397/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2701
Epoch 1398/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2551
Epoch 1399/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2655
Epoch 1400/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3146
Epoch 1401/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2828
Epoch 1402/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2605
Epoch 1403/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2607
Epoch 1404/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2610
Epoch 1405/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2860
Epoch 1406/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2597
Epoch 1407/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2705
Epoch 1408/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2794
Epoch 1409/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2759
Epoch 1410/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2651
Epoch 1411/1500
```

```
2/2 [==============================] - 0s 4ms/step - loss: 0.2671
Epoch 1412/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2927
Epoch 1413/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2886
Epoch 1414/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2636
Epoch 1415/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2638
Epoch 1416/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2651
Epoch 1417/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2617
Epoch 1418/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2599
Epoch 1419/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2707
Epoch 1420/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2740
Epoch 1421/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2758
Epoch 1422/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2940
Epoch 1423/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.3031
Epoch 1424/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2971
Epoch 1425/1500
2/2 [==============================] - 0s 6ms/step - loss: 0.2741
Epoch 1426/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2709
Epoch 1427/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2641
Epoch 1428/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2911
Epoch 1429/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2652
Epoch 1430/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2644
Epoch 1431/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2819
Epoch 1432/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2583
Epoch 1433/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2556
Epoch 1434/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2576
Epoch 1435/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2716
Epoch 1436/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2750
Epoch 1437/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2612
Epoch 1438/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2644
Epoch 1439/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2677
Epoch 1440/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2884
Epoch 1441/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2596
Epoch 1442/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2648
Epoch 1443/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2910
Epoch 1444/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2694
Epoch 1445/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2610
Epoch 1446/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2548
Epoch 1447/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2644
Epoch 1448/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2711
Epoch 1449/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2645
Epoch 1450/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2964
Epoch 1451/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2718
Epoch 1452/1500
2/2 [==============================] - 0s 4ms/step - loss: 0.2769
Epoch 1453/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2798
Epoch 1454/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2735
Epoch 1455/1500
2/2 [==============================] - 0s 2ms/step - loss: 0.2647
Epoch 1456/1500
2/2 [==============================] - 0s 7ms/step - loss: 0.2725
Epoch 1457/1500
2/2 [==============================] - 0s 5ms/step - loss: 0.2812
Epoch 1458/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2616
Epoch 1459/1500
```

