Московский авиационный институт
(Национальный исследовательский университет)
Институт №8 «Информационные технологии и прикладная математика»

Кафедра вычислительной математики и программирования

Лабораторная работа №4
по курсу «Нейроинформатика»

Сети с радиальными базисными элементами

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Оценка:

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Лабораторная №4

Сети с радиальными базисными элементами

Вариант № 17

Красоткин Семён (М80-408Б-19)

Цель работы

Исследование свойств некоторых видов сетей с радиальными базисными элементами, алгоритмов обучения, а также применение сетей в задачах классификации и аппроксимации функции.

Код

```
import keras
import tensorflow as tf
import matplotlib.pyplot as plt
import numpy as np
import itertools

from keras import backend
from keras.layers import *
from sklearn.model_selection import train_test_split
```

RBF

```
class RBFLayer(keras.layers.Layer):
    def __init__(self, output_dim, mu_init =
tf.keras.initializers.RandomUniform(minval = -1, maxval =
1),**kwargs):
        self.output_dim = output_dim
        self.mu_init = mu_init
        super(RBFLayer, self).__init__(**kwargs)

    def build(self, input_shape):
        self.mu = self.add_weight(name = "mu",
                                  shape = (input_shape[1],
self.output_dim),
                                  initializer = self.mu_init,
                                  trainable = True)
        self.sigma = self.add_weight(name = "sigma",
                                     shape = (self.output_dim,),
                                     initializer = "random_normal",
                                     trainable = True)
        super(RBFLayer, self).build(input_shape)

    def call(self, inputs):
```

```
        diff = backend.expand_dims(inputs) - self.mu
        output = backend.exp(backend.sum(diff ** 2, axis = 1) *
self.sigma)
        return output
```

Классификация

```
# Уравнение эллипса в параметрическом виде.
def ellipse(t, a, b, x0, y0):
    x = x0 + a * np.cos(t)
    y = y0 + b * np.sin(t)
    return x, y

# Уравнение параболы в параметрическом виде.
def parabola(t, p, x0, y0):
    x = x0 + t ** 2 / (2. * p)
    y = y0 + t
    return x, y

# Функция вращения фигуры на заданный угол.
def rotate(x, y, alpha):
    xr = x * np.cos(alpha) - y * np.sin(alpha)
    yr = x * np.sin(alpha) + y * np.cos(alpha)
    return xr, yr

# Эллипс
a1 = 0.4
b1 = 0.15
alpha1 = np.pi / 6
x01 = 0.1
y01 = -0.15

# Эллипс
a2 = 0.7
b2 = 0.5
alpha2 = np.pi / 3
x02 = 0
y02 = 0

# Парабола
p = 1
alpha3 = np.pi / 2
x03 = -0.8
y03 = 0

t = np.arange(0, 2 * np.pi, 0.025)

fig1x, fig1y = ellipse(t, a1, b1, x01, y01)
fig1x, fig1y = rotate(fig1x, fig1y, alpha1)

fig2x, fig2y = ellipse(t, a2, b2, x02, y02)
```

