

## 01\_1\_AND\_Keras\_custom\_data

December 22, 2020

```
[1]: import tensorflow as tf  
from tensorflow import keras
```

```
[2]: tf.__version__
```

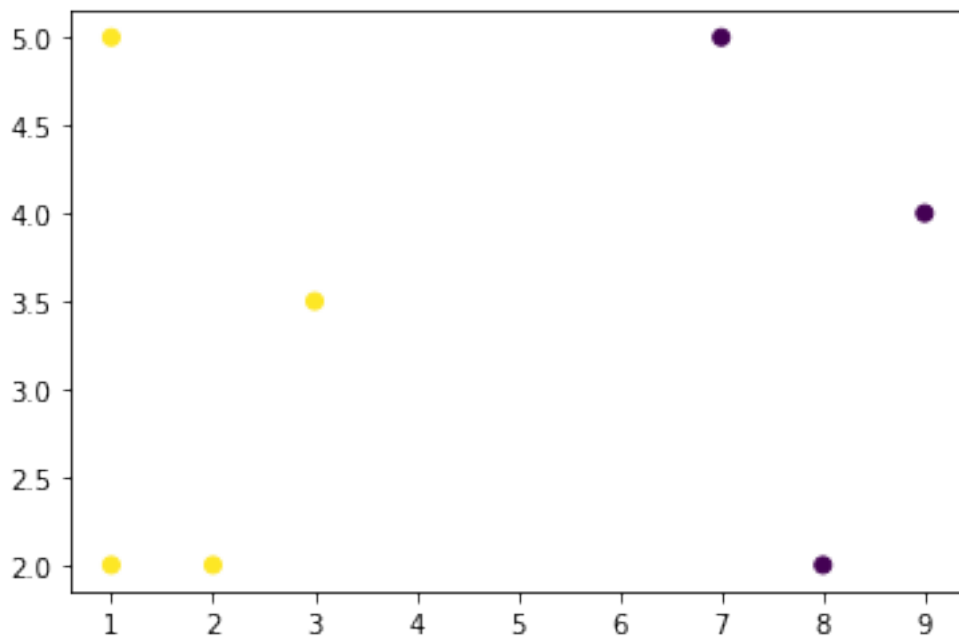
```
[2]: '2.4.0'
```

```
[3]: import numpy as np  
import matplotlib.pyplot as plt
```

```
[4]: x_data = np.array([[1, 2], [1, 5], [2, 2], [3, 3.5], [7, 5], [9, 4], [8, 2]])  
      ↪#training_points  
y_data = [1, 1, 1, 1, 0, 0, 0]  
  
x_data = np.array(x_data, dtype=np.float32)  
y_data = np.array(y_data, dtype=np.float32)
```

```
[5]: plt.scatter(x_data[:, 0], x_data[:, 1], c=y_data)
```

```
[5]: <matplotlib.collections.PathCollection at 0x7fa63ecc2b38>
```



```
[6]: from tensorflow.keras import layers
      from tensorflow.keras import activations
      from tensorflow.keras import optimizers
      from tensorflow.keras import models

[7]: model = models.Sequential()
      model.add(layers.Dense(2, input_dim=2))
      model.add(layers.Activation('tanh'))
      model.add(layers.Dense(1))
      model.add(layers.Activation('sigmoid'))

[8]: sgd = optimizers.SGD(lr=0.1)
      model.compile(loss='binary_crossentropy', optimizer=sgd, metrics=['accuracy'])

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

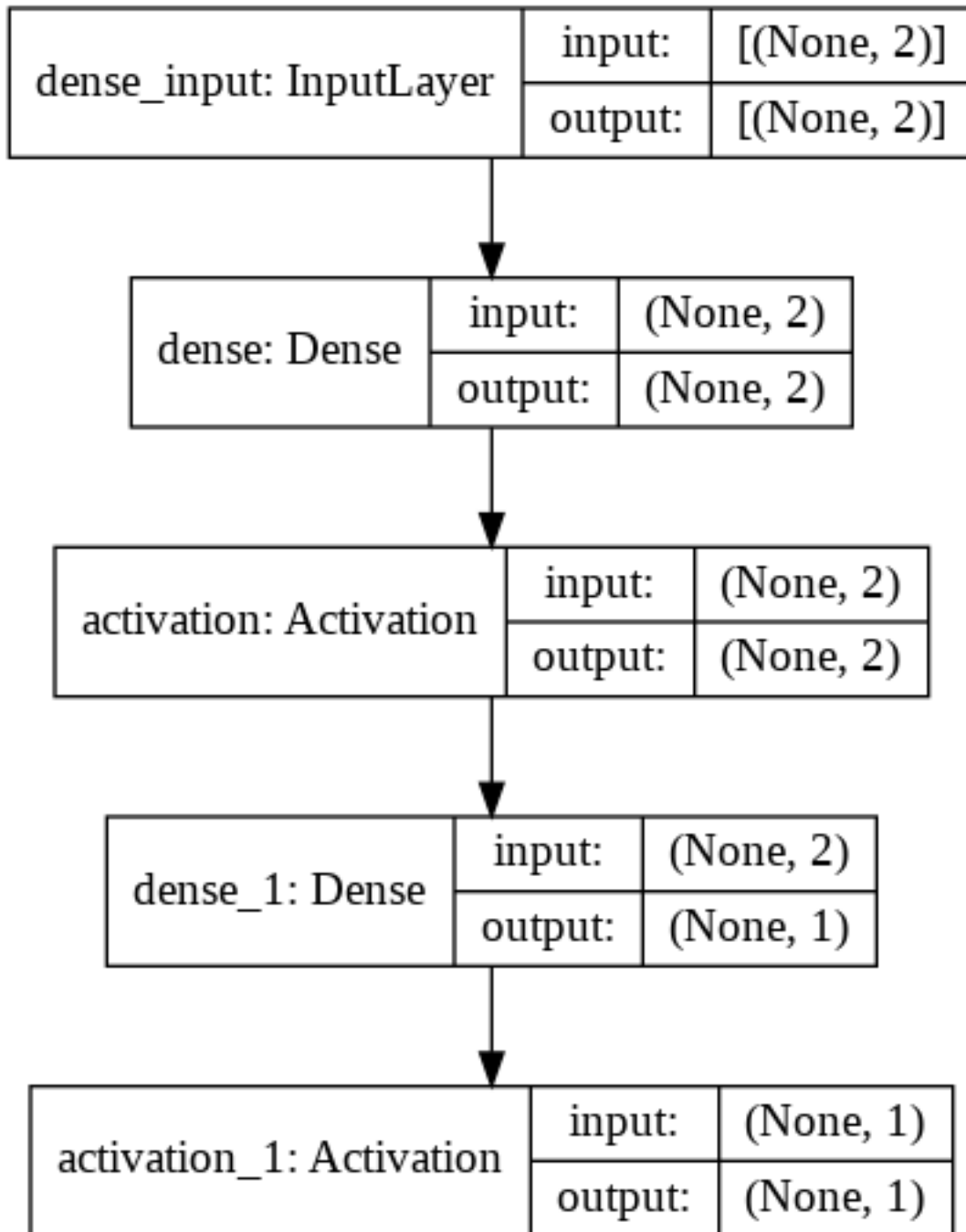
Model: "sequential"

Layer (type)	Output Shape	Param #
dense (Dense)	(None, 2)	6
activation (Activation)	(None, 2)	0
dense_1 (Dense)	(None, 1)	3
activation_1 (Activation)	(None, 1)	0

Total params: 9  
 Trainable params: 9  
 Non-trainable params: 0

```
[10]: from tensorflow.keras.utils import plot_model
       plot_model(model, to_file='model_and.png', show_shapes=True)
```

[10]:



```
[11]: history = model.fit(x_data, y_data, batch_size=1, epochs=500)
```

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Epoch 1/500
7/7 [=====] - 1s 2ms/step - loss: 0.6189 - accuracy:
0.5929
Epoch 2/500
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7/7 [=====] - 0s 2ms/step - loss: 0.3550 - accuracy:  
 0.8872  
 Epoch 3/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.4503 - accuracy:  
 0.9185  
 Epoch 4/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.4763 - accuracy:  
 0.6658  
 Epoch 5/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.3231 - accuracy:  
 1.0000  
 Epoch 6/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.3285 - accuracy:  
 0.8827  
 Epoch 7/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.4073 - accuracy:  
 0.6580  
 Epoch 8/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.2182 - accuracy:  
 1.0000  
 Epoch 9/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.2301 - accuracy:  
 1.0000  
 Epoch 10/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.2814 - accuracy:  
 0.8455  
 Epoch 11/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.1564 - accuracy:  
 1.0000  
 Epoch 12/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.1617 - accuracy:  
 1.0000  
 Epoch 13/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.1528 - accuracy:  
 1.0000  
 Epoch 14/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.1372 - accuracy:  
 1.0000  
 Epoch 15/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.1203 - accuracy:  
 1.0000  
 Epoch 16/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0993 - accuracy:  
 1.0000  
 Epoch 17/500  
 7/7 [=====] - 0s 1ms/step - loss: 0.1152 - accuracy:  
 1.0000  
 Epoch 18/500

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7/7 [=====] - 0s 2ms/step - loss: 0.1018 - accuracy:
1.0000
Epoch 19/500
7/7 [=====] - 0s 2ms/step - loss: 0.0871 - accuracy:
1.0000
Epoch 20/500
7/7 [=====] - 0s 2ms/step - loss: 0.0838 - accuracy:
1.0000
Epoch 21/500
7/7 [=====] - 0s 2ms/step - loss: 0.0830 - accuracy:
1.0000
Epoch 22/500
7/7 [=====] - 0s 2ms/step - loss: 0.0891 - accuracy:
1.0000
Epoch 23/500
7/7 [=====] - 0s 2ms/step - loss: 0.0791 - accuracy:
1.0000
Epoch 24/500
7/7 [=====] - 0s 2ms/step - loss: 0.0773 - accuracy:
1.0000
Epoch 25/500
7/7 [=====] - 0s 2ms/step - loss: 0.0803 - accuracy:
1.0000
Epoch 26/500
7/7 [=====] - 0s 2ms/step - loss: 0.0568 - accuracy:
1.0000
Epoch 27/500
7/7 [=====] - 0s 3ms/step - loss: 0.0655 - accuracy:
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Epoch 28/500
7/7 [=====] - 0s 1ms/step - loss: 0.0711 - accuracy:
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Epoch 29/500
7/7 [=====] - 0s 2ms/step - loss: 0.0613 - accuracy:
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Epoch 30/500
7/7 [=====] - 0s 1ms/step - loss: 0.0662 - accuracy:
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Epoch 31/500
7/7 [=====] - 0s 2ms/step - loss: 0.0491 - accuracy:
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Epoch 32/500
7/7 [=====] - 0s 2ms/step - loss: 0.0548 - accuracy:
1.0000
Epoch 33/500
7/7 [=====] - 0s 1ms/step - loss: 0.0442 - accuracy:
1.0000
Epoch 34/500

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7/7 [=====] - 0s 2ms/step - loss: 0.0526 - accuracy:  
1.0000  
Epoch 35/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0495 - accuracy:  
1.0000  
Epoch 36/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0527 - accuracy:  
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Epoch 37/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0480 - accuracy:  
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Epoch 38/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0451 - accuracy:  
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Epoch 39/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0436 - accuracy:  
1.0000  
Epoch 40/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0372 - accuracy:  
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Epoch 41/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0400 - accuracy:  
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Epoch 42/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0451 - accuracy:  
