In [1]:
```
!pip install tensorflow
```

```
Requirement already satisfied: tensorflow in c:\users\mosai\anaconda3\lib\sit
e-packages (2.12.0)
Requirement already satisfied: tensorflow-intel==2.12.0 in c:\users\mosai\ana
conda3\lib\site-packages (from tensorflow) (2.12.0)
Requirement already satisfied: jax>=0.3.15 in c:\users\mosai\anaconda3\lib\si
te-packages (from tensorflow-intel==2.12.0->tensorflow) (0.4.8)
Requirement already satisfied: termcolor>=1.1.0 in c:\users\mosai\anaconda3\l
ib\site-packages (from tensorflow-intel==2.12.0->tensorflow) (2.3.0)
Requirement already satisfied: wrapt<1.15,>=1.11.0 in c:\users\mosai\anaconda
3\lib\site-packages (from tensorflow-intel==2.12.0->tensorflow) (1.14.1)
Requirement already satisfied: opt-einsum>=2.3.2 in c:\users\mosai\anaconda3
\lib\site-packages (from tensorflow-intel==2.12.0->tensorflow) (3.3.0)
Requirement already satisfied: astunparse>=1.6.0 in c:\users\mosai\anaconda3
\lib\site-packages (from tensorflow-intel==2.12.0->tensorflow) (1.6.3)
Requirement already satisfied: gast<=0.4.0,>=0.2.1 in c:\users\mosai\anaconda
3\lib\site-packages (from tensorflow-intel==2.12.0->tensorflow) (0.4.0)
Requirement already satisfied: absl-py>=1.0.0 in c:\users\mosai\anaconda3\lib
\site-packages (from tensorflow-intel==2.12.0->tensorflow) (1.4.0)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in c:\users\mosai\anaconda
3\lib\site-packages (from tensorflow-intel==2.12.0->tensorflow) (1.54.0)
Requirement already satisfied: setuptools in c:\users\mosai\anaconda3\lib\sit
e-packages (from tensorflow-intel==2.12.0->tensorflow) (63.4.1)
Requirement already satisfied: typing-extensions>=3.6.6 in c:\users\mosai\ana
conda3\lib\site-packages (from tensorflow-intel==2.12.0->tensorflow) (4.3.0)
Requirement already satisfied: flatbuffers>=2.0 in c:\users\mosai\anaconda3\l
ib\site-packages (from tensorflow-intel==2.12.0->tensorflow) (23.3.3)
Requirement already satisfied: google-pasta>=0.1.1 in c:\users\mosai\anaconda
3\lib\site-packages (from tensorflow-intel==2.12.0->tensorflow) (0.2.0)
Requirement already satisfied: six>=1.12.0 in c:\users\mosai\anaconda3\lib\si
te-packages (from tensorflow-intel==2.12.0->tensorflow) (1.16.0)
Requirement already satisfied: tensorboard<2.13,>=2.12 in c:\users\mosai\anac
onda3\lib\site-packages (from tensorflow-intel==2.12.0->tensorflow) (2.12.2)
Requirement already satisfied: h5py>=2.9.0 in c:\users\mosai\anaconda3\lib\si
te-packages (from tensorflow-intel==2.12.0->tensorflow) (3.7.0)
Requirement already satisfied: tensorflow-estimator<2.13,>=2.12.0 in c:\users
\mosai\anaconda3\lib\site-packages (from tensorflow-intel==2.12.0->tensorflo
w) (2.12.0)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in c:\use
rs\mosai\anaconda3\lib\site-packages (from tensorflow-intel==2.12.0->tensorfl
ow) (0.31.0)
Requirement already satisfied: packaging in c:\users\mosai\anaconda3\lib\site
-packages (from tensorflow-intel==2.12.0->tensorflow) (21.3)
Requirement already satisfied: protobuf!=4.21.0,!=4.21.1,!=4.21.2,!=4.21.3,!=
4.21.4,!=4.21.5,<5.0.0dev,>=3.20.3 in c:\users\mosai\anaconda3\lib\site-packa
ges (from tensorflow-intel==2.12.0->tensorflow) (4.22.3)
Requirement already satisfied: numpy<1.24,>=1.22 in c:\users\mosai\anaconda3
\lib\site-packages (from tensorflow-intel==2.12.0->tensorflow) (1.23.5)
Requirement already satisfied: keras<2.13,>=2.12.0 in c:\users\mosai\anaconda
3\lib\site-packages (from tensorflow-intel==2.12.0->tensorflow) (2.12.0)
Requirement already satisfied: libclang>=13.0.0 in c:\users\mosai\anaconda3\l
ib\site-packages (from tensorflow-intel==2.12.0->tensorflow) (16.0.0)
Requirement already satisfied: wheel<1.0,>=0.23.0 in c:\users\mosai\anaconda3
\lib\site-packages (from astunparse>=1.6.0->tensorflow-intel==2.12.0->tensorf
low) (0.37.1)
