Lab Assignment No. 11

Code:

```
import tensorflow as tf
from tensorflow import keras
from keras import Sequential
from keras.layers import Dense, Dropout
from sklearn.datasets import make_gaussian_quantiles
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns


X1, y1 = make_gaussian_quantiles(cov=3.,
                                 n_samples=10000, n_features=2,
                                 n_classes=2, random_state=1)
X1 = pd.DataFrame(X1,columns=['x','y'])
y1 = pd.Series(y1)

X1

            x         y
0      0.759772  1.418316
1      2.429896 -2.974839
2     -1.312662 -3.837630
3      1.544247  0.904236
4      0.675905  3.471664
...         ...       ...
9995  -1.519436 -0.076489
9996  -2.862951  1.931277
9997  -0.977937  0.364132
9998  -3.888984 -2.809069
9999   0.075637 -0.391988

[10000 rows x 2 columns]

y1

0       0
1       1
2       1
3       0
4       1
       ..
9995    0
9996    1
9997    0
9998    1
```
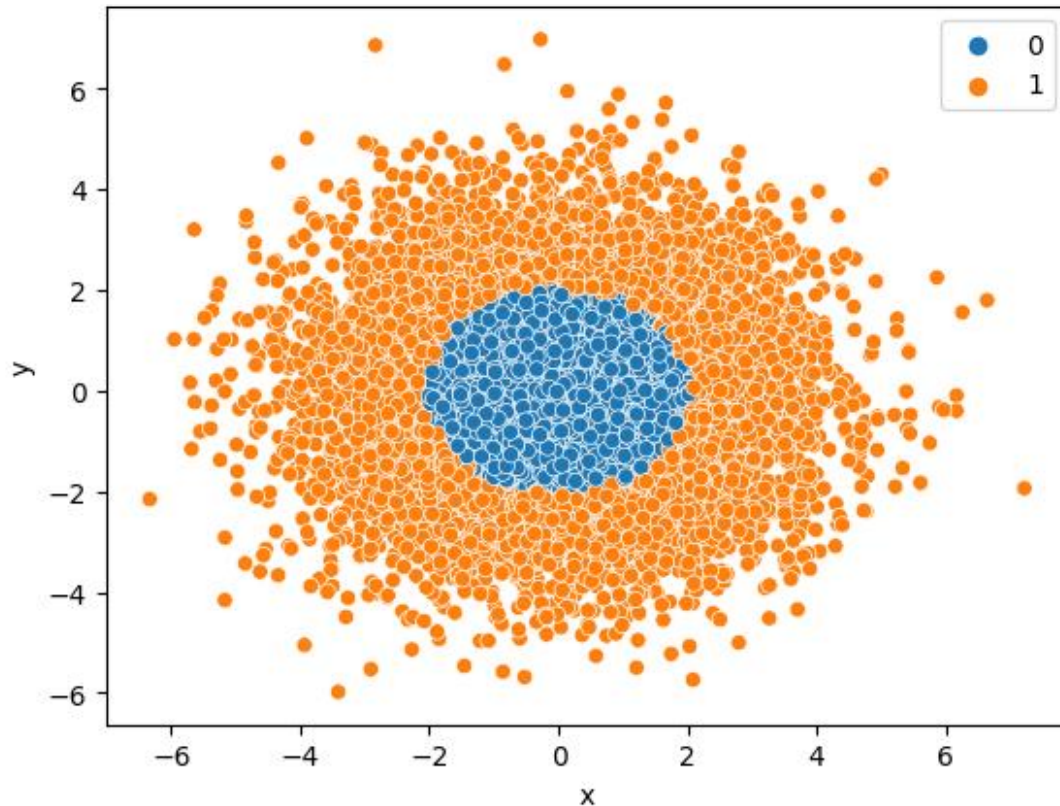
```
9999    0
Length: 10000, dtype: int64
```

```
sns.scatterplot(x=X1.iloc[:,0], y=X1.iloc[:,1], hue=y1)
```
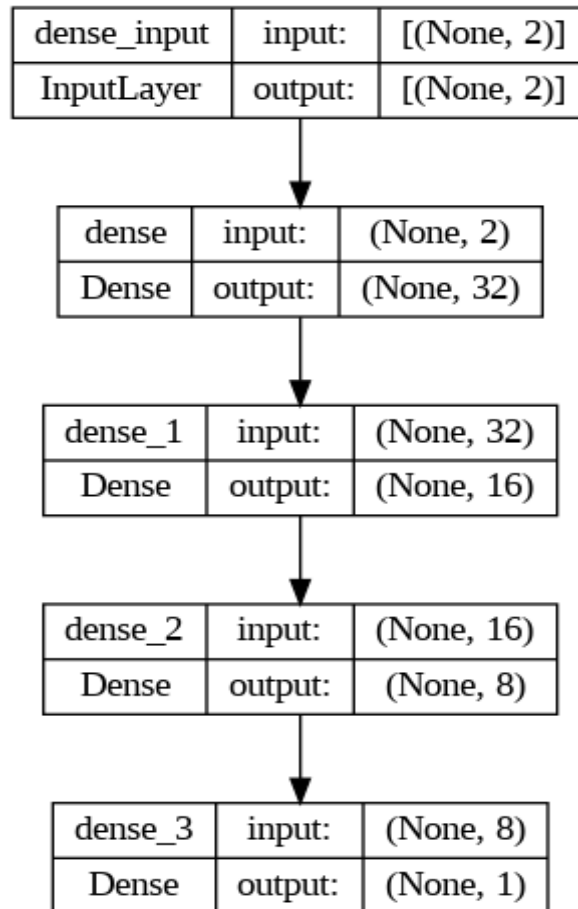
```
<Axes: xlabel='x', ylabel='y'>
```



```
model = Sequential()
model.add(Dense(32, activation='relu', input_dim=2))
model.add(Dense(16, activation='relu'))
model.add(Dense(8, activation='relu'))
model.add(Dense(1, activation='sigmoid'))

from keras.utils import plot_model
plot_model(model, show_shapes=True)
```