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Epoch 43/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0333 - accuracy:  
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Epoch 44/500  
7/7 [=====] - 0s 1ms/step - loss: 0.0415 - accuracy:  
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Epoch 45/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0382 - accuracy:  
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Epoch 46/500  
7/7 [=====] - 0s 1ms/step - loss: 0.0410 - accuracy:  
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Epoch 47/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0396 - accuracy:  
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Epoch 48/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0361 - accuracy:  
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Epoch 49/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0404 - accuracy:  
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Epoch 50/500

7/7 [=====] - 0s 2ms/step - loss: 0.0306 - accuracy:  
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Epoch 51/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0292 - accuracy:  
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Epoch 52/500  
7/7 [=====] - 0s 1ms/step - loss: 0.0348 - accuracy:  
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Epoch 53/500  
7/7 [=====] - 0s 1ms/step - loss: 0.0307 - accuracy:  
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Epoch 54/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0278 - accuracy:  
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Epoch 55/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0332 - accuracy:  
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Epoch 56/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0312 - accuracy:  
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Epoch 57/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0310 - accuracy:  
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Epoch 58/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0306 - accuracy:  
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Epoch 59/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0242 - accuracy:  
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Epoch 60/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0287 - accuracy:  
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Epoch 61/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0282 - accuracy:  
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Epoch 62/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0246 - accuracy:  
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Epoch 63/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0263 - accuracy:  
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Epoch 64/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0225 - accuracy:  
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Epoch 65/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0250 - accuracy:  
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Epoch 66/500

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7/7 [=====] - 0s 2ms/step - loss: 0.0272 - accuracy:
1.0000
Epoch 67/500
7/7 [=====] - 0s 3ms/step - loss: 0.0246 - accuracy:
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Epoch 68/500
7/7 [=====] - 0s 2ms/step - loss: 0.0224 - accuracy:
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Epoch 69/500
7/7 [=====] - 0s 2ms/step - loss: 0.0214 - accuracy:
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Epoch 70/500
7/7 [=====] - 0s 2ms/step - loss: 0.0228 - accuracy:
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Epoch 71/500
7/7 [=====] - 0s 1ms/step - loss: 0.0241 - accuracy:
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Epoch 72/500
7/7 [=====] - 0s 1ms/step - loss: 0.0199 - accuracy:
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Epoch 73/500
7/7 [=====] - 0s 1ms/step - loss: 0.0226 - accuracy:
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Epoch 74/500
7/7 [=====] - 0s 2ms/step - loss: 0.0231 - accuracy:
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Epoch 75/500
7/7 [=====] - 0s 2ms/step - loss: 0.0216 - accuracy:
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Epoch 76/500
7/7 [=====] - 0s 2ms/step - loss: 0.0192 - accuracy:
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Epoch 77/500
7/7 [=====] - 0s 2ms/step - loss: 0.0194 - accuracy:
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7/7 [=====] - 0s 2ms/step - loss: 0.0182 - accuracy:
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Epoch 79/500
7/7 [=====] - 0s 2ms/step - loss: 0.0219 - accuracy:
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Epoch 80/500
7/7 [=====] - 0s 2ms/step - loss: 0.0193 - accuracy:
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Epoch 81/500
7/7 [=====] - 0s 2ms/step - loss: 0.0174 - accuracy:
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Epoch 82/500

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7/7 [=====] - 0s 3ms/step - loss: 0.0185 - accuracy:  
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 7/7 [=====] - 0s 2ms/step - loss: 0.0223 - accuracy:  
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 7/7 [=====] - 0s 2ms/step - loss: 0.0208 - accuracy:  
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 7/7 [=====] - 0s 1ms/step - loss: 0.0165 - accuracy:  
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7/7 [=====] - 0s 2ms/step - loss: 0.0173 - accuracy:  
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 7/7 [=====] - 0s 2ms/step - loss: 0.0150 - accuracy:  
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7/7 [=====] - 0s 1ms/step - loss: 0.0110 - accuracy:  