Requirement already satisfied: scipy>=1.7 in c:\users\mosai\anaconda3\lib\sit
e-packages (from jax>=0.3.15->tensorflow-intel==2.12.0->tensorflow) (1.9.1)
Requirement already satisfied: ml-dtypes>=0.0.3 in c:\users\mosai\anaconda3\l
```

```
ib\site-packages (from jax>=0.3.15->tensorflow-intel==2.12.0->tensorflow) (0.
1.0)
Requirement already satisfied: google-auth-oauthlib<1.1,>=0.5 in c:\users\mos
ai\anaconda3\lib\site-packages (from tensorboard<2.13,>=2.12->tensorflow-inte
l==2.12.0->tensorflow) (1.0.0)
Requirement already satisfied: google-auth<3,>=1.6.3 in c:\users\mosai\anacon
da3\lib\site-packages (from tensorboard<2.13,>=2.12->tensorflow-intel==2.12.0
->tensorflow) (2.17.3)
Requirement already satisfied: markdown>=2.6.8 in c:\users\mosai\anaconda3\li
b\site-packages (from tensorboard<2.13,>=2.12->tensorflow-intel==2.12.0->tens
orflow) (3.3.4)
Requirement already satisfied: werkzeug>=1.0.1 in c:\users\mosai\anaconda3\li
b\site-packages (from tensorboard<2.13,>=2.12->tensorflow-intel==2.12.0->tens
orflow) (2.0.3)
Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in c:\users\mosa
i\anaconda3\lib\site-packages (from tensorboard<2.13,>=2.12->tensorflow-intel
==2.12.0->tensorflow) (1.8.1)
Requirement already satisfied: requests<3,>=2.21.0 in c:\users\mosai\anaconda
3\lib\site-packages (from tensorboard<2.13,>=2.12->tensorflow-intel==2.12.0->
tensorflow) (2.28.1)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in c:\us
ers\mosai\anaconda3\lib\site-packages (from tensorboard<2.13,>=2.12->tensorfl
ow-intel==2.12.0->tensorflow) (0.7.0)
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in c:\users\mosai\ana
conda3\lib\site-packages (from packaging->tensorflow-intel==2.12.0->tensorflo
w) (3.0.9)
Requirement already satisfied: rsa<5,>=3.1.4 in c:\users\mosai\anaconda3\lib
\site-packages (from google-auth<3,>=1.6.3->tensorboard<2.13,>=2.12->tensorfl
ow-intel==2.12.0->tensorflow) (4.9)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in c:\users\mosai\anaco
nda3\lib\site-packages (from google-auth<3,>=1.6.3->tensorboard<2.13,>=2.12->
tensorflow-intel==2.12.0->tensorflow) (5.3.0)
Requirement already satisfied: pyasn1-modules>=0.2.1 in c:\users\mosai\anacon
da3\lib\site-packages (from google-auth<3,>=1.6.3->tensorboard<2.13,>=2.12->t
ensorflow-intel==2.12.0->tensorflow) (0.2.8)
Requirement already satisfied: requests-oauthlib>=0.7.0 in c:\users\mosai\ana
conda3\lib\site-packages (from google-auth-oauthlib<1.1,>=0.5->tensorboard<2.
13,>=2.12->tensorflow-intel==2.12.0->tensorflow) (1.3.1)
Requirement already satisfied: idna<4,>=2.5 in c:\users\mosai\anaconda3\lib\s
ite-packages (from requests<3,>=2.21.0->tensorboard<2.13,>=2.12->tensorflow-i
ntel==2.12.0->tensorflow) (3.3)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\mosai\anaconda3
\lib\site-packages (from requests<3,>=2.21.0->tensorboard<2.13,>=2.12->tensor
flow-intel==2.12.0->tensorflow) (2022.9.14)
Requirement already satisfied: charset-normalizer<3,>=2 in c:\users\mosai\ana
conda3\lib\site-packages (from requests<3,>=2.21.0->tensorboard<2.13,>=2.12->
tensorflow-intel==2.12.0->tensorflow) (2.0.4)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in c:\users\mosai\anacon
da3\lib\site-packages (from requests<3,>=2.21.0->tensorboard<2.13,>=2.12->ten
sorflow-intel==2.12.0->tensorflow) (1.26.11)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in c:\users\mosai\anacond
a3\lib\site-packages (from pyasn1-modules>=0.2.1->google-auth<3,>=1.6.3->tens
orboard<2.13,>=2.12->tensorflow-intel==2.12.0->tensorflow) (0.4.8)
Requirement already satisfied: oauthlib>=3.0.0 in c:\users\mosai\anaconda3\li
b\site-packages (from requests-oauthlib>=0.7.0->google-auth-oauthlib<1.1,>=0.
5->tensorboard<2.13,>=2.12->tensorflow-intel==2.12.0->tensorflow) (3.2.2)
```