```
2/2 [==============================] - 0s 3ms/step - loss: 0.2639
Epoch 1460/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.3028
Epoch 1461/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2966
Epoch 1462/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2811
Epoch 1463/1500
1/2 [==============>...] - ETA: 0s - loss: 0.2977Epoch 1500/1500
2/2 [==============================] - 0s 3ms/step - loss: 0.2570
CPU times: user 12.4 s, sys: 689 ms, total: 13.1 s
Wall time: 13.9 s
```

[30]: `<keras.callbacks.History at 0x7b2b3981e2f0>`

[32]:
```
p = model.predict(f).flatten()
```

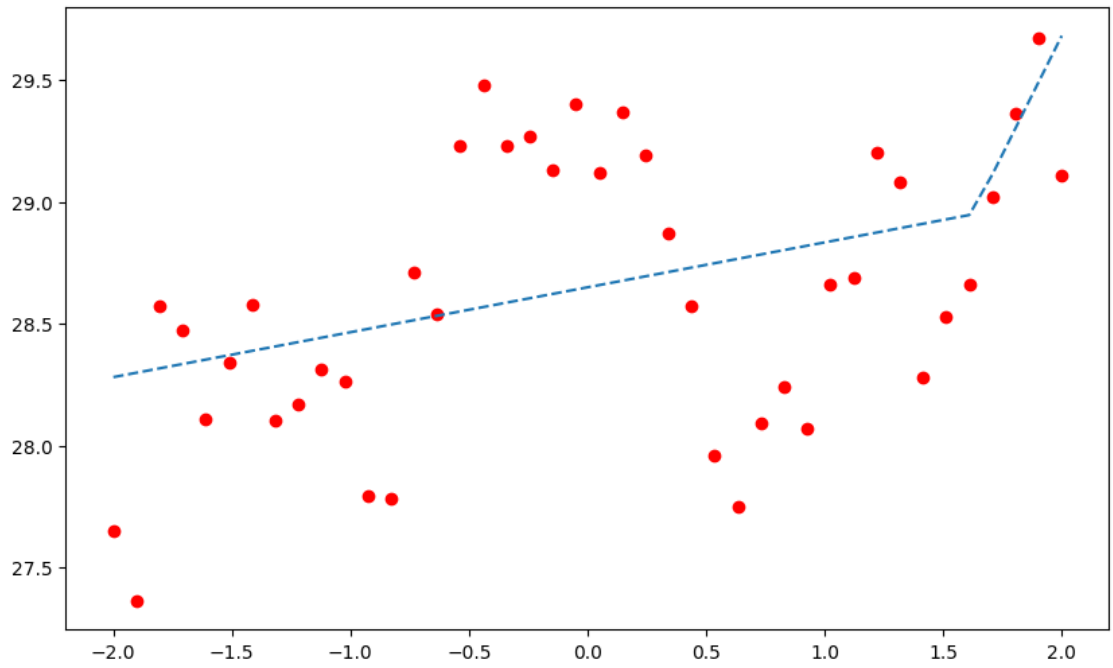
```
2/2 [==============================] - 0s 3ms/step
```

[33]:
```
MSE(l, p)
```

[33]: `0.25947178078708283`

[34]:
```
plt.figure(figsize=(10, 6))
plt.plot(f, l, 'ro', label='sample date ')
plt.plot(f, p, '--', label='DNN app')
```

[34]: `[<matplotlib.lines.Line2D at 0x7b2b38576f50>]`

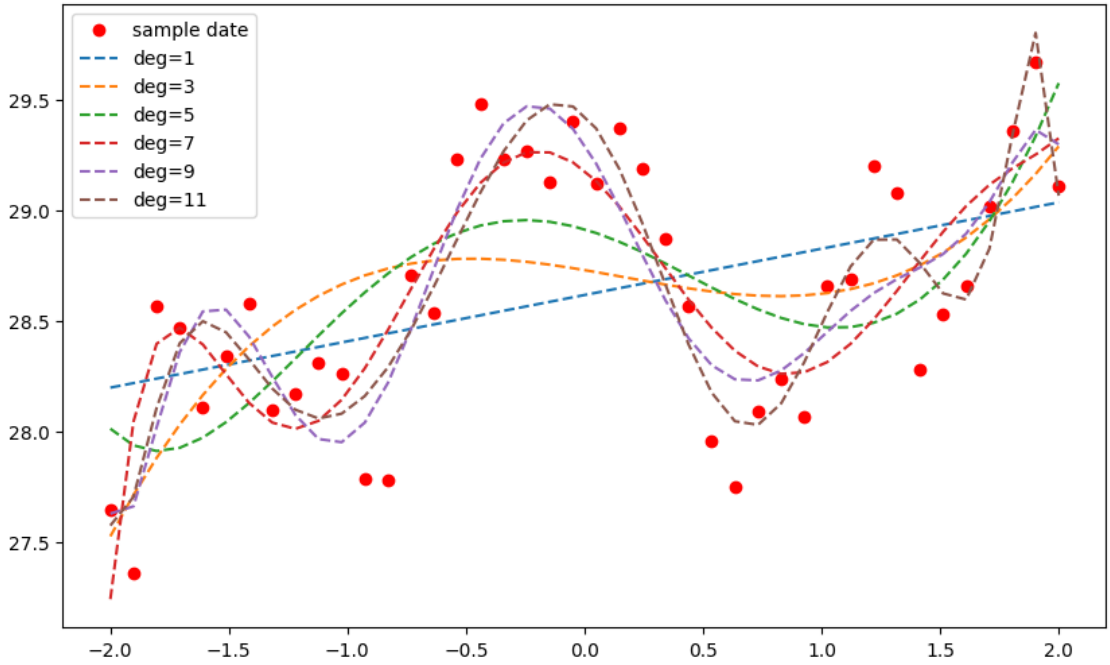


3 Capacity

[35]:
```
reg = {}
for d in range(1, 12, 2):
    reg[d]=np.polyfit(f, l, deg=d)
    p = np.polyval(reg[d], f)
    mse = MSE(l, p)
    print(f'{d:2d} | MSE={mse}')
```