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Epoch 131/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0127 - accuracy:  
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Epoch 132/500  
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7/7 [=====] - 0s 2ms/step - loss: 0.0121 - accuracy:  
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Epoch 134/500  
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7/7 [=====] - 0s 2ms/step - loss: 0.0113 - accuracy:  
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Epoch 136/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0107 - accuracy:  
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Epoch 137/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0108 - accuracy:  
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Epoch 138/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0125 - accuracy:  
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7/7 [=====] - 0s 2ms/step - loss: 0.0104 - accuracy:  
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Epoch 140/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0117 - accuracy:  
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7/7 [=====] - 0s 2ms/step - loss: 0.0119 - accuracy:  
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7/7 [=====] - 0s 2ms/step - loss: 0.0100 - accuracy:  
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Epoch 144/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0104 - accuracy:  
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Epoch 146/500

7/7 [=====] - 0s 1ms/step - loss: 0.0106 - accuracy:  
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 7/7 [=====] - 0s 2ms/step - loss: 0.0105 - accuracy:  
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 7/7 [=====] - 0s 2ms/step - loss: 0.0102 - accuracy:  
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 7/7 [=====] - 0s 3ms/step - loss: 0.0108 - accuracy:  
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 7/7 [=====] - 0s 2ms/step - loss: 0.0107 - accuracy:  
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 7/7 [=====] - 0s 1ms/step - loss: 0.0096 - accuracy:  
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 7/7 [=====] - 0s 2ms/step - loss: 0.0099 - accuracy:  
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 7/7 [=====] - 0s 3ms/step - loss: 0.0096 - accuracy:  
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 7/7 [=====] - 0s 3ms/step - loss: 0.0111 - accuracy:  
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 Epoch 157/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0093 - accuracy:  
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 7/7 [=====] - 0s 2ms/step - loss: 0.0102 - accuracy:  
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 Epoch 160/500  
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 Epoch 161/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0092 - accuracy:  
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 Epoch 162/500

7/7 [=====] - 0s 2ms/step - loss: 0.0094 - accuracy:  
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 Epoch 163/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0091 - accuracy:  
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 7/7 [=====] - 0s 2ms/step - loss: 0.0104 - accuracy:  
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 7/7 [=====] - 0s 2ms/step - loss: 0.0096 - accuracy:  
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 7/7 [=====] - 0s 2ms/step - loss: 0.0099 - accuracy:  
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 7/7 [=====] - 0s 1ms/step - loss: 0.0100 - accuracy:  
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 7/7 [=====] - 0s 2ms/step - loss: 0.0095 - accuracy:  
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 7/7 [=====] - 0s 2ms/step - loss: 0.0097 - accuracy:  
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 Epoch 171/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0103 - accuracy:  
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 Epoch 172/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0084 - accuracy:  
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 Epoch 173/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0101 - accuracy:  
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 Epoch 174/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0101 - accuracy:  
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 Epoch 175/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0091 - accuracy:  
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 Epoch 176/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0083 - accuracy:  
 1.0000  
 Epoch 177/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0090 - accuracy:  
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 Epoch 178/500

7/7 [=====] - 0s 2ms/step - loss: 0.0083 - accuracy:  
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 Epoch 179/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0096 - accuracy:  
 1.0000  
 Epoch 180/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0079 - accuracy:  
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 Epoch 181/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0086 - accuracy:  
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 Epoch 182/500  
 7/7 [=====] - 0s 1ms/step - loss: 0.0086 - accuracy:  
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 Epoch 183/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0084 - accuracy:  
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 7/7 [=====] - 0s 2ms/step - loss: 0.0086 - accuracy:  
 1.0000  
 Epoch 185/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0082 - accuracy:  
 1.0000  
 Epoch 186/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0082 - accuracy:  
 1.0000  
 Epoch 187/500  