In [2]:
```
from keras.datasets import imdb
```

In [3]:
```
(train_data, train_labels), (test_data, test_labels) = imdb.load_data(num_word
```

In [4]:
```
train_data[0]
```

```
 297,
 98,
 32,
 2071,
 56,
 26,
 141,
 6,
 194,
 7486,
 18,
 4,
 226,
 22,
 21,
 134,
 476,
 26,
 480,
 5,
```

Preparing the Data

Encoding the integer sequences into a binary matrix

In [5]:
```
import numpy as np
def vectorize_sequences(sequences, dimension=10000):
    results = np.zeros((len(sequences), dimension))
    for i, sequence in enumerate(sequences):
        results[i, sequence] = 1.
    return results
x_train = vectorize_sequences(train_data)
x_test = vectorize_sequences(test_data)
```

In [6]:
```
x_train[0]
```

Out[6]:
```
array([0., 1., 1., ..., 0., 0., 0.])
```

In [7]:
```
y_train = np.asarray(train_labels).astype('float32')
y_test = np.asarray(test_labels).astype('float32')
```

The model definition

In [8]:
```
from keras import models
from keras import layers
model = models.Sequential()
model.add(layers.Dense(16, activation='relu', input_shape=(10000,)))
model.add(layers.Dense(16, activation='relu'))
model.add(layers.Dense(1, activation='sigmoid'))
```

Compiling the model

In [9]:
```
model.compile(optimizer='rmsprop',
loss='binary_crossentropy',
metrics=['accuracy'])
```

Configuring the optimizer

In [10]:
```
from keras import optimizers
model.compile(optimizer=optimizers.RMSprop(lr=0.001),
loss='binary_crossentropy',
metrics=['accuracy'])
```

```
C:\Users\mosai\anaconda3\lib\site-packages\keras\optimizers\legacy\rmsprop.p
y:143: UserWarning: The `lr` argument is deprecated, use `learning_rate` inst
ead.
  super().__init__(name, **kwargs)
```

Using custom losses and metrics

In [11]:
```
from keras import losses
from keras import metrics
model.compile(optimizer=optimizers.RMSprop(lr=0.001),
loss=losses.binary_crossentropy,
metrics=[metrics.binary_accuracy])
```

Setting aside a validation set

In [12]:
```
x_val = x_train[:10000]
partial_x_train = x_train[10000:]
y_val = y_train[:10000]
partial_y_train = y_train[10000:]
```