dense_input	input:	[(None, 2)]
InputLayer	output:	[(None, 2)]

dense	input:	(None, 2)
Dense	output:	(None, 32)

dense_1	input:	(None, 32)
Dense	output:	(None, 16)

dense_2	input:	(None, 16)
Dense	output:	(None, 8)

dense_3	input:	(None, 8)
Dense	output:	(None, 1)

```python
model.compile(optimizer='adam', loss="binary_crossentropy",
metrics=['accuracy'])

model.fit(X1, y1, epochs=50, verbose=1)
```

Output:

```
Epoch 1/50
313/313 [==============================] - 5s 5ms/step - loss: 0.4545 -
accuracy: 0.7580
Epoch 2/50
313/313 [==============================] - 2s 5ms/step - loss: 0.0947 -
accuracy: 0.9822
Epoch 3/50
313/313 [==============================] - 1s 4ms/step - loss: 0.0521 -
accuracy: 0.9877
Epoch 4/50
313/313 [==============================] - 2s 6ms/step - loss: 0.0415 -
accuracy: 0.9879
Epoch 5/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0345 -
accuracy: 0.9903
```

```
Epoch 6/50
313/313 [==============================] - 1s 4ms/step - loss: 0.0313 -
accuracy: 0.9911
Epoch 7/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0284 -
accuracy: 0.9900
Epoch 8/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0268 -
accuracy: 0.9912
Epoch 9/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0243 -
accuracy: 0.9912
Epoch 10/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0241 -
accuracy: 0.9907
Epoch 11/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0230 -
accuracy: 0.9918
Epoch 12/50
313/313 [==============================] - 1s 5ms/step - loss: 0.0210 -
accuracy: 0.9920
Epoch 13/50
313/313 [==============================] - 2s 6ms/step - loss: 0.0211 -
accuracy: 0.9924
Epoch 14/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0223 -
accuracy: 0.9920
Epoch 15/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0187 -
accuracy: 0.9935
Epoch 16/50
313/313 [==============================] - 1s 4ms/step - loss: 0.0176 -
accuracy: 0.9935
Epoch 17/50
313/313 [==============================] - 2s 5ms/step - loss: 0.0196 -
accuracy: 0.9930
Epoch 18/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0193 -
accuracy: 0.9921
Epoch 19/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0171 -
accuracy: 0.9936
Epoch 20/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0164 -
accuracy: 0.9937
Epoch 21/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0183 -
accuracy: 0.9929
Epoch 22/50
```

```
313/313 [==============================] - 1s 2ms/step - loss: 0.0177 -
accuracy: 0.9924
Epoch 23/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0195 -
accuracy: 0.9920
Epoch 24/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0174 -
accuracy: 0.9927
Epoch 25/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0144 -
accuracy: 0.9948
Epoch 26/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0169 -