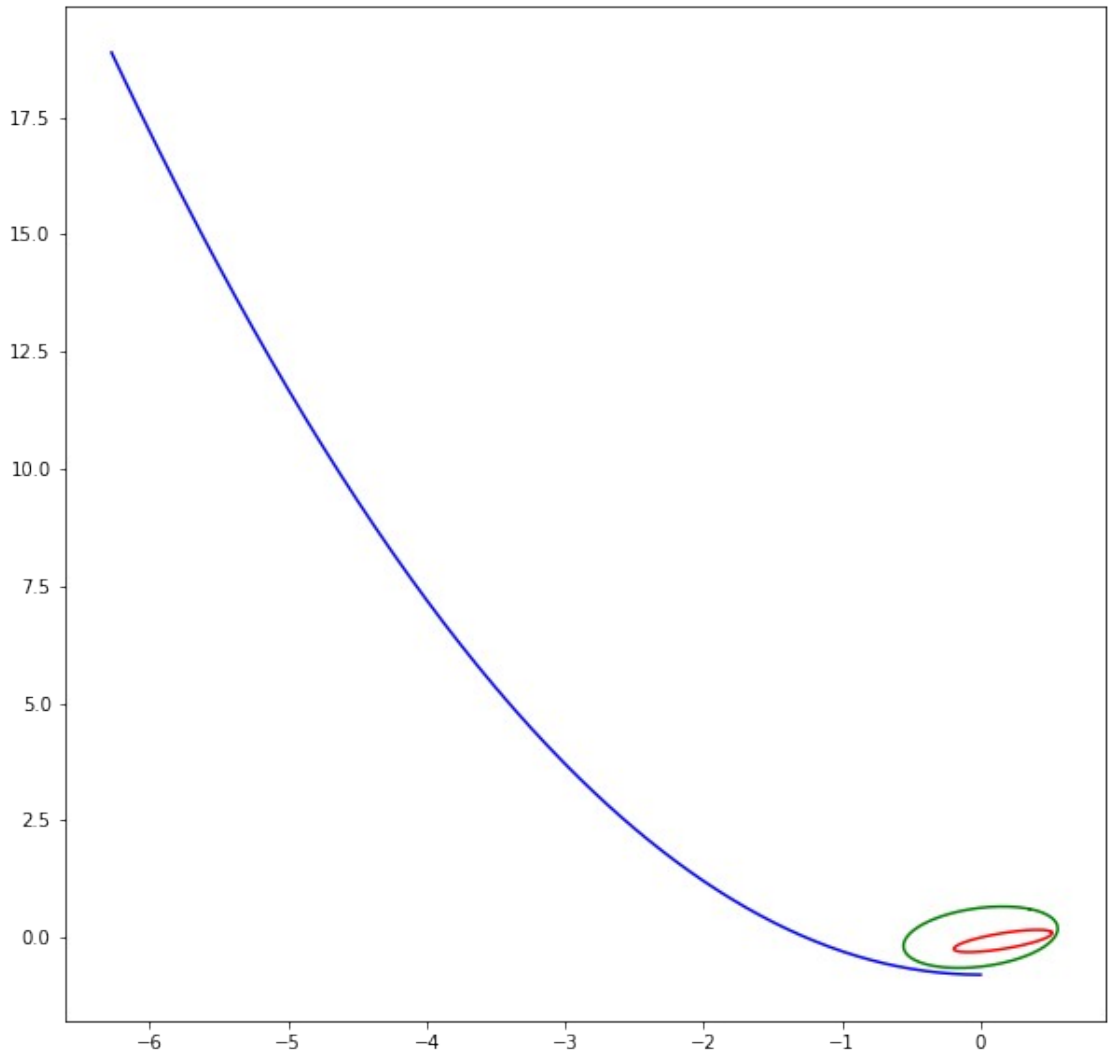
```
fig2x, fig2y = rotate(fig2x, fig2y, alpha2)

fig3x, fig3y = parabola(t, p, x03, y03)

fig3x, fig3y = rotate(fig3x, fig3y, alpha3)

figure = plt.figure(figsize = (10, 10))

plt.plot(fig1x, fig1y, c = 'r')
plt.plot(fig2x, fig2y, c = 'g')
plt.plot(fig3x, fig3y, c = 'b')
plt.show()
```




```
datax = np.concatenate((fig1x, fig2x, fig3x), axis=0)
datay = np.concatenate((fig1y, fig2y, fig3y), axis=0)


data = np.array([datax, datay])
```

```
l1 = [[1, 0, 0] for _ in range(len(fig1x))]
l2 = [[0, 1, 0] for _ in range(len(fig2x))]
l3 = [[0, 0, 1] for _ in range(len(fig3x))]

labels = np.array(l1 + l2 + l3)

data = data.transpose()

train, test, train_labels, test_labels = train_test_split(data,
labels, test_size = 0.2, random_state = 10,shuffle = True)

model = keras.models.Sequential()

model.add(RBFLayer(3, input_dim = 2))
model.add(Dense(3, activation = "sigmoid"))

model.compile(tf.keras.optimizers.Adam(learning_rate = 1e-3), 'mse',
['accuracy'])

hist = model.fit(train, train_labels, batch_size = 1, epochs = 200)
```

```
Epoch 1/200
604/604 [==============================] - 2s 2ms/step - loss: 0.2949
- accuracy: 0.4106
Epoch 2/200
604/604 [==============================] - 2s 3ms/step - loss: 0.2100
- accuracy: 0.5215
Epoch 3/200
604/604 [==============================] - 2s 3ms/step - loss: 0.1971
- accuracy: 0.5596
Epoch 4/200
604/604 [==============================] - 2s 3ms/step - loss: 0.1896
- accuracy: 0.5993
Epoch 5/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1824
- accuracy: 0.6109
Epoch 6/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1750
- accuracy: 0.6109
Epoch 7/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1682
- accuracy: 0.6374
Epoch 8/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1621
- accuracy: 0.6772
Epoch 9/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1566
- accuracy: 0.6457
Epoch 10/200
```

```
604/604 [==============================] - 1s 2ms/step - loss: 0.1519
- accuracy: 0.6523
Epoch 11/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1478
- accuracy: 0.6540
Epoch 12/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1441
- accuracy: 0.6937
Epoch 13/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1410
- accuracy: 0.6656
Epoch 14/200
604/604 [==============================] - 1s 1ms/step - loss: 0.1381
- accuracy: 0.6755
Epoch 15/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1355
- accuracy: 0.6672
Epoch 16/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1330
- accuracy: 0.6656
Epoch 17/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1306
- accuracy: 0.6821
Epoch 18/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1284
- accuracy: 0.7169
Epoch 19/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1261
- accuracy: 0.7268
Epoch 20/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1239
- accuracy: 0.7583
Epoch 21/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1216
- accuracy: 0.7632
Epoch 22/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1192
- accuracy: 0.7748
Epoch 23/200
604/604 [==============================] - 1s 1ms/step - loss: 0.1171
- accuracy: 0.8146
Epoch 24/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1147
- accuracy: 0.8228
Epoch 25/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1125
- accuracy: 0.8212
Epoch 26/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1101
- accuracy: 0.8493
```

```
Epoch 27/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1078
- accuracy: 0.8411
Epoch 28/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1056
- accuracy: 0.8444
Epoch 29/200
604/604 [==============================] - 1s 2ms/step - loss: 0.1033
- accuracy: 0.8560
Epoch 30/200
604/604 [==============================] - 1s 1ms/step - loss: 0.1012
- accuracy: 0.8725
Epoch 31/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0991
- accuracy: 0.8775
Epoch 32/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0969
- accuracy: 0.8675
Epoch 33/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0950
- accuracy: 0.8709
Epoch 34/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0930
- accuracy: 0.8990
Epoch 35/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0911
- accuracy: 0.8841
Epoch 36/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0893
- accuracy: 0.9073
Epoch 37/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0874
- accuracy: 0.9023
Epoch 38/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0858
- accuracy: 0.8974
Epoch 39/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0842
- accuracy: 0.9255
Epoch 40/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0825
- accuracy: 0.9172
Epoch 41/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0811
- accuracy: 0.9305
Epoch 42/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0797
- accuracy: 0.9288
Epoch 43/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0783
```

```
- accuracy: 0.9321
Epoch 44/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0769
- accuracy: 0.9338
Epoch 45/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0756
- accuracy: 0.9354
Epoch 46/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0744
- accuracy: 0.9371
Epoch 47/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0732
- accuracy: 0.9404
Epoch 48/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0718
- accuracy: 0.9437
Epoch 49/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0712
- accuracy: 0.9404
Epoch 50/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0699
- accuracy: 0.9387
Epoch 51/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0690
- accuracy: 0.9454
Epoch 52/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0678
- accuracy: 0.9470
Epoch 53/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0671
- accuracy: 0.9454
Epoch 54/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0661
- accuracy: 0.9503
Epoch 55/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0653
- accuracy: 0.9520
Epoch 56/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0645
- accuracy: 0.9454
Epoch 57/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0637
- accuracy: 0.9520
Epoch 58/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0627
- accuracy: 0.9520
Epoch 59/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0620
- accuracy: 0.9536
Epoch 60/200
```

```
604/604 [==============================] - 1s 2ms/step - loss: 0.0612
- accuracy: 0.9570
Epoch 61/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0606
- accuracy: 0.9503
Epoch 62/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0598
- accuracy: 0.9536
Epoch 63/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0591
- accuracy: 0.9603
Epoch 64/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0584
- accuracy: 0.9570
Epoch 65/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0577
- accuracy: 0.9586
Epoch 66/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0571
- accuracy: 0.9536
Epoch 67/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0565
- accuracy: 0.9536
Epoch 68/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0558
- accuracy: 0.9570
Epoch 69/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0551
- accuracy: 0.9603
Epoch 70/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0546
- accuracy: 0.9603
Epoch 71/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0538
- accuracy: 0.9570
Epoch 72/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0535
- accuracy: 0.9603
Epoch 73/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0529
- accuracy: 0.9586
Epoch 74/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0522
- accuracy: 0.9652
Epoch 75/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0515
- accuracy: 0.9636
Epoch 76/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0512
- accuracy: 0.9652
```

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Epoch 77/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0506
- accuracy: 0.9570
Epoch 78/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0500
- accuracy: 0.9603
Epoch 79/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0496
- accuracy: 0.9685
Epoch 80/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0488
- accuracy: 0.9768
Epoch 81/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0487
- accuracy: 0.9619
Epoch 82/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0481
- accuracy: 0.9652
Epoch 83/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0477
- accuracy: 0.9702
Epoch 84/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0474
- accuracy: 0.9702
Epoch 85/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0469
- accuracy: 0.9752
Epoch 86/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0460
- accuracy: 0.9785
Epoch 87/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0457
- accuracy: 0.9768
Epoch 88/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0456
- accuracy: 0.9652
Epoch 89/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0450
- accuracy: 0.9752
Epoch 90/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0445
- accuracy: 0.9702
Epoch 91/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0444
- accuracy: 0.9669
Epoch 92/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0436
- accuracy: 0.9752
Epoch 93/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0435
```