Training your model

In [13]:
```
model.compile(optimizer='rmsprop',
loss='binary_crossentropy',
metrics=['acc'])
history = model.fit(partial_x_train,
partial_y_train,
epochs=20,
batch_size=512,
validation_data=(x_val, y_val))
```

```
Epoch 1/20
30/30 [==============================] - 4s 93ms/step - loss: 0.5570 - acc:
0.7499 - val_loss: 0.4385 - val_acc: 0.8429
Epoch 2/20
30/30 [==============================] - 1s 27ms/step - loss: 0.3542 - acc:
0.8914 - val_loss: 0.3285 - val_acc: 0.8851
Epoch 3/20
30/30 [==============================] - 1s 31ms/step - loss: 0.2576 - acc:
0.9162 - val_loss: 0.2952 - val_acc: 0.8855
Epoch 4/20
30/30 [==============================] - 1s 31ms/step - loss: 0.2041 - acc:
0.9356 - val_loss: 0.2840 - val_acc: 0.8854
Epoch 5/20
30/30 [==============================] - 1s 28ms/step - loss: 0.1700 - acc:
0.9455 - val_loss: 0.3010 - val_acc: 0.8771
Epoch 6/20
30/30 [==============================] - 1s 28ms/step - loss: 0.1445 - acc:
0.9559 - val_loss: 0.2812 - val_acc: 0.8875
Epoch 7/20
30/30 [==============================] - 1s 25ms/step - loss: 0.1191 - acc:
0.9663 - val_loss: 0.2926 - val_acc: 0.8844
Epoch 8/20
30/30 [==============================] - 1s 24ms/step - loss: 0.1083 - acc:
0.9683 - val_loss: 0.3316 - val_acc: 0.8776
Epoch 9/20
30/30 [==============================] - 1s 24ms/step - loss: 0.0875 - acc:
0.9764 - val_loss: 0.3167 - val_acc: 0.8823
Epoch 10/20
30/30 [==============================] - 1s 24ms/step - loss: 0.0782 - acc:
0.9797 - val_loss: 0.3324 - val_acc: 0.8829
Epoch 11/20
30/30 [==============================] - 1s 25ms/step - loss: 0.0660 - acc:
0.9836 - val_loss: 0.3518 - val_acc: 0.8807
Epoch 12/20
30/30 [==============================] - 1s 25ms/step - loss: 0.0558 - acc:
0.9879 - val_loss: 0.3716 - val_acc: 0.8765
Epoch 13/20
30/30 [==============================] - 1s 24ms/step - loss: 0.0486 - acc:
0.9891 - val_loss: 0.3894 - val_acc: 0.8782
Epoch 14/20
30/30 [==============================] - 1s 24ms/step - loss: 0.0407 - acc:
0.9925 - val_loss: 0.4072 - val_acc: 0.8769
Epoch 15/20
30/30 [==============================] - 1s 24ms/step - loss: 0.0353 - acc:
0.9927 - val_loss: 0.4377 - val_acc: 0.8723
Epoch 16/20
30/30 [==============================] - 1s 24ms/step - loss: 0.0282 - acc:
0.9953 - val_loss: 0.4517 - val_acc: 0.8740
Epoch 17/20
30/30 [==============================] - 1s 25ms/step - loss: 0.0254 - acc:
0.9956 - val_loss: 0.4702 - val_acc: 0.8743
Epoch 18/20
30/30 [==============================] - 1s 24ms/step - loss: 0.0193 - acc:
0.9973 - val_loss: 0.4917 - val_acc: 0.8722
Epoch 19/20
30/30 [==============================] - 1s 26ms/step - loss: 0.0156 - acc:
0.9983 - val_loss: 0.5225 - val_acc: 0.8701
```