 7/7 [=====] - 0s 1ms/step - loss: 0.0091 - accuracy:  
 1.0000  
 Epoch 188/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0081 - accuracy:  
 1.0000  
 Epoch 189/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0079 - accuracy:  
 1.0000  
 Epoch 190/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0075 - accuracy:  
 1.0000  
 Epoch 191/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0074 - accuracy:  
 1.0000  
 Epoch 192/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0070 - accuracy:  
 1.0000  
 Epoch 193/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0076 - accuracy:  
 1.0000  
 Epoch 194/500

7/7 [=====] - 0s 2ms/step - loss: 0.0069 - accuracy:  
 1.0000  
 Epoch 195/500  
 7/7 [=====] - 0s 1ms/step - loss: 0.0086 - accuracy:  
 1.0000  
 Epoch 196/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0084 - accuracy:  
 1.0000  
 Epoch 197/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0081 - accuracy:  
 1.0000  
 Epoch 198/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0088 - accuracy:  
 1.0000  
 Epoch 199/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0084 - accuracy:  
 1.0000  
 Epoch 200/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0071 - accuracy:  
 1.0000  
 Epoch 201/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0082 - accuracy:  
 1.0000  
 Epoch 202/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0084 - accuracy:  
 1.0000  
 Epoch 203/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0074 - accuracy:  
 1.0000  
 Epoch 204/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0077 - accuracy:  
 1.0000  
 Epoch 205/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0077 - accuracy:  
 1.0000  
 Epoch 206/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0073 - accuracy:  
 1.0000  
 Epoch 207/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0079 - accuracy:  
 1.0000  
 Epoch 208/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0077 - accuracy:  
 1.0000  
 Epoch 209/500  
 7/7 [=====] - 0s 1ms/step - loss: 0.0066 - accuracy:  
 1.0000  
 Epoch 210/500



7/7 [=====] - 0s 2ms/step - loss: 0.0079 - accuracy:  
1.0000  
Epoch 211/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0064 - accuracy:  
1.0000  
Epoch 212/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0074 - accuracy:  
1.0000  
Epoch 213/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0072 - accuracy:  
1.0000  
Epoch 214/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0067 - accuracy:  
1.0000  
Epoch 215/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0067 - accuracy:  
1.0000  
Epoch 216/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0072 - accuracy:  
1.0000  
Epoch 217/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0070 - accuracy:  
1.0000  
Epoch 218/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0070 - accuracy:  
1.0000  
Epoch 219/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0068 - accuracy:  
1.0000  
Epoch 220/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0074 - accuracy:  
1.0000  
Epoch 221/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0067 - accuracy:  
1.0000  
Epoch 222/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0063 - accuracy:  
1.0000  
Epoch 223/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0067 - accuracy:  
1.0000  
Epoch 224/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0059 - accuracy:  
1.0000  
Epoch 225/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0067 - accuracy:  
1.0000  
Epoch 226/500

7/7 [=====] - 0s 2ms/step - loss: 0.0065 - accuracy:  
 1.0000  
 Epoch 227/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0061 - accuracy:  
 1.0000  
 Epoch 228/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0067 - accuracy:  
 1.0000  
 Epoch 229/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0063 - accuracy:  
 1.0000  
 Epoch 230/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0066 - accuracy:  
 1.0000  
 Epoch 231/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0070 - accuracy:  
 1.0000  
 Epoch 232/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0060 - accuracy:  
 1.0000  
 Epoch 233/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0067 - accuracy:  
 1.0000  
 Epoch 234/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0076 - accuracy:  
 1.0000  
 Epoch 235/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0071 - accuracy:  
 1.0000  
 Epoch 236/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0067 - accuracy:  
 1.0000  
 Epoch 237/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0071 - accuracy:  
 1.0000  
 Epoch 238/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0065 - accuracy:  
 1.0000  
 Epoch 239/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0058 - accuracy:  
 1.0000  
 Epoch 240/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0068 - accuracy:  
 1.0000  
 Epoch 241/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0065 - accuracy:  
 1.0000  
 Epoch 242/500

7/7 [=====] - 0s 2ms/step - loss: 0.0067 - accuracy:  
 1.0000  
 Epoch 243/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0060 - accuracy:  
 1.0000  
 Epoch 244/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0057 - accuracy:  
 1.0000  
 Epoch 245/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0067 - accuracy:  
 1.0000  
 Epoch 246/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0067 - accuracy:  
 1.0000  
 Epoch 247/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0066 - accuracy:  
 1.0000  
 Epoch 248/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0055 - accuracy:  
 1.0000  
 Epoch 249/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0066 - accuracy:  
 1.0000  
 Epoch 250/500  
 7/7 [=====] - 0s 1ms/step - loss: 0.0066 - accuracy:  