```
 1 | MSE=0.2632064923883438
 3 | MSE=0.21240879462159845
 5 | MSE=0.18387702243048723
 7 | MSE=0.1119949724980867
 9 | MSE=0.08172685239892942
11 | MSE=0.05964934545440818
```

[36]:
```
plt.figure(figsize=(10, 6))
plt.plot(f, l, 'ro', label='sample date')
for d in reg:
    p = np.polyval(reg[d], f)
    plt.plot(f, p, '--', label=f'deg={d}')
    plt.legend();
```



[37]:
```
def create_dnn_model(hl=1, hu=256):
    ''' Function to create Keras DNN model.
    Parameters
    ----------
    ----------
    hl: int
        number of hidden layers
    hu: int
        number of hidden units (per laye)
    '''

    model = Sequential()
    for _ in range(hl):
        model.add(Dense(hu, activation='relu', input_dim=1))
    model.add(Dense(1, activation='linear'))
    model.compile(loss='mse', optimizer='rmsprop')
    return model
```

[38]:
```
model = create_dnn_model(3)
```

[39]:
```
model.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
 Layer (type)                 Output Shape              Param #
=================================================================
 dense_2 (Dense)              (None, 256)               512

 dense_3 (Dense)              (None, 256)               65792

 dense_4 (Dense)              (None, 256)               65792

 dense_5 (Dense)              (None, 1)                 257

=================================================================
Total params: 132,353
Trainable params: 132,353
Non-trainable params: 0
_________________________________________________________________
```

[40]:
```
%time model.fit(f, l, epochs=2500, verbose=False)
```

```
CPU times: user 15.4 s, sys: 813 ms, total: 16.2 s
Wall time: 12.8 s
```

[40]:
```
<keras.callbacks.History at 0x7b2b306ea4a0>
```

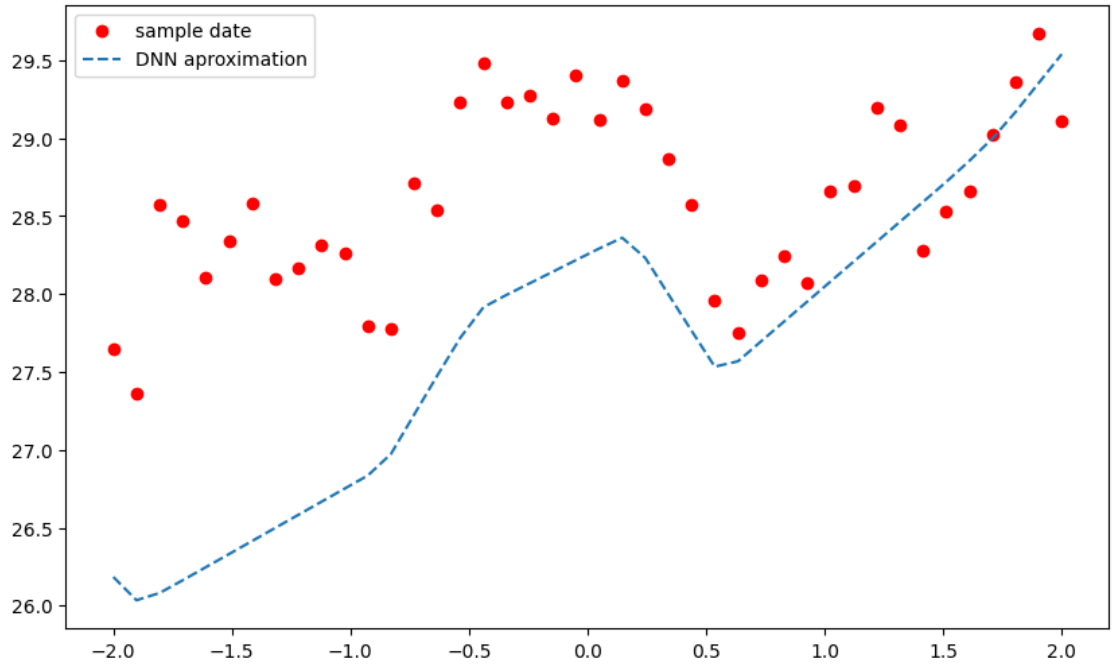
[41]:
```
p = model.predict(f).flatten()
```