```
- accuracy: 0.9702
Epoch 94/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0431
- accuracy: 0.9785
Epoch 95/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0426
- accuracy: 0.9834
Epoch 96/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0422
- accuracy: 0.9785
Epoch 97/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0419
- accuracy: 0.9702
Epoch 98/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0416
- accuracy: 0.9735
Epoch 99/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0414
- accuracy: 0.9735
Epoch 100/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0410
- accuracy: 0.9735
Epoch 101/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0405
- accuracy: 0.9834
Epoch 102/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0402
- accuracy: 0.9785
Epoch 103/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0400
- accuracy: 0.9735
Epoch 104/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0397
- accuracy: 0.9834
Epoch 105/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0392
- accuracy: 0.9868
Epoch 106/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0392
- accuracy: 0.9752
Epoch 107/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0387
- accuracy: 0.9818
Epoch 108/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0384
- accuracy: 0.9818
Epoch 109/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0380
- accuracy: 0.9785
Epoch 110/200
```

```
604/604 [==============================] - 1s 2ms/step - loss: 0.0378
- accuracy: 0.9719
Epoch 111/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0375
- accuracy: 0.9801
Epoch 112/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0375
- accuracy: 0.9851
Epoch 113/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0372
- accuracy: 0.9735
Epoch 114/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0368
- accuracy: 0.9768
Epoch 115/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0366
- accuracy: 0.9768
Epoch 116/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0363
- accuracy: 0.9801
Epoch 117/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0359
- accuracy: 0.9818
Epoch 118/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0358
- accuracy: 0.9801
Epoch 119/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0355
- accuracy: 0.9851
Epoch 120/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0353
- accuracy: 0.9851
Epoch 121/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0350
- accuracy: 0.9834
Epoch 122/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0348
- accuracy: 0.9735
Epoch 123/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0345
- accuracy: 0.9768
Epoch 124/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0344
- accuracy: 0.9801
Epoch 125/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0342
- accuracy: 0.9801
Epoch 126/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0339
- accuracy: 0.9868
```

```
Epoch 127/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0338
- accuracy: 0.9752
Epoch 128/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0333
- accuracy: 0.9818
Epoch 129/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0333
- accuracy: 0.9768
Epoch 130/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0331
- accuracy: 0.9818
Epoch 131/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0329
- accuracy: 0.9834
Epoch 132/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0328
- accuracy: 0.9752
Epoch 133/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0325
- accuracy: 0.9901
Epoch 134/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0323
- accuracy: 0.9801
Epoch 135/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0322
- accuracy: 0.9801
Epoch 136/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0321
- accuracy: 0.9818
Epoch 137/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0318
- accuracy: 0.9834
Epoch 138/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0315
- accuracy: 0.9801
Epoch 139/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0313
- accuracy: 0.9818
Epoch 140/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0313
- accuracy: 0.9801
Epoch 141/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0311
- accuracy: 0.9818
Epoch 142/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0309
- accuracy: 0.9768
Epoch 143/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0306
```

```
- accuracy: 0.9801
Epoch 144/200
604/604 [==============================] - 2s 3ms/step - loss: 0.0304
- accuracy: 0.9834
Epoch 145/200
604/604 [==============================] - 2s 3ms/step - loss: 0.0305
- accuracy: 0.9801
Epoch 146/200
604/604 [==============================] - 2s 3ms/step - loss: 0.0303
- accuracy: 0.9851
Epoch 147/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0299
- accuracy: 0.9801
Epoch 148/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0297
- accuracy: 0.9834
Epoch 149/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0296
- accuracy: 0.9818
Epoch 150/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0294
- accuracy: 0.9868
Epoch 151/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0293
- accuracy: 0.9818
Epoch 152/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0292
- accuracy: 0.9851
Epoch 153/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0291
- accuracy: 0.9851
Epoch 154/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0289
- accuracy: 0.9818
Epoch 155/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0281
- accuracy: 0.9851
Epoch 156/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0286
- accuracy: 0.9801
Epoch 157/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0286
- accuracy: 0.9834
Epoch 158/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0285
- accuracy: 0.9901
Epoch 159/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0283
- accuracy: 0.9818
Epoch 160/200
```

```
604/604 [==============================] - 1s 2ms/step - loss: 0.0280
- accuracy: 0.9801
Epoch 161/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0279
- accuracy: 0.9851
Epoch 162/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0277
- accuracy: 0.9851
Epoch 163/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0279
- accuracy: 0.9768
Epoch 164/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0276
- accuracy: 0.9851
Epoch 165/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0275
- accuracy: 0.9884
Epoch 166/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0272
- accuracy: 0.9851
Epoch 167/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0271
- accuracy: 0.9851
Epoch 168/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0269
- accuracy: 0.9818
Epoch 169/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0266
- accuracy: 0.9901
Epoch 170/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0268
- accuracy: 0.9818
Epoch 171/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0267
- accuracy: 0.9868
Epoch 172/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0263
- accuracy: 0.9851
Epoch 173/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0264
- accuracy: 0.9901
Epoch 174/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0264
- accuracy: 0.9834
Epoch 175/200
604/604 [==============================] - 1s 1ms/step - loss: 0.0262
- accuracy: 0.9834
Epoch 176/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0260
- accuracy: 0.9768
```

```
Epoch 177/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0260
- accuracy: 0.9884
Epoch 178/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0257
- accuracy: 0.9868
Epoch 179/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0256
- accuracy: 0.9851
Epoch 180/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0253
- accuracy: 0.9834
Epoch 181/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0254
- accuracy: 0.9934
Epoch 182/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0253
- accuracy: 0.9950
Epoch 183/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0252
- accuracy: 0.9834
Epoch 184/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0249
- accuracy: 0.9917
Epoch 185/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0253
- accuracy: 0.9851
Epoch 186/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0250
- accuracy: 0.9768
Epoch 187/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0250
- accuracy: 0.9851
Epoch 188/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0248
- accuracy: 0.9884
Epoch 189/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0244
- accuracy: 0.9901
Epoch 190/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0245
- accuracy: 0.9834
Epoch 191/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0244
- accuracy: 0.9884
Epoch 192/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0237
- accuracy: 0.9868
Epoch 193/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0242
```

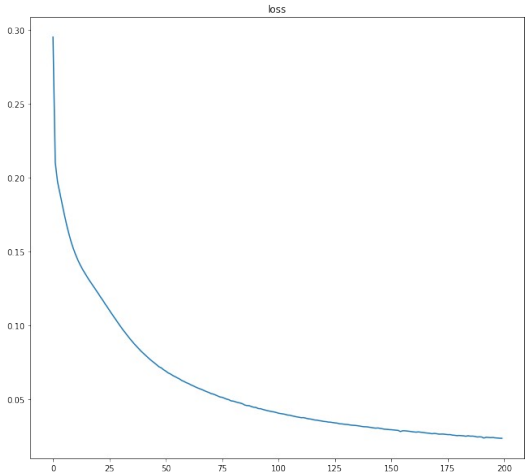
```
- accuracy: 0.9917
Epoch 194/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0241
- accuracy: 0.9834
Epoch 195/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0240
- accuracy: 0.9868
Epoch 196/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0241
- accuracy: 0.9868
Epoch 197/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0238
- accuracy: 0.9884
Epoch 198/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0237
- accuracy: 0.9818
Epoch 199/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0236
- accuracy: 0.9868
Epoch 200/200
604/604 [==============================] - 1s 2ms/step - loss: 0.0235
- accuracy: 0.9868
```

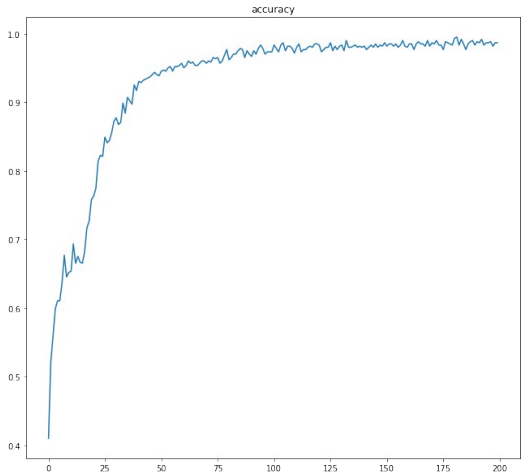
```
figure = plt.figure(figsize = (24, 10))
histx = []
for i in range(len(hist.history['loss'])):
    histx.append(i)