 1.0000  
 Epoch 251/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0054 - accuracy:  
 1.0000  
 Epoch 252/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0053 - accuracy:  
 1.0000  
 Epoch 253/500  
 7/7 [=====] - 0s 1ms/step - loss: 0.0060 - accuracy:  
 1.0000  
 Epoch 254/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0068 - accuracy:  
 1.0000  
 Epoch 255/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0055 - accuracy:  
 1.0000  
 Epoch 256/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0065 - accuracy:  
 1.0000  
 Epoch 257/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0059 - accuracy:  
 1.0000  
 Epoch 258/500

7/7 [=====] - 0s 3ms/step - loss: 0.0063 - accuracy:  
 1.0000  
 Epoch 259/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0061 - accuracy:  
 1.0000  
 Epoch 260/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0060 - accuracy:  
 1.0000  
 Epoch 261/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0056 - accuracy:  
 1.0000  
 Epoch 262/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0060 - accuracy:  
 1.0000  
 Epoch 263/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0064 - accuracy:  
 1.0000  
 Epoch 264/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0064 - accuracy:  
 1.0000  
 Epoch 265/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0057 - accuracy:  
 1.0000  
 Epoch 266/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0052 - accuracy:  
 1.0000  
 Epoch 267/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0060 - accuracy:  
 1.0000  
 Epoch 268/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0059 - accuracy:  
 1.0000  
 Epoch 269/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0064 - accuracy:  
 1.0000  
 Epoch 270/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0053 - accuracy:  
 1.0000  
 Epoch 271/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0052 - accuracy:  
 1.0000  
 Epoch 272/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0054 - accuracy:  
 1.0000  
 Epoch 273/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0052 - accuracy:  
 1.0000  
 Epoch 274/500

7/7 [=====] - 0s 2ms/step - loss: 0.0059 - accuracy:  
 1.0000  
 Epoch 275/500  
 7/7 [=====] - 0s 1ms/step - loss: 0.0056 - accuracy:  
 1.0000  
 Epoch 276/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0060 - accuracy:  
 1.0000  
 Epoch 277/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0056 - accuracy:  
 1.0000  
 Epoch 278/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0054 - accuracy:  
 1.0000  
 Epoch 279/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0048 - accuracy:  
 1.0000  
 Epoch 280/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0057 - accuracy:  
 1.0000  
 Epoch 281/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0053 - accuracy:  
 1.0000  
 Epoch 282/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0049 - accuracy:  
 1.0000  
 Epoch 283/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0057 - accuracy:  
 1.0000  
 Epoch 284/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0051 - accuracy:  
 1.0000  
 Epoch 285/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0056 - accuracy:  
 1.0000  
 Epoch 286/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0049 - accuracy:  
 1.0000  
 Epoch 287/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0048 - accuracy:  
 1.0000  
 Epoch 288/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0047 - accuracy:  
 1.0000  
 Epoch 289/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0054 - accuracy:  
 1.0000  
 Epoch 290/500

7/7 [=====] - 0s 3ms/step - loss: 0.0049 - accuracy:  
1.0000  
Epoch 291/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0050 - accuracy:  
1.0000  
Epoch 292/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0053 - accuracy:  
1.0000  
Epoch 293/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0054 - accuracy:  
1.0000  
Epoch 294/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0052 - accuracy:  
1.0000  
Epoch 295/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0056 - accuracy:  
1.0000  
Epoch 296/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0045 - accuracy:  
1.0000  
Epoch 297/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0046 - accuracy:  
1.0000  
Epoch 298/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0053 - accuracy:  
1.0000  
Epoch 299/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0050 - accuracy:  
1.0000  
Epoch 300/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0050 - accuracy:  
1.0000  
Epoch 301/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0053 - accuracy:  
1.0000  
Epoch 302/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0047 - accuracy:  
1.0000  
Epoch 303/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0053 - accuracy:  
1.0000  
Epoch 304/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0047 - accuracy:  
1.0000  
Epoch 305/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0050 - accuracy:  
1.0000  
Epoch 306/500

7/7 [=====] - 0s 2ms/step - loss: 0.0051 - accuracy:  
 1.0000  
 Epoch 307/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0051 - accuracy:  
 1.0000  
 Epoch 308/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0043 - accuracy:  
 1.0000  
 Epoch 309/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0050 - accuracy:  
 1.0000  
 Epoch 310/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0047 - accuracy:  
 1.0000  
 Epoch 311/500  
 7/7 [=====] - 0s 1ms/step - loss: 0.0042 - accuracy:  
 1.0000  
 Epoch 312/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0049 - accuracy:  
 1.0000  
 Epoch 313/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0049 - accuracy:  
 1.0000  
 Epoch 314/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0045 - accuracy:  