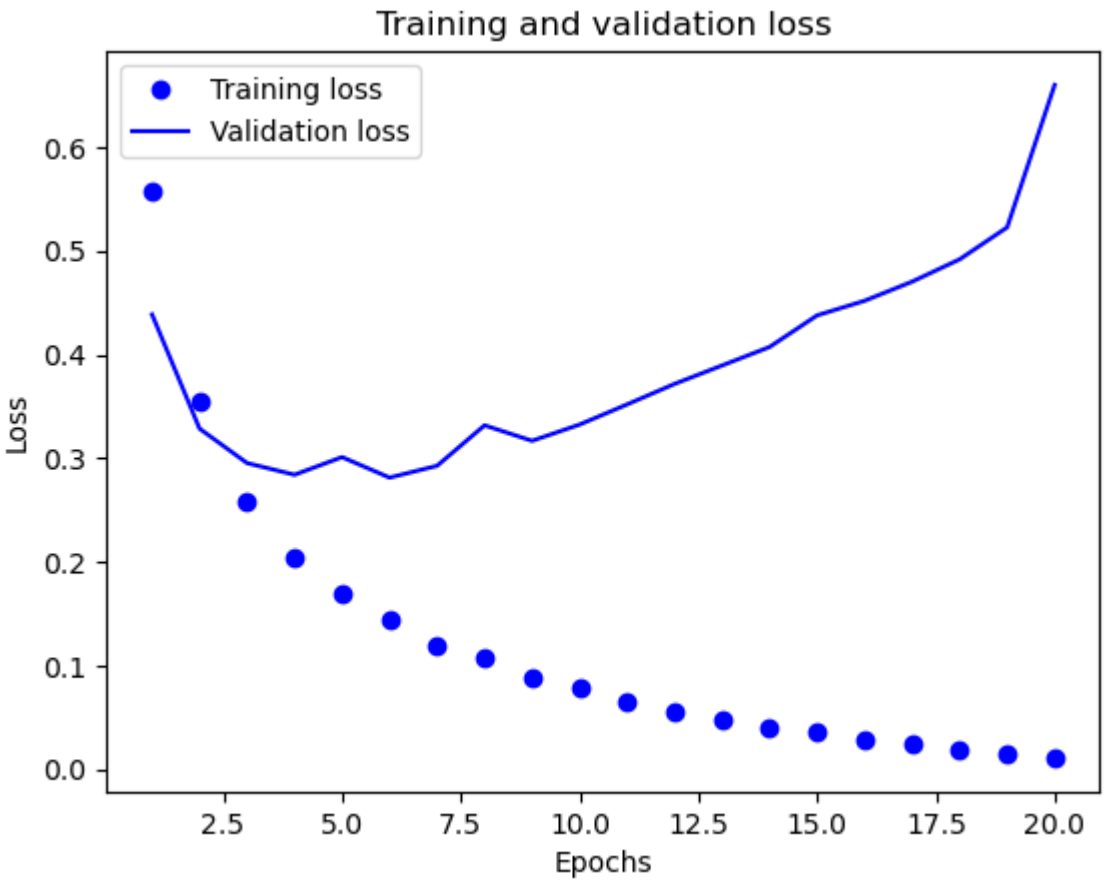
```
Epoch 20/20
30/30 [==============================] - 1s 24ms/step - loss: 0.0112 - acc:
0.9993 - val_loss: 0.6598 - val_acc: 0.8525
```

In [18]:
```
history_dict = history.history
history_dict.keys()
#[u'acc', u'loss', u'val_acc', u'val_loss']
```