```
2/2 [==============================] - 0s 4ms/step
```

[42]:
```
MSE(l, p)
```

[42]:
```
1.415395251279863
```

[43]:
```
plt.figure(figsize=(10, 6))
plt.plot(f, l, 'ro', label='sample date')
plt.plot(f, p, '--', label='DNN aproximation')
plt.legend();
```



[52]:
```
te = int(0.25 * len(f))
va = int(0.25 * len(f))
```

[53]:
```
np.random.seed(100)
ind = np.arange(len(f))
np.random.shuffle(ind)
```

[54]:
```
ind_te = np.sort(ind[:te])
ind_va = np.sort(ind[te:te + va])
ind_tr = np.sort(ind[te + va:])
```

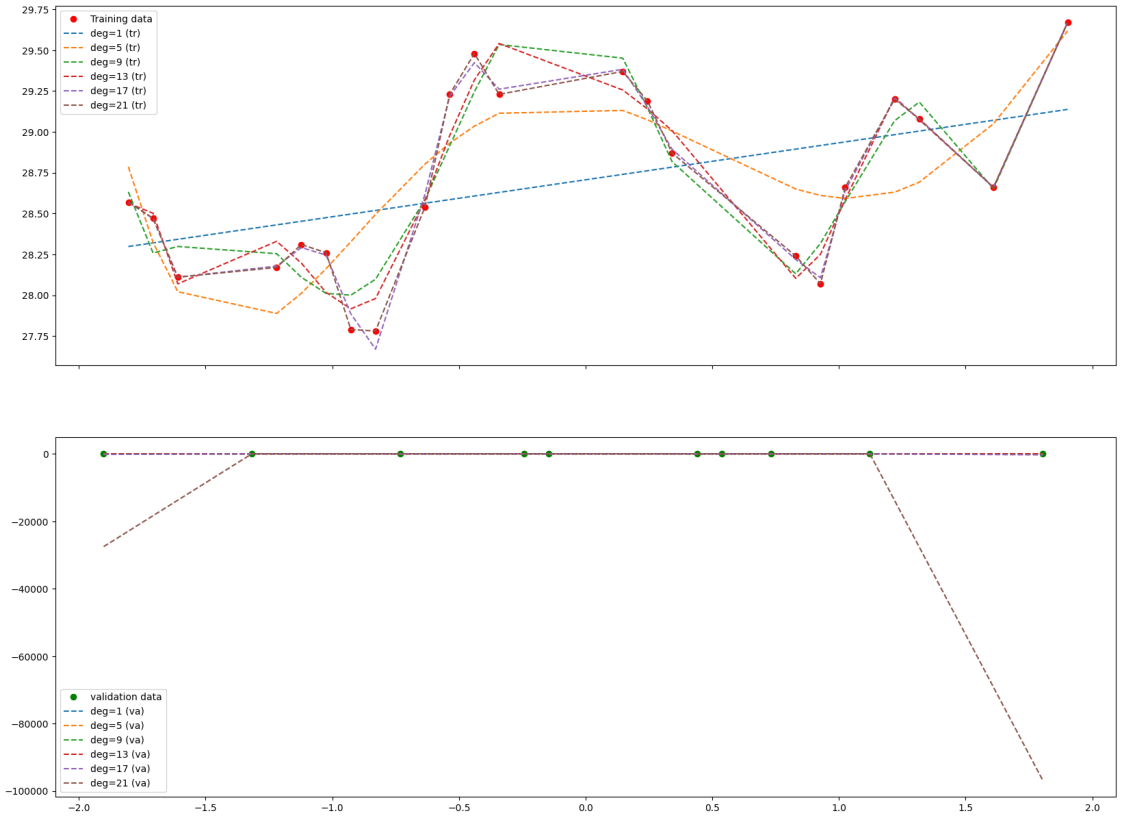
[55]:
```
f_te = f[ind_te]
f_va = f[ind_va]
f_tr = f[ind_tr]
```

[56]:
```
l_te = l[ind_tr]
l_va = l[ind_va]
l_tr = l[ind_tr]
```

[57]:
```
reg = {}
mse = {}
for d in range(1, 22, 4):
    reg[d] = np.polyfit(f_tr, l_tr, deg=d)
    p = np.polyval(reg[d], f_tr)
    mse_tr = MSE(l_tr, p)
    p = np.polyval(reg[d], f_va)
    mse_va = MSE(l_va, p)
    mse [d] = (mse_tr, mse_va)
    print(f'{d:2d} | MSE_tr={mse_tr:7.5f} | MSE_va={mse_va:7.5f}')
```