 1.0000  
 Epoch 315/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0041 - accuracy:  
 1.0000  
 Epoch 316/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0044 - accuracy:  
 1.0000  
 Epoch 317/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0051 - accuracy:  
 1.0000  
 Epoch 318/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0044 - accuracy:  
 1.0000  
 Epoch 319/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0047 - accuracy:  
 1.0000  
 Epoch 320/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0050 - accuracy:  
 1.0000  
 Epoch 321/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0043 - accuracy:  
 1.0000  
 Epoch 322/500

7/7 [=====] - 0s 2ms/step - loss: 0.0051 - accuracy:  
 1.0000  
 Epoch 323/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0047 - accuracy:  
 1.0000  
 Epoch 324/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0049 - accuracy:  
 1.0000  
 Epoch 325/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0045 - accuracy:  
 1.0000  
 Epoch 326/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0049 - accuracy:  
 1.0000  
 Epoch 327/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0050 - accuracy:  
 1.0000  
 Epoch 328/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0042 - accuracy:  
 1.0000  
 Epoch 329/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0050 - accuracy:  
 1.0000  
 Epoch 330/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0049 - accuracy:  
 1.0000  
 Epoch 331/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0050 - accuracy:  
 1.0000  
 Epoch 332/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0040 - accuracy:  
 1.0000  
 Epoch 333/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0048 - accuracy:  
 1.0000  
 Epoch 334/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0050 - accuracy:  
 1.0000  
 Epoch 335/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0043 - accuracy:  
 1.0000  
 Epoch 336/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0043 - accuracy:  
 1.0000  
 Epoch 337/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0045 - accuracy:  
 1.0000  
 Epoch 338/500



7/7 [=====] - 0s 3ms/step - loss: 0.0040 - accuracy:  
1.0000  
Epoch 339/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0040 - accuracy:  
1.0000  
Epoch 340/500  
7/7 [=====] - 0s 1ms/step - loss: 0.0040 - accuracy:  
1.0000  
Epoch 341/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0050 - accuracy:  
1.0000  
Epoch 342/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0044 - accuracy:  
1.0000  
Epoch 343/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0046 - accuracy:  
1.0000  
Epoch 344/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0047 - accuracy:  
1.0000  
Epoch 345/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0038 - accuracy:  
1.0000  
Epoch 346/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0050 - accuracy:  
1.0000  
Epoch 347/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0042 - accuracy:  
1.0000  
Epoch 348/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0046 - accuracy:  
1.0000  
Epoch 349/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0049 - accuracy:  
1.0000  
Epoch 350/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0041 - accuracy:  
1.0000  
Epoch 351/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0041 - accuracy:  
1.0000  
Epoch 352/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0039 - accuracy:  
1.0000  
Epoch 353/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0042 - accuracy:  
1.0000  
Epoch 354/500

7/7 [=====] - 0s 3ms/step - loss: 0.0048 - accuracy:  
 1.0000  
 Epoch 355/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0041 - accuracy:  
 1.0000  
 Epoch 356/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0039 - accuracy:  
 1.0000  
 Epoch 357/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0038 - accuracy:  
 1.0000  
 Epoch 358/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0045 - accuracy:  
 1.0000  
 Epoch 359/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0042 - accuracy:  
 1.0000  
 Epoch 360/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0045 - accuracy:  
 1.0000  
 Epoch 361/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0045 - accuracy:  
 1.0000  
 Epoch 362/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0047 - accuracy:  
 1.0000  
 Epoch 363/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0041 - accuracy:  
 1.0000  
 Epoch 364/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0035 - accuracy:  
 1.0000  
 Epoch 365/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0035 - accuracy:  
 1.0000  
 Epoch 366/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0043 - accuracy:  
 1.0000  
 Epoch 367/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0042 - accuracy:  
 1.0000  
 Epoch 368/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0044 - accuracy:  
 1.0000  
 Epoch 369/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0045 - accuracy:  
 1.0000  
 Epoch 370/500

7/7 [=====] - 0s 2ms/step - loss: 0.0041 - accuracy:  
1.0000  
Epoch 371/500  
7/7 [=====] - 0s 1ms/step - loss: 0.0044 - accuracy:  
1.0000  
Epoch 372/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0037 - accuracy:  
1.0000  
Epoch 373/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0039 - accuracy:  
1.0000  
Epoch 374/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0045 - accuracy:  
1.0000  
Epoch 375/500  
7/7 [=====] - 0s 1ms/step - loss: 0.0041 - accuracy:  
1.0000  
Epoch 376/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0042 - accuracy:  
1.0000  
Epoch 377/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0044 - accuracy:  
1.0000  
Epoch 378/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0040 - accuracy:  