accuracy: 0.9936
Epoch 27/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0171 -
accuracy: 0.9928
Epoch 28/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0148 -
accuracy: 0.9946
Epoch 29/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0174 -
accuracy: 0.9930
Epoch 30/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0137 -
accuracy: 0.9948
Epoch 31/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0170 -
accuracy: 0.9935
Epoch 32/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0146 -
accuracy: 0.9943
Epoch 33/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0160 -
accuracy: 0.9935
Epoch 34/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0145 -
accuracy: 0.9938
Epoch 35/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0177 -
accuracy: 0.9928
Epoch 36/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0173 -
accuracy: 0.9927
Epoch 37/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0166 -
accuracy: 0.9924
Epoch 38/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0139 -
```

```
accuracy: 0.9942
Epoch 39/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0133 -
accuracy: 0.9944
Epoch 40/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0140 -
accuracy: 0.9942
Epoch 41/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0123 -
accuracy: 0.9957
Epoch 42/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0155 -
accuracy: 0.9932
Epoch 43/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0145 -
accuracy: 0.9937
Epoch 44/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0156 -
accuracy: 0.9927
Epoch 45/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0148 -
accuracy: 0.9938
Epoch 46/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0137 -
accuracy: 0.9948
Epoch 47/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0158 -
accuracy: 0.9931
Epoch 48/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0174 -
accuracy: 0.9924
Epoch 49/50
313/313 [==============================] - 1s 3ms/step - loss: 0.0137 -
accuracy: 0.9940
Epoch 50/50
313/313 [==============================] - 1s 2ms/step - loss: 0.0170 -
accuracy: 0.9925

<keras.callbacks.History at 0x7f2618d1c5b0>
```
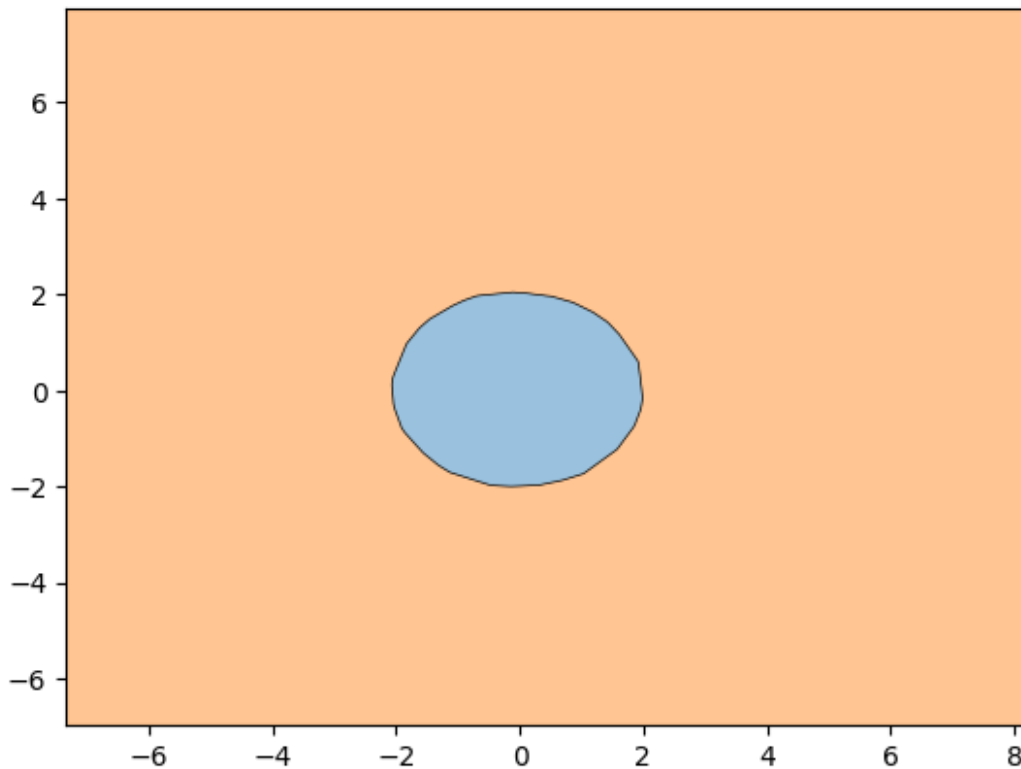
```
model.predict(X1)
```

```
313/313 [==============================] - 0s 1ms/step
```

```
array([[2.0704062e-08],
       [1.0000000e+00],
       [1.0000000e+00],
       ...,
       [4.4519486e-14],
       [1.0000000e+00],
       [8.1487582e-16]], dtype=float32)
```

```
loss, accuracy = model.evaluate(x=X1, y=y1)
```

```
313/313 [==============================] - 1s 3ms/step - loss: 0.0201 -
accuracy: 0.9911
```

```
print(f"Model having Loss of {loss} and accuracy with {accuracy}")
```

```
Model having Loss of 0.020140156149864197 and accuracy with 0.991100013256073
```