Out[18]:
```
dict_keys(['loss', 'acc', 'val_loss', 'val_acc'])
```

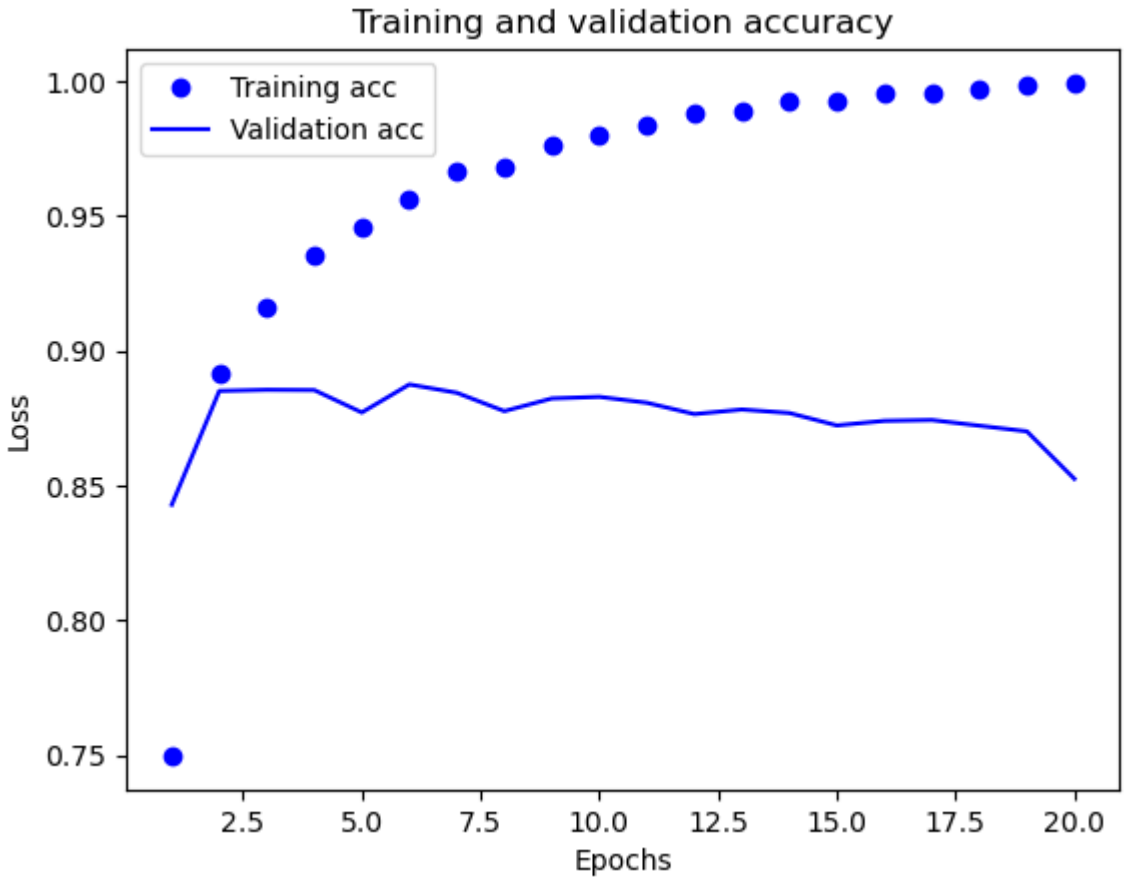
Plotting the training and validation loss

In [30]:
```
import matplotlib.pyplot as plt
history_dict = history.history
loss_values = history_dict['loss']
val_loss_values = history_dict['val_loss']
acc = history_dict["val_acc"]
epochs = range(1, len(acc) + 1)
plt.plot(epochs, loss_values, 'bo', label='Training loss')
plt.plot(epochs, val_loss_values, 'b', label='Validation loss')
plt.title('Training and validation loss')
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.legend()
plt.show()
```



Plotting the training and validation accuracy

In [38]:
```
plt.clf()
acc_values = history_dict['acc']
val_acc_values = history_dict['val_acc']
plt.plot(epochs, acc_values, 'bo', label='Training acc')
plt.plot(epochs, val_acc_values, 'b', label='Validation acc')
plt.title('Training and validation accuracy')
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.legend()
plt.show()
```



Retraining a model from scratch

In [39]:
```
model = models.Sequential()
model.add(layers.Dense(16, activation='relu', input_shape=(10000,)))
model.add(layers.Dense(16, activation='relu'))
model.add(layers.Dense(1, activation='sigmoid'))
model.compile(optimizer='rmsprop',
loss='binary_crossentropy',
metrics=['accuracy'])
model.fit(x_train, y_train, epochs=4, batch_size=512)
results = model.evaluate(x_test, y_test)
```

```
Epoch 1/4
49/49 [==============================] - 2s 21ms/step - loss: 0.4782 - accura
cy: 0.8114
Epoch 2/4
49/49 [==============================] - 1s 20ms/step - loss: 0.2849 - accura
cy: 0.9021
Epoch 3/4
49/49 [==============================] - 1s 19ms/step - loss: 0.2215 - accura
cy: 0.9200
Epoch 4/4
49/49 [==============================] - 1s 25ms/step - loss: 0.1879 - accura
cy: 0.9343
782/782 [==============================] - 2s 2ms/step - loss: 0.2937 - accur
acy: 0.8813
```

In [40]:
```
results
```

Out[40]:
```
[0.29372963309288025, 0.8812800049781799]
```

In [ ]:
```

```