figure.add_subplot(1, 2, 1)
plt.title("loss")
plt.plot(histx, hist.history['loss'])

figure.add_subplot(1, 2, 2)
plt.title("accuracy")
plt.plot(histx, hist.history['accuracy'])

plt.show()
```






```
x = np.linspace(-18, 1, 200)
y = np.linspace(-1, 6, 200)

figure = plt.figure(figsize = (24, 10))

ax1 = figure.add_subplot(1, 2, 1)
ax2 = figure.add_subplot(1, 2, 2)

ax1.plot(fig1x, fig1y, c = 'r')
ax1.plot(fig2x, fig2y, c = 'g')
ax1.plot(fig3x, fig3y, c = 'b')

data = np.array(list(itertools.product(x, y)))

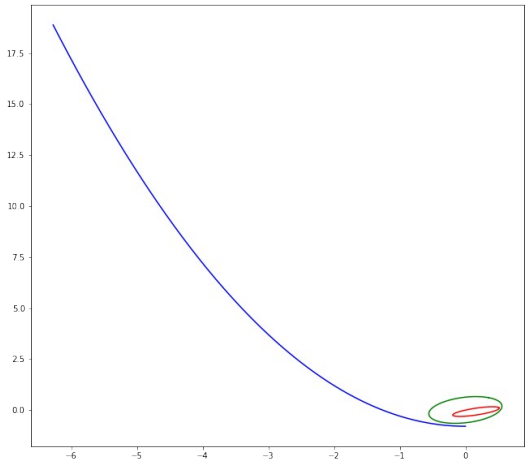
xy = data.transpose()

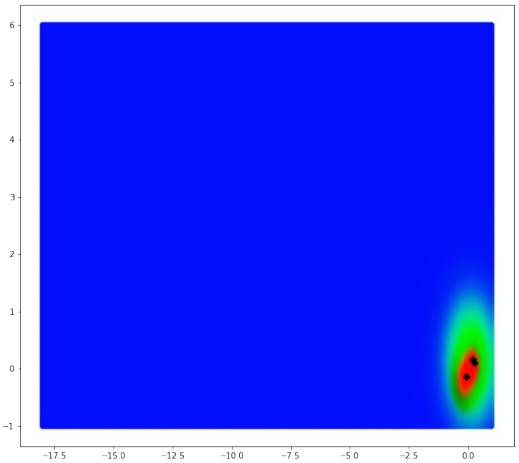
pred = model.predict(data)


ax2.scatter(xy[0], xy[1], c = pred)
mu = model.get_layer(index = 0).get_weights()[0]
plt.scatter(mu[0], mu[1], color = "black", marker = "D")

plt.show()
```

```
1250/1250 [==============================] - 2s 1ms/step
```





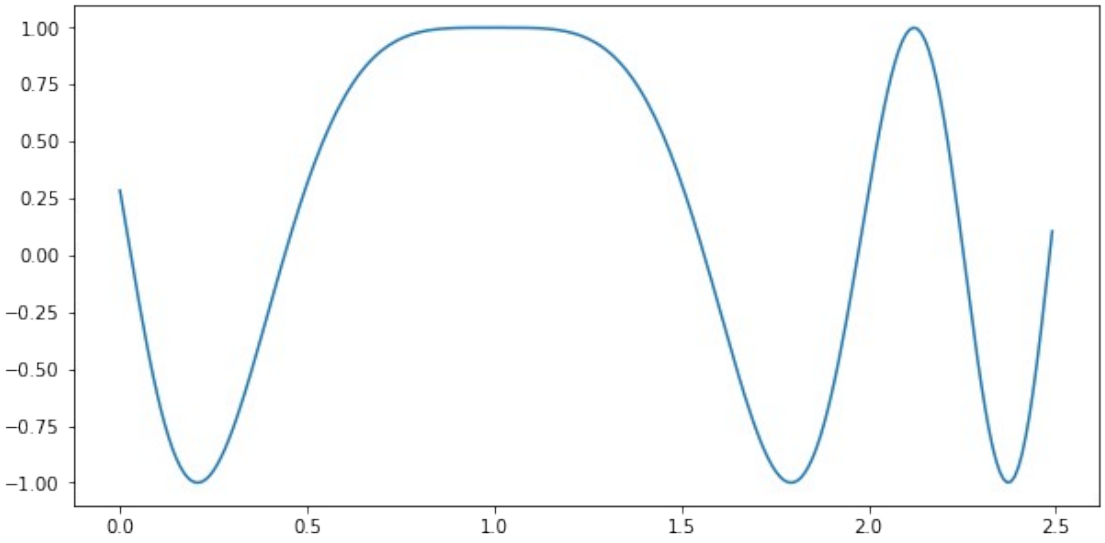
Апроксимация

```
f = lambda t: np.cos(-5*t**2 + 10*t - 5)
t = np.arange(0, 2.5, 0.01)
ft = f(t)

t = np.arange(0, 2.5, 0.01)
ft = f(t)

figure = plt.figure(figsize = (10, 5))