1.0000  
Epoch 379/500  
7/7 [=====] - 0s 4ms/step - loss: 0.0040 - accuracy:  
1.0000  
Epoch 380/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0039 - accuracy:  
1.0000  
Epoch 381/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0039 - accuracy:  
1.0000  
Epoch 382/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0036 - accuracy:  
1.0000  
Epoch 383/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0037 - accuracy:  
1.0000  
Epoch 384/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0035 - accuracy:  
1.0000  
Epoch 385/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0037 - accuracy:  
1.0000  
Epoch 386/500

7/7 [=====] - 0s 2ms/step - loss: 0.0041 - accuracy:  
 1.0000  
 Epoch 387/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0039 - accuracy:  
 1.0000  
 Epoch 388/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0042 - accuracy:  
 1.0000  
 Epoch 389/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0039 - accuracy:  
 1.0000  
 Epoch 390/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0037 - accuracy:  
 1.0000  
 Epoch 391/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0039 - accuracy:  
 1.0000  
 Epoch 392/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0035 - accuracy:  
 1.0000  
 Epoch 393/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0039 - accuracy:  
 1.0000  
 Epoch 394/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0042 - accuracy:  
 1.0000  
 Epoch 395/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0039 - accuracy:  
 1.0000  
 Epoch 396/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0034 - accuracy:  
 1.0000  
 Epoch 397/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0035 - accuracy:  
 1.0000  
 Epoch 398/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0041 - accuracy:  
 1.0000  
 Epoch 399/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0036 - accuracy:  
 1.0000  
 Epoch 400/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0039 - accuracy:  
 1.0000  
 Epoch 401/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0039 - accuracy:  
 1.0000  
 Epoch 402/500

7/7 [=====] - 0s 3ms/step - loss: 0.0041 - accuracy: 1.0000  
Epoch 403/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0041 - accuracy: 1.0000  
Epoch 404/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0037 - accuracy: 1.0000  
Epoch 405/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0043 - accuracy: 1.0000  
Epoch 406/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0037 - accuracy: 1.0000  
Epoch 407/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0041 - accuracy: 1.0000  
Epoch 408/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0038 - accuracy: 1.0000  
Epoch 409/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0033 - accuracy: 1.0000  
Epoch 410/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0034 - accuracy: 1.0000  
Epoch 411/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0036 - accuracy: 1.0000  
Epoch 412/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0038 - accuracy: 1.0000  
Epoch 413/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0039 - accuracy: 1.0000  
Epoch 414/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0032 - accuracy: 1.0000  
Epoch 415/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0034 - accuracy: 1.0000  
Epoch 416/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0038 - accuracy: 1.0000  
Epoch 417/500  
7/7 [=====] - 0s 1ms/step - loss: 0.0039 - accuracy: 1.0000  
Epoch 418/500

7/7 [=====] - 0s 2ms/step - loss: 0.0033 - accuracy:  
 1.0000  
 Epoch 419/500  
 7/7 [=====] - 0s 1ms/step - loss: 0.0041 - accuracy:  
 1.0000  
 Epoch 420/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0035 - accuracy:  
 1.0000  
 Epoch 421/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0036 - accuracy:  
 1.0000  
 Epoch 422/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0033 - accuracy:  
 1.0000  
 Epoch 423/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0032 - accuracy:  
 1.0000  
 Epoch 424/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0035 - accuracy:  
 1.0000  
 Epoch 425/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0034 - accuracy:  
 1.0000  
 Epoch 426/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0032 - accuracy:  
 1.0000  
 Epoch 427/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0036 - accuracy:  
 1.0000  
 Epoch 428/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0036 - accuracy:  
 1.0000  
 Epoch 429/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0038 - accuracy:  
 1.0000  
 Epoch 430/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0036 - accuracy:  
 1.0000  
 Epoch 431/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0035 - accuracy:  
 1.0000  
 Epoch 432/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0031 - accuracy:  
 1.0000  
 Epoch 433/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0034 - accuracy:  
 1.0000  
 Epoch 434/500

7/7 [=====] - 0s 2ms/step - loss: 0.0034 - accuracy:  
1.0000  
Epoch 435/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0035 - accuracy:  
1.0000  
Epoch 436/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0035 - accuracy:  
1.0000  
Epoch 437/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0034 - accuracy:  
1.0000  
Epoch 438/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0038 - accuracy:  
1.0000  
Epoch 439/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0038 - accuracy:  
1.0000  
Epoch 440/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0032 - accuracy:  
1.0000  
Epoch 441/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0035 - accuracy:  
1.0000  
Epoch 442/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0033 - accuracy:  
1.0000  
