

```
In [5]: import numpy as np
import pandas as pd
import tensorflow as tf
```

```
In [6]: tf.__version__
```

```
Out[6]: '2.19.0'
```

```
In [11]: dataset = pd.read_csv(r'Churn_Modelling.csv')
X = dataset.iloc[:, 3:-1].values
y = dataset.iloc[:, -1].values
```

```
In [13]: X
```

```
Out[13]: array([[619, 'France', 'Female', ..., 1, 1, 101348.88],
               [608, 'Spain', 'Female', ..., 0, 1, 112542.58],
               [502, 'France', 'Female', ..., 1, 0, 113931.57],
               ...,
               [709, 'France', 'Female', ..., 0, 1, 42085.58],
               [772, 'Germany', 'Male', ..., 1, 0, 92888.52],
               [792, 'France', 'Female', ..., 1, 0, 38190.78]], dtype=object)
```

```
In [15]: from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
X[:, 2] = le.fit_transform(X[:, 2])
```

```
In [17]: from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder
ct = ColumnTransformer(transformers=[('encoder', OneHotEncoder(), [1])], remainder=
X = np.array(ct.fit_transform(X))
```

```
In [19]: from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2, random_s
```

```
In [23]: from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

```
In [25]: ann = tf.keras.models.Sequential()
```

```
In [29]: ann.add(tf.keras.layers.Dense(units=6,activation='relu'))
ann.add(tf.keras.layers.Dense(units=6,activation='relu'))
ann.add(tf.keras.layers.Dense(units=1,activation='sigmoid'))
```

```
In [31]: ann.compile(optimizer='sgd',
                    loss='binary_crossentropy',
                    metrics=['accuracy'])
```

```
In [33]: ann.fit(X_train,y_train, batch_size=32,
                epochs=50)
```

Epoch 1/50  
250/250 ————— 5s 5ms/step - accuracy: 0.5530 - loss: 0.7085  
Epoch 2/50  
250/250 ————— 1s 4ms/step - accuracy: 0.7957 - loss: 0.4984  
Epoch 3/50  
250/250 ————— 1s 4ms/step - accuracy: 0.7926 - loss: 0.4638  
Epoch 4/50  
250/250 ————— 1s 4ms/step - accuracy: 0.7997 - loss: 0.4414  
Epoch 5/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8073 - loss: 0.4358  
Epoch 6/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8248 - loss: 0.4069  
Epoch 7/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8289 - loss: 0.3986  
Epoch 8/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8472 - loss: 0.3744  
Epoch 9/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8513 - loss: 0.3713  
Epoch 10/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8442 - loss: 0.3768  
Epoch 11/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8573 - loss: 0.3546  
Epoch 12/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8548 - loss: 0.3526  
Epoch 13/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8548 - loss: 0.3505  
Epoch 14/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8586 - loss: 0.3460  
Epoch 15/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8564 - loss: 0.3568  
Epoch 16/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8534 - loss: 0.3548  
Epoch 17/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8610 - loss: 0.3510  
Epoch 18/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8592 - loss: 0.3454  
Epoch 19/50  
250/250 ————— 1s 5ms/step - accuracy: 0.8666 - loss: 0.3333  
Epoch 20/50  
250/250 ————— 1s 5ms/step - accuracy: 0.8567 - loss: 0.3527  
Epoch 21/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8624 - loss: 0.3445  
Epoch 22/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8634 - loss: 0.3358  
Epoch 23/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8599 - loss: 0.3468  
Epoch 24/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8673 - loss: 0.3314  
Epoch 25/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8607 - loss: 0.3442  
Epoch 26/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8585 - loss: 0.3431  
Epoch 27/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8666 - loss: 0.3314  
Epoch 28/50  
250/250 ————— 1s 4ms/step - accuracy: 0.8613 - loss: 0.3375

```

Epoch 29/50
250/250 ————— 1s 4ms/step - accuracy: 0.8662 - loss: 0.3418
Epoch 30/50
250/250 ————— 1s 4ms/step - accuracy: 0.8632 - loss: 0.3325
Epoch 31/50
250/250 ————— 1s 4ms/step - accuracy: 0.8599 - loss: 0.3498
Epoch 32/50
250/250 ————— 1s 5ms/step - accuracy: 0.8557 - loss: 0.3519
Epoch 33/50
250/250 ————— 1s 4ms/step - accuracy: 0.8657 - loss: 0.3298
Epoch 34/50
250/250 ————— 1s 4ms/step - accuracy: 0.8643 - loss: 0.3406
Epoch 35/50
250/250 ————— 1s 4ms/step - accuracy: 0.8614 - loss: 0.3407
Epoch 36/50
250/250 ————— 1s 4ms/step - accuracy: 0.8566 - loss: 0.3491
Epoch 37/50
250/250 ————— 1s 4ms/step - accuracy: 0.8627 - loss: 0.3394
Epoch 38/50
250/250 ————— 1s 4ms/step - accuracy: 0.8585 - loss: 0.3468
Epoch 39/50
250/250 ————— 1s 4ms/step - accuracy: 0.8625 - loss: 0.3345
Epoch 40/50
250/250 ————— 1s 4ms/step - accuracy: 0.8660 - loss: 0.3327
Epoch 41/50
250/250 ————— 1s 4ms/step - accuracy: 0.8650 - loss: 0.3344
Epoch 42/50
250/250 ————— 1s 4ms/step - accuracy: 0.8599 - loss: 0.3389
Epoch 43/50
250/250 ————— 1s 4ms/step - accuracy: 0.8706 - loss: 0.3256
Epoch 44/50
250/250 ————— 1s 4ms/step - accuracy: 0.8585 - loss: 0.3423
Epoch 45/50
250/250 ————— 1s 4ms/step - accuracy: 0.8730 - loss: 0.3191
Epoch 46/50
250/250 ————— 1s 4ms/step - accuracy: 0.8632 - loss: 0.3444
Epoch 47/50
250/250 ————— 1s 4ms/step - accuracy: 0.8658 - loss: 0.3386
Epoch 48/50
250/250 ————— 1s 4ms/step - accuracy: 0.8635 - loss: 0.3332
Epoch 49/50
250/250 ————— 1s 4ms/step - accuracy: 0.8604 - loss: 0.3449
Epoch 50/50
250/250 ————— 1s 4ms/step - accuracy: 0.8722 - loss: 0.3263

```

Out[33]: <keras.src.callbacks.history.History at 0x22092230b90>

```
In [41]: ann.predict(X_test)>0.5
```

```
63/63 ————— 0s 3ms/step
```

```
Out[41]: array([[False],
                [False],
                [False],
                ...,
                [False],
                [False],
                [False]])
```