plt.plot(t, ft)
plt.show()
```




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

model.add(RBFLayer(32, input_dim = 1,
mu_init=keras.initializers.RandomUniform(minval = 0, maxval = 2.5)))
model.add(Dense(16, activation='tanh'))
model.add(Dense(1, activation = "linear"))
```

```
model.compile(tf.keras.optimizers.RMSprop(0.003), 'mse')

hist = model.fit(t, ft, batch_size = 1, epochs = 1000, shuffle = True)
```

```
Epoch 1/1000
250/250 [==============================] - 1s 2ms/step - loss: 0.5801
Epoch 2/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.4698
Epoch 3/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.4383
Epoch 4/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.3936
Epoch 5/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.3149
Epoch 6/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.2505
Epoch 7/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.2198
Epoch 8/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.2068
Epoch 9/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.1694
Epoch 10/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.1196
Epoch 11/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0794
Epoch 12/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0560
Epoch 13/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0463
Epoch 14/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0391
Epoch 15/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0331
Epoch 16/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0411
Epoch 17/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0346
Epoch 18/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0357
Epoch 19/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0344
Epoch 20/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0341
Epoch 21/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0286
Epoch 22/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0337
Epoch 23/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0285
Epoch 24/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0326
Epoch 25/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0308
Epoch 26/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0310
Epoch 27/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0305
Epoch 28/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0262
Epoch 29/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0286
Epoch 30/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0278
Epoch 31/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0257
Epoch 32/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0289
Epoch 33/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0292
Epoch 34/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0301
Epoch 35/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0263
Epoch 36/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0282
Epoch 37/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0270
Epoch 38/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0282
Epoch 39/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0269
Epoch 40/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0254
Epoch 41/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0261
Epoch 42/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0260
Epoch 43/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0261
Epoch 44/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0248
Epoch 45/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0259
Epoch 46/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0259
Epoch 47/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0253
Epoch 48/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0239
Epoch 49/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0260
Epoch 50/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0244
Epoch 51/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0273
Epoch 52/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0232
Epoch 53/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0262
Epoch 54/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0254
Epoch 55/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0350
Epoch 56/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0238
Epoch 57/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0224
Epoch 58/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0231
Epoch 59/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0200
Epoch 60/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0221
Epoch 61/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0229
Epoch 62/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0211
Epoch 63/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0241
Epoch 64/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0208
Epoch 65/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0221
Epoch 66/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0223
Epoch 67/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0239
Epoch 68/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0232
Epoch 69/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0225
Epoch 70/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0199
Epoch 71/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0253
Epoch 72/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0239
Epoch 73/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0207
Epoch 74/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0216
Epoch 75/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0212
Epoch 76/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0218
Epoch 77/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0204
Epoch 78/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0224
Epoch 79/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0222
Epoch 80/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0206
Epoch 81/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0219
Epoch 82/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0204
Epoch 83/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0215
Epoch 84/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0216
Epoch 85/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0222
Epoch 86/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0209
Epoch 87/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0225
Epoch 88/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0208
Epoch 89/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0219
Epoch 90/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0205
Epoch 91/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0214
Epoch 92/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0216
Epoch 93/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0219
Epoch 94/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0194
Epoch 95/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0217
Epoch 96/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0213
Epoch 97/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0223
Epoch 98/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0226
Epoch 99/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0210
Epoch 100/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0215
Epoch 101/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0193
Epoch 102/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0228
Epoch 103/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0197
Epoch 104/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0196
Epoch 105/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0196
Epoch 106/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0201
Epoch 107/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0206
Epoch 108/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0197
Epoch 109/1000
250/250 [==============================] - 1s 3ms/step - loss: 0.0188
Epoch 110/1000
250/250 [==============================] - 1s 3ms/step - loss: 0.0230
Epoch 111/1000
250/250 [==============================] - 1s 3ms/step - loss: 0.0188
Epoch 112/1000
250/250 [==============================] - 1s 3ms/step - loss: 0.0201
Epoch 113/1000
250/250 [==============================] - 1s 3ms/step - loss: 0.0188
Epoch 114/1000
250/250 [==============================] - 1s 3ms/step - loss: 0.0197
Epoch 115/1000
250/250 [==============================] - 1s 3ms/step - loss: 0.0196
Epoch 116/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0196
Epoch 117/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0189
Epoch 118/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0197
Epoch 119/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0187
Epoch 120/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0183
Epoch 121/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0184
Epoch 122/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0208
Epoch 123/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0164
Epoch 124/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0222
Epoch 125/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0200
Epoch 126/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0185
Epoch 127/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0193
Epoch 128/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0188
Epoch 129/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0185
Epoch 130/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0178
Epoch 131/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0167
Epoch 132/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0196
Epoch 133/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0184
Epoch 134/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0163
Epoch 135/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0189
Epoch 136/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0179
Epoch 137/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0171
Epoch 138/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0186
Epoch 139/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0193
Epoch 140/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0185
Epoch 141/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0193
Epoch 142/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0182
Epoch 143/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0181
Epoch 144/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0187
Epoch 145/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0195
Epoch 146/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0192
Epoch 147/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0170
Epoch 148/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0181
Epoch 149/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0205
Epoch 150/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0191
Epoch 151/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0171
Epoch 152/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0173
Epoch 153/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0173
Epoch 154/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0173
Epoch 155/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0178
Epoch 156/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0157
Epoch 157/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0160
Epoch 158/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0168
Epoch 159/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0177
Epoch 160/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0175
Epoch 161/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0171
Epoch 162/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0170
Epoch 163/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0171
Epoch 164/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0164
Epoch 165/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0179
Epoch 166/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0156
Epoch 167/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0174
Epoch 168/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0171
Epoch 169/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0196
Epoch 170/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0156
Epoch 171/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0183
Epoch 172/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0155
Epoch 173/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0166
Epoch 174/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0159
Epoch 175/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0169
Epoch 176/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0176
Epoch 177/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0159
Epoch 178/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0166
Epoch 179/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0169
Epoch 180/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0169
Epoch 181/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0156
Epoch 182/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0162
Epoch 183/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0175
Epoch 184/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0154
Epoch 185/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0154
Epoch 186/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0162
Epoch 187/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0138
Epoch 188/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0151
Epoch 189/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0150
Epoch 190/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0150
Epoch 191/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0157
Epoch 192/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0152
Epoch 193/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0144
Epoch 194/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0163
Epoch 195/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0163
Epoch 196/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0138
Epoch 197/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0133
Epoch 198/1000
```

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250/250 [==============================] - 0s 2ms/step - loss: 0.0152
Epoch 199/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0167
Epoch 200/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0148
Epoch 201/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0158
Epoch 202/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0117
Epoch 203/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0133
Epoch 204/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0148
Epoch 205/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0166
Epoch 206/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0160
Epoch 207/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0146
Epoch 208/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0122
Epoch 209/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0165
Epoch 210/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0144
Epoch 211/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0138
Epoch 212/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0147
Epoch 213/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0131
Epoch 214/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0111
Epoch 215/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0148
Epoch 216/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0106
Epoch 217/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0148
Epoch 218/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0125
Epoch 219/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0142
Epoch 220/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0127
Epoch 221/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0120
Epoch 222/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0129
Epoch 223/1000
```

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250/250 [==============================] - 0s 2ms/step - loss: 0.0113
Epoch 224/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0129
Epoch 225/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0110
Epoch 226/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0106
Epoch 227/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0126
Epoch 228/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0131
Epoch 229/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0103
Epoch 230/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0143
Epoch 231/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0112
Epoch 232/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0117
Epoch 233/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0134
Epoch 234/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0128
Epoch 235/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0104
Epoch 236/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0096
Epoch 237/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0105
Epoch 238/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0120
Epoch 239/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0106
Epoch 240/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0117
Epoch 241/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0110
Epoch 242/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0107
Epoch 243/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0096
Epoch 244/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0113
Epoch 245/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0100
Epoch 246/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0123
Epoch 247/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0116
Epoch 248/1000
```