Epoch 443/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0038 - accuracy:  
1.0000  
Epoch 444/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0036 - accuracy:  
1.0000  
Epoch 445/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0032 - accuracy:  
1.0000  
Epoch 446/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0033 - accuracy:  
1.0000  
Epoch 447/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0039 - accuracy:  
1.0000  
Epoch 448/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0030 - accuracy:  
1.0000  
Epoch 449/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0030 - accuracy:  
1.0000  
Epoch 450/500

7/7 [=====] - 0s 2ms/step - loss: 0.0032 - accuracy:  
1.0000  
Epoch 451/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0030 - accuracy:  
1.0000  
Epoch 452/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0034 - accuracy:  
1.0000  
Epoch 453/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0032 - accuracy:  
1.0000  
Epoch 454/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0033 - accuracy:  
1.0000  
Epoch 455/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0031 - accuracy:  
1.0000  
Epoch 456/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0035 - accuracy:  
1.0000  
Epoch 457/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0036 - accuracy:  
1.0000  
Epoch 458/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0035 - accuracy:  
1.0000  
Epoch 459/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0033 - accuracy:  
1.0000  
Epoch 460/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0036 - accuracy:  
1.0000  
Epoch 461/500  
7/7 [=====] - 0s 5ms/step - loss: 0.0031 - accuracy:  
1.0000  
Epoch 462/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0031 - accuracy:  
1.0000  
Epoch 463/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0031 - accuracy:  
1.0000  
Epoch 464/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0028 - accuracy:  
1.0000  
Epoch 465/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0035 - accuracy:  
1.0000  
Epoch 466/500



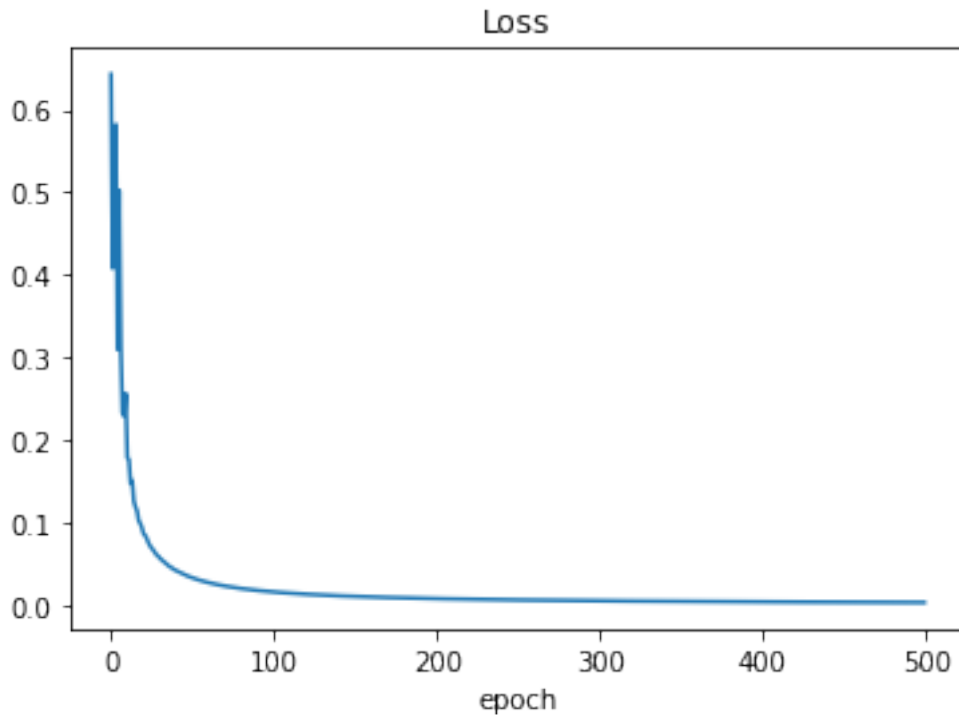
7/7 [=====] - 0s 2ms/step - loss: 0.0029 - accuracy:  
1.0000  
Epoch 467/500  
7/7 [=====] - 0s 1ms/step - loss: 0.0034 - accuracy:  
1.0000  
Epoch 468/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0031 - accuracy:  
1.0000  
Epoch 469/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0035 - accuracy:  
1.0000  
Epoch 470/500  
7/7 [=====] - 0s 1ms/step - loss: 0.0030 - accuracy:  
1.0000  
Epoch 471/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0029 - accuracy:  
1.0000  
Epoch 472/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0032 - accuracy:  
1.0000  
Epoch 473/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0029 - accuracy:  
1.0000  
Epoch 474/500  
7/7 [=====] - 0s 4ms/step - loss: 0.0031 - accuracy:  
1.0000  
Epoch 475/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0030 - accuracy:  
1.0000  
Epoch 476/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0032 - accuracy:  
1.0000  
Epoch 477/500  
7/7 [=====] - 0s 6ms/step - loss: 0.0029 - accuracy:  
1.0000  
Epoch 478/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0030 - accuracy:  
1.0000  
Epoch 479/500  
7/7 [=====] - 0s 2ms/step - loss: 0.0029 - accuracy:  
1.0000  
Epoch 480/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0031 - accuracy:  
1.0000  
Epoch 481/500  
7/7 [=====] - 0s 3ms/step - loss: 0.0030 - accuracy:  
1.0000  
Epoch 482/500

7/7 [=====] - 0s 2ms/step - loss: 0.0033 - accuracy:  
 1.0000  
 Epoch 483/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0031 - accuracy:  
 1.0000  
 Epoch 484/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0035 - accuracy:  
 1.0000  
 Epoch 485/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0029 - accuracy:  
 1.0000  
 Epoch 486/500  
 7/7 [=====] - 0s 4ms/step - loss: 0.0030 - accuracy:  
 1.0000  
 Epoch 487/500  
 7/7 [=====] - 0s 3ms/step - loss: 0.0031 - accuracy:  
 1.0000  
 Epoch 488/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0032 - accuracy:  
 1.0000  
 Epoch 489/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0030 - accuracy:  
 1.0000  
 Epoch 490/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0032 - accuracy:  
 1.0000  
 Epoch 491/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0027 - accuracy:  
 1.0000  
 Epoch 492/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0031 - accuracy:  
 1.0000  
 Epoch 493/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0028 - accuracy:  
 1.0000  
 Epoch 494/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0032 - accuracy:  
 1.0000  
 Epoch 495/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0030 - accuracy:  
 1.0000  
 Epoch 496/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0028 - accuracy:  
 1.0000  
 Epoch 497/500  
 7/7 [=====] - 0s 2ms/step - loss: 0.0030 - accuracy:  
 1.0000  
 Epoch 498/500

```
7/7 [=====] - 0s 2ms/step - loss: 0.0032 - accuracy: 1.0000
Epoch 499/500
7/7 [=====] - 0s 3ms/step - loss: 0.0032 - accuracy: 1.0000
Epoch 500/500
7/7 [=====] - 0s 1ms/step - loss: 0.0029 - accuracy: 1.0000
```

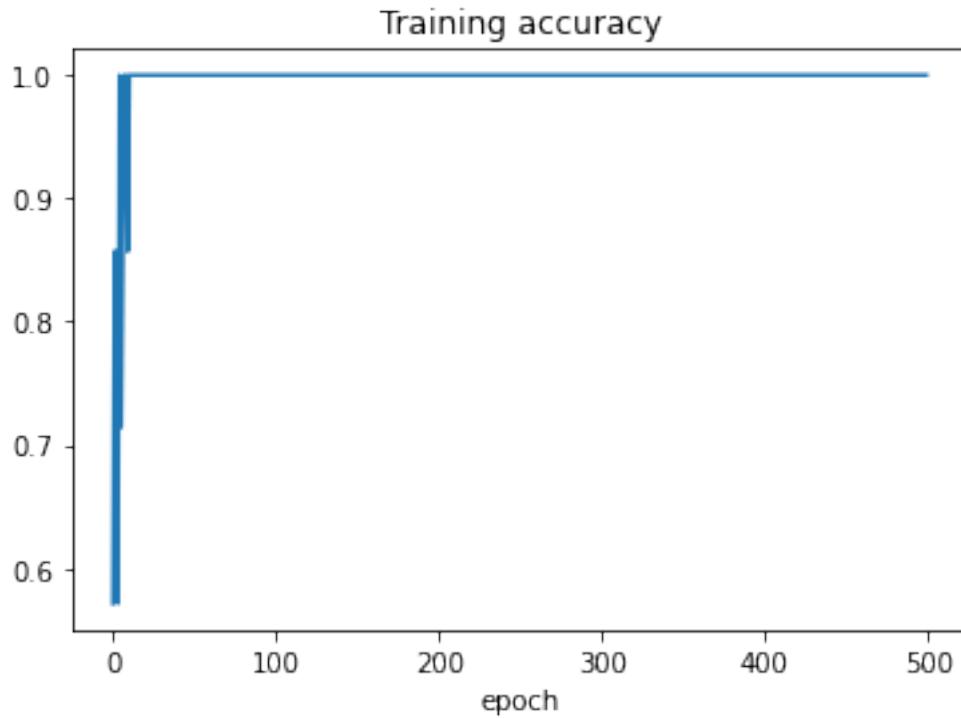
```
[12]: plt.plot(history.history['loss'])
      plt.title('Loss')
      plt.xlabel('epoch')
```

```
[12]: Text(0.5, 0, 'epoch')
```



```
[13]: plt.plot(history.history['accuracy'])
      plt.title('Training accuracy')
      plt.xlabel('epoch')
```

```
[13]: Text(0.5, 0, 'epoch')
```



```
[14]: hypothesis = model.predict(x_data)
      print(hypothesis)
```

```
[[0.99787354]
 [0.99791104]
 [0.9962323 ]
 [0.9976549 ]
 [0.00398898]
 [0.00320292]
 [0.00320286]]
```

```
[15]: predicted = hypothesis > 0.5
      print(predicted)
```

```
[[ True]
 [ True]
 [ True]
 [ True]
 [False]
 [False]
 [False]]
```