```
 1 | MSE_tr=0.23568 | MSE_va=0.31081
 5 | MSE_tr=0.11849 | MSE_va=0.57600
 9 | MSE_tr=0.03216 | MSE_va=0.89271
13 | MSE_tr=0.01980 | MSE_va=2.54061
17 | MSE_tr=0.00166 | MSE_va=13533.44415
21 | MSE_tr=0.00000 | MSE_va=1015207839.59853
```

[60]:
```
fig, ax = plt.subplots(2, 1, figsize=(20, 15), sharex=True)
ax[0].plot(f_tr, l_tr, 'ro', label='Training data')
ax[1].plot(f_va, l_va, 'go', label='validation data')
for d in reg:
    p = np.polyval(reg[d], f_tr)
    ax[0].plot(f_tr, p, '--', label=f'deg={d} (tr)')
    p = np.polyval(reg[d], f_va)
    plt.plot(f_va, p, '--', label=f'deg={d} (va)')
    ax[0].legend()
    ax[1].legend();
```



[69]:
```
from keras.callbacks import EarlyStopping
```

[70]:
```
model = create_dnn_model(2, 256)
```

[71]:
```
callbacks = [EarlyStopping(monitor='loss', patience=100,␣
 ↪restore_best_weights=True)]
```

[72]:
```
%%time
model.fit(f_tr, l_tr, epochs=3000, verbose=False, validation_data=(f_va, l_va),␣
 ↪callbacks=callbacks)
```

```
CPU times: user 9.24 s, sys: 364 ms, total: 9.61 s
Wall time: 9.73 s
```

[72]:
```
<keras.callbacks.History at 0x7b2b285128c0>
```

4 Training and Validation Data including DNN Predictions

[73]:
```
fig, ax = plt.subplots(2, 1, sharex=True, figsize=(10, 8))
ax[0].plot(f_tr, l_tr, 'ro', label='Training data')
p = model.predict(f_tr)
ax[0].plot(f_tr, p, '--', label=f'DNN (tr)')
ax[0].legend()
ax[1].plot(f_va, l_va,  'go', label="validation data")
p= model.predict(f_va)
ax[1].plot(f_va, p, '--', label=f'DNN (va)')
ax[1].legend();
```

```
1/1 [==============================] - 0s 44ms/step
1/1 [==============================] - 0s 15ms/step
```