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250/250 [==============================] - 0s 2ms/step - loss: 0.0095
Epoch 249/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0100
Epoch 250/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0097
Epoch 251/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0112
Epoch 252/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0091
Epoch 253/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0111
Epoch 254/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0091
Epoch 255/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0105
Epoch 256/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0123
Epoch 257/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0107
Epoch 258/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0108
Epoch 259/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0108
Epoch 260/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0097
Epoch 261/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0097
Epoch 262/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0120
Epoch 263/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0100
Epoch 264/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0095
Epoch 265/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0105
Epoch 266/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0106
Epoch 267/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0095
Epoch 268/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0106
Epoch 269/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0093
Epoch 270/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0122
Epoch 271/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0097
Epoch 272/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0103
Epoch 273/1000
```

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250/250 [==============================] - 0s 2ms/step - loss: 0.0081
Epoch 274/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0082
Epoch 275/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0083
Epoch 276/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0083
Epoch 277/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0071
Epoch 278/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0086
Epoch 279/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0082
Epoch 280/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0069
Epoch 281/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0075
Epoch 282/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0080
Epoch 283/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0075
Epoch 284/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0071
Epoch 285/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0065
Epoch 286/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0087
Epoch 287/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0077
Epoch 288/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0068
Epoch 289/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0068
Epoch 290/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0076
Epoch 291/1000
250/250 [==============================] - 0s 1ms/step - loss: 0.0075
Epoch 292/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0068
Epoch 293/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0072
Epoch 294/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0073
Epoch 295/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0074
Epoch 296/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0067
Epoch 297/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0083
Epoch 298/1000
```

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250/250 [==============================] - 0s 2ms/step - loss: 0.0069
Epoch 299/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0076
Epoch 300/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0071
Epoch 301/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0065
Epoch 302/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0069
Epoch 303/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0073
Epoch 304/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0070
Epoch 305/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0066
Epoch 306/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0063
Epoch 307/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0070
Epoch 308/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0068
Epoch 309/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0073
Epoch 310/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0060
Epoch 311/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0080
Epoch 312/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 313/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0083
Epoch 314/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0065
Epoch 315/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0069
Epoch 316/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0075
Epoch 317/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0062
Epoch 318/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0071
Epoch 319/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0072
Epoch 320/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0061
Epoch 321/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0079
Epoch 322/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0060
Epoch 323/1000
```

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250/250 [==============================] - 0s 2ms/step - loss: 0.0070
Epoch 324/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0064
Epoch 325/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0073
Epoch 326/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0069
Epoch 327/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0072
Epoch 328/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0061
Epoch 329/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 330/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0067
Epoch 331/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 332/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0079
Epoch 333/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0067
Epoch 334/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0062
Epoch 335/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0063
Epoch 336/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0065
Epoch 337/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0061
Epoch 338/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0067
Epoch 339/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 340/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0064
Epoch 341/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 342/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0067
Epoch 343/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 344/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0069
Epoch 345/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0068
Epoch 346/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0062
Epoch 347/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 348/1000
```

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250/250 [==============================] - 0s 2ms/step - loss: 0.0062
Epoch 349/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0061
Epoch 350/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0064
Epoch 351/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0074
Epoch 352/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0060
Epoch 353/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 354/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0060
Epoch 355/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0057
Epoch 356/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0063
Epoch 357/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0063
Epoch 358/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 359/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 360/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 361/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0061
Epoch 362/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 363/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 364/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 365/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 366/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0062
Epoch 367/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0065
Epoch 368/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 369/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0050
Epoch 370/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0066
Epoch 371/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0066
Epoch 372/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 373/1000
```

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250/250 [==============================] - 0s 2ms/step - loss: 0.0063
Epoch 374/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0060
Epoch 375/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 376/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 377/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0057
Epoch 378/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0061
Epoch 379/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0060
Epoch 380/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0057
Epoch 381/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 382/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0055
Epoch 383/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 384/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 385/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0061
Epoch 386/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0064
Epoch 387/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0057
Epoch 388/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0057
Epoch 389/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0060
Epoch 390/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 391/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 392/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 393/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 394/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0055
Epoch 395/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0050
Epoch 396/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0060
Epoch 397/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 398/1000
```

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250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 399/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0057
Epoch 400/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 401/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 402/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 403/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0050
Epoch 404/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0065
Epoch 405/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0052
Epoch 406/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0054
Epoch 407/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0052
Epoch 408/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 409/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 410/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0055
Epoch 411/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0055
Epoch 412/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 413/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0054
Epoch 414/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 415/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 416/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0052
Epoch 417/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0052
Epoch 418/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0055
Epoch 419/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 420/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0060
Epoch 421/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 422/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 423/1000
```

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250/250 [==============================] - 0s 2ms/step - loss: 0.0054
Epoch 424/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 425/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0061
Epoch 426/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0055
Epoch 427/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 428/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 429/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0062
Epoch 430/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 431/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 432/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0054
Epoch 433/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 434/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 435/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 436/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0054
Epoch 437/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 438/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 439/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 440/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0054
Epoch 441/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 442/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 443/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0054
Epoch 444/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0050
Epoch 445/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 446/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0049
Epoch 447/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0052
Epoch 448/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 449/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0055
Epoch 450/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 451/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0052
Epoch 452/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 453/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 454/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0055
Epoch 455/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 456/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 457/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0050
Epoch 458/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 459/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 460/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0060
Epoch 461/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0050
Epoch 462/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0057
Epoch 463/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 464/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 465/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 466/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0055
Epoch 467/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0063
Epoch 468/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0045
Epoch 469/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0049
Epoch 470/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0060
Epoch 471/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 472/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 473/1000
```

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250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 474/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0049
Epoch 475/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0052
Epoch 476/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 477/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 478/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 479/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0055
Epoch 480/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0067
Epoch 481/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0054
Epoch 482/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 483/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 484/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 485/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 486/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0054
Epoch 487/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0062
Epoch 488/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0059
Epoch 489/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 490/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 491/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0049
Epoch 492/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0055
Epoch 493/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0057
Epoch 494/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0045
Epoch 495/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 496/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 497/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0058
Epoch 498/1000
```

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250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 499/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 500/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 501/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0049
Epoch 502/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0054
Epoch 503/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0052
Epoch 504/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 505/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 506/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 507/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 508/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 509/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0055
Epoch 510/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 511/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 512/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0050
Epoch 513/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 514/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 515/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 516/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 517/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0055
Epoch 518/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 519/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 520/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 521/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 522/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 523/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0049
Epoch 524/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 525/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 526/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0050
Epoch 527/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0050
Epoch 528/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0044
Epoch 529/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0045
Epoch 530/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0052
Epoch 531/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 532/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 533/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 534/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 535/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0049
Epoch 536/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0050
Epoch 537/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 538/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 539/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 540/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0050
Epoch 541/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 542/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 543/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 544/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 545/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 546/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 547/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 548/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0045
Epoch 549/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 550/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0045
Epoch 551/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 552/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0049
Epoch 553/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 554/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 555/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 556/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 557/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 558/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 559/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0050
Epoch 560/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 561/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 562/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 563/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0044
Epoch 564/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 565/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 566/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0045
Epoch 567/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 568/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 569/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 570/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0044
Epoch 571/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0045
Epoch 572/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 573/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 574/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0044
Epoch 575/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 576/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0050
Epoch 577/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 578/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 579/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 580/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 581/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0045
Epoch 582/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 583/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 584/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 585/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 586/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 587/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 588/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0049
Epoch 589/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0052
Epoch 590/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 591/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0057
Epoch 592/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 593/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0044
Epoch 594/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0045
Epoch 595/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 596/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 597/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 598/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 599/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 600/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 601/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0056
Epoch 602/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 603/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 604/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 605/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 606/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 607/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 608/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 609/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 610/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 611/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 612/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 613/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 614/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0044
Epoch 615/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 616/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 617/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 618/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0052
Epoch 619/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0049
Epoch 620/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 621/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0050
Epoch 622/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0045
Epoch 623/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0053
Epoch 624/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0052
Epoch 625/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0051
Epoch 626/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0049
Epoch 627/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0055
Epoch 628/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 629/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 630/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 631/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0052
Epoch 632/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0050
Epoch 633/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 634/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 635/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 636/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 637/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0044
Epoch 638/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 639/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 640/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0045
Epoch 641/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 642/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0048
Epoch 643/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 644/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 645/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 646/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0045
Epoch 647/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 648/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0045
Epoch 649/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0044
Epoch 650/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 651/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 652/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 653/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 654/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 655/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 656/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 657/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 658/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 659/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 660/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 661/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0049
Epoch 662/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 663/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 664/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 665/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 666/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 667/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 668/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 669/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 670/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 671/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 672/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 673/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 674/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 675/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 676/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 677/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 678/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 679/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 680/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0044
Epoch 681/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 682/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 683/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 684/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0045
Epoch 685/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 686/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0044
Epoch 687/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 688/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 689/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 690/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 691/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0044
Epoch 692/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 693/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 694/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 695/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 696/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 697/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 698/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0045
Epoch 699/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 700/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 701/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0046
Epoch 702/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 703/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 704/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 705/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 706/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 707/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 708/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 709/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 710/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 711/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 712/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 713/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 714/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 715/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 716/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 717/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 718/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 719/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 720/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 721/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 722/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 723/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 724/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 725/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 726/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 727/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 728/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 729/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 730/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 731/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 732/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 733/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 734/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 735/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 736/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 737/1000
250/250 [==============================] - 1s 2ms/step - loss: 0.0036
Epoch 738/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 739/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 740/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 741/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 742/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 743/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 744/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 745/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 746/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 747/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 748/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 749/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 750/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 751/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 752/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 753/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 754/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 755/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 756/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 757/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 758/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 759/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 760/1000
250/250 [==============================] - 1s 2ms/step - loss: 0.0040
Epoch 761/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 762/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 763/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 764/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 765/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 766/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 767/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 768/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 769/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 770/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 771/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 772/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0047
Epoch 773/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 774/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 775/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 776/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 777/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 778/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 779/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 780/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 781/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 782/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 783/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 784/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 785/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 786/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 787/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 788/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 789/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 790/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 791/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 792/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 793/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 794/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 795/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 796/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 797/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0043
Epoch 798/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 799/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 800/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 801/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 802/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 803/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 804/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 805/1000
250/250 [==============================] - 1s 3ms/step - loss: 0.0035
Epoch 806/1000
250/250 [==============================] - 1s 2ms/step - loss: 0.0041
Epoch 807/1000
250/250 [==============================] - 1s 2ms/step - loss: 0.0039
Epoch 808/1000
250/250 [==============================] - 1s 3ms/step - loss: 0.0040
Epoch 809/1000
250/250 [==============================] - 1s 3ms/step - loss: 0.0036
Epoch 810/1000
250/250 [==============================] - 1s 3ms/step - loss: 0.0041
Epoch 811/1000
250/250 [==============================] - 1s 2ms/step - loss: 0.0035
Epoch 812/1000
250/250 [==============================] - 1s 3ms/step - loss: 0.0038
Epoch 813/1000
250/250 [==============================] - 1s 2ms/step - loss: 0.0038
Epoch 814/1000
250/250 [==============================] - 1s 3ms/step - loss: 0.0036
Epoch 815/1000
250/250 [==============================] - 1s 3ms/step - loss: 0.0033
Epoch 816/1000
250/250 [==============================] - 1s 3ms/step - loss: 0.0037
Epoch 817/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 818/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0042
Epoch 819/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 820/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 821/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 822/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 823/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 824/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 825/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 826/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 827/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 828/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 829/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 830/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 831/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 832/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 833/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 834/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 835/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 836/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 837/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0032
Epoch 838/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 839/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 840/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 841/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 842/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 843/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 844/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 845/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 846/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 847/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 848/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 849/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 850/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 851/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 852/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 853/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0031
Epoch 854/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 855/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 856/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 857/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 858/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 859/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0032
Epoch 860/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 861/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 862/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 863/1000
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Epoch 864/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 865/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 866/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 867/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0032
Epoch 868/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 869/1000
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Epoch 870/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 871/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 872/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 873/1000
```

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250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 874/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 875/1000
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Epoch 876/1000
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Epoch 877/1000
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Epoch 878/1000
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Epoch 879/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 880/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 881/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 882/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0032
Epoch 883/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 884/1000
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Epoch 885/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 886/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 887/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 888/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 889/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 890/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 891/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 892/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0031
Epoch 893/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 894/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0032
Epoch 895/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0031
Epoch 896/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 897/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0031
Epoch 898/1000
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```
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 899/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 900/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 901/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 902/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 903/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0032
Epoch 904/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 905/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 906/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0032
Epoch 907/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 908/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 909/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 910/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 911/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 912/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 913/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 914/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0041
Epoch 915/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 916/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 917/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 918/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0032
Epoch 919/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 920/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 921/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 922/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 923/1000
```

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250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 924/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 925/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 926/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 927/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 928/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 929/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 930/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 931/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 932/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 933/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 934/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 935/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 936/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 937/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 938/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 939/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 940/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 941/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 942/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 943/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 944/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 945/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 946/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 947/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 948/1000
```

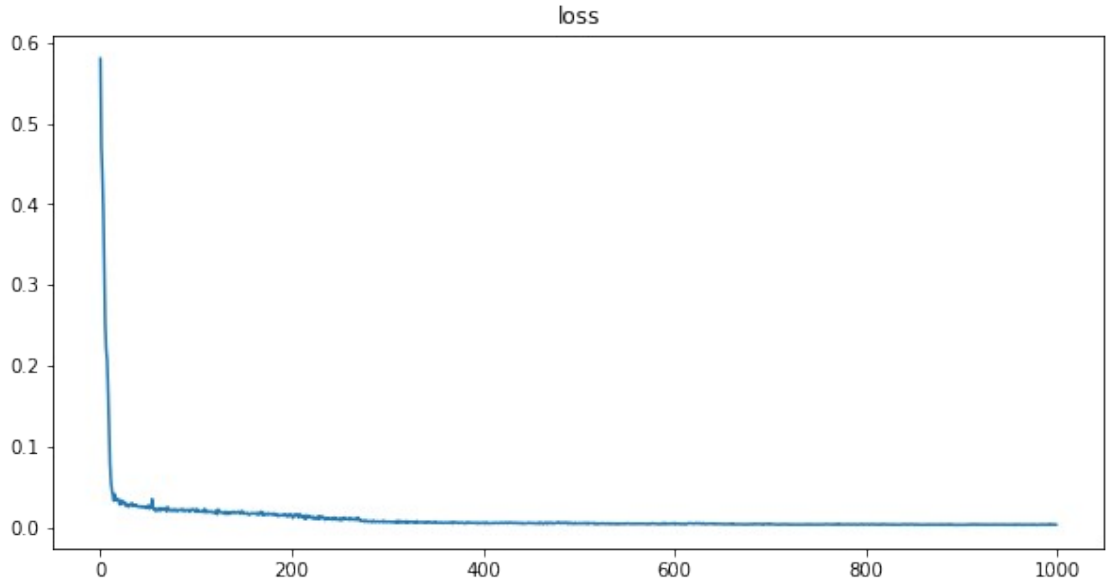
```
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 949/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 950/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 951/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 952/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 953/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 954/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 955/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 956/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0031
Epoch 957/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0039
Epoch 958/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0030
Epoch 959/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 960/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 961/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 962/1000
250/250 [==============================] - 1s 2ms/step - loss: 0.0038
Epoch 963/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 964/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 965/1000
250/250 [==============================] - 1s 2ms/step - loss: 0.0031
Epoch 966/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 967/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 968/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 969/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 970/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 971/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 972/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 973/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 974/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 975/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0038
Epoch 976/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0031
Epoch 977/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0037
Epoch 978/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 979/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 980/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0032
Epoch 981/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 982/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 983/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 984/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 985/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 986/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 987/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 988/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 989/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 990/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0033
Epoch 991/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 992/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 993/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0044
Epoch 994/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0032
Epoch 995/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0036
Epoch 996/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 997/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0040
Epoch 998/1000
```

```
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
Epoch 999/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0032
Epoch 1000/1000
250/250 [==============================] - 0s 2ms/step - loss: 0.0035
```

```
figure = plt.figure(figsize = (10, 5))
histx = []
for i in range(len(hist.history['loss'])):
    histx.append(i)


plt.plot(histx, hist.history['loss'])
plt.title("loss")
plt.show()
```



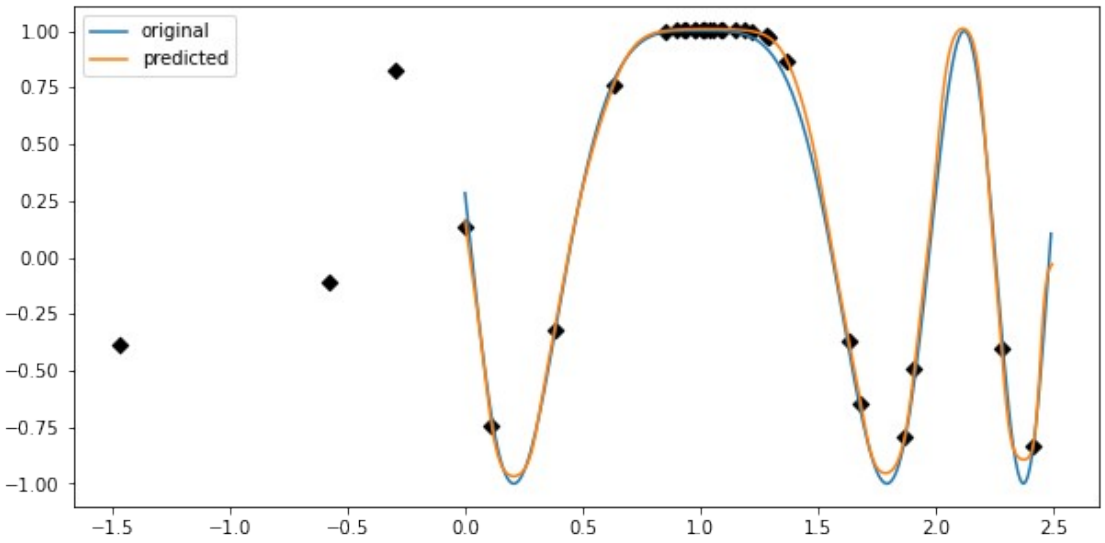

```
t2 = np.arange(0, 2.5, 0.005)

pred = model.predict(t2)

figure = plt.figure(figsize = (10, 5))

plt.plot(t, ft, label = 'original')
plt.plot(t2, pred, label = 'predicted')
mu = model.get_layer(index = 0).get_weights()[0][0]
plt.scatter(mu, model.predict(mu), color = "black", marker = "D")
plt.legend()
plt.show()
```

```
16/16 [==============================] - 0s 2ms/step
1/1 [==============================] - 0s 17ms/step
```



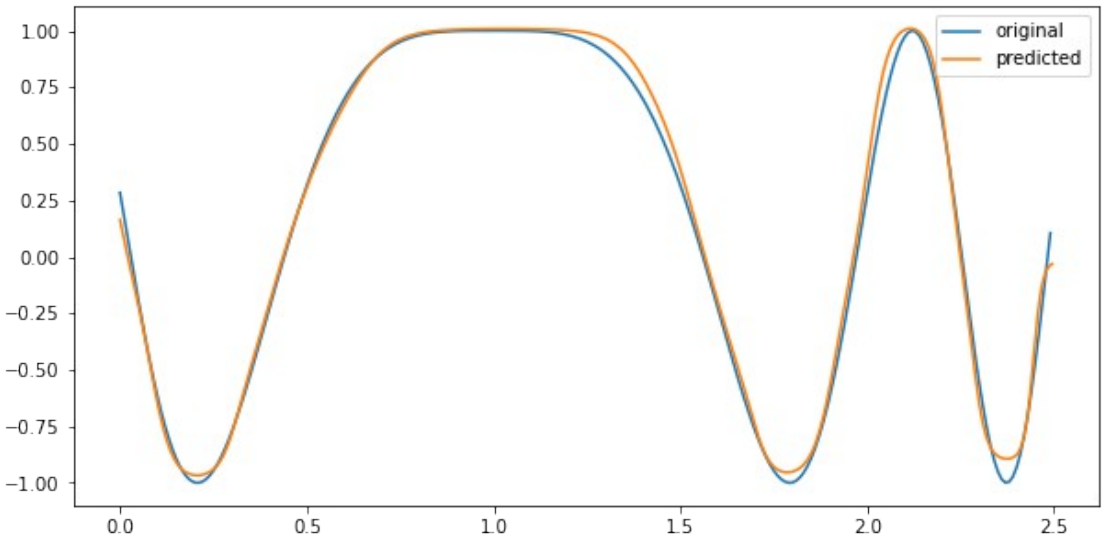

```
t2 = np.arange(0, 2.5, 0.005)

pred = model.predict(t2)

figure = plt.figure(figsize = (10, 5))

plt.plot(t, ft, label = 'original')
plt.plot(t2, pred, label = 'predicted')
plt.legend()
plt.show()
```

```
16/16 [==============================] - 0s 2ms/step
```



Выводы

Ознакомился с многослойными нейронными сетями со слоями с радиальными базисными элементами. Реализовал две многослойные модели для решения задач классификации и апроксимации.