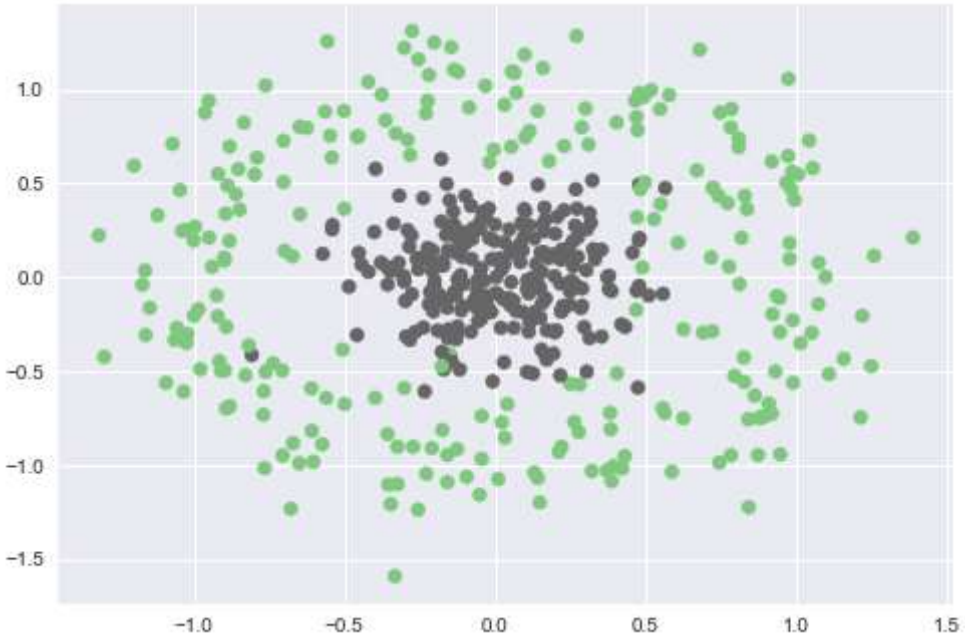
In [ ]:
```
from sklearn.datasets import make_circles
import matplotlib.pyplot as plt
import numpy as np
```

In [ ]:
```
X,Y = make_circles(n_samples=500, shuffle=True, noise=0.2, random_state=1, factor=0.2)
```

In [ ]:
```
plt.style.use("seaborn")
plt.scatter(X[:,0],X[:,1],c=Y,cmap=plt.cm.Accent)
plt.show()
```



In [ ]:
```
def softmax(a):
    e_pa = np.exp(a)
    ans = e_pa/np.sum(e_pa,axis=1,keepdims=True) #keepdims to the shape of array same a
    return ans
```

In [ ]:
```
class NeuralNetwork:

    def __init__(self,input_size,layers,output_size):

        np.random.seed(0)

        model = {}

        #Layer 1
        model['W1'] = np.random.randn(input_size,layers[0])
        model['b1'] = np.zeros((1,layers[0]))

        # Layer 2
        model['W2'] = np.random.randn(layers[0],layers[1])
        model['b2'] = np.zeros((1,layers[1]))

        # Layer 3
```

```
        model['W3'] = np.random.randn(layers[1],output_size)
        model['b3'] = np.zeros((1,output_size))

        self.model = model
        self.activation_outputs = None

    def forward(self,x):

        W1,W2,W3 = self.model['W1'],self.model['W2'],self.model['W3']
        b1,b2,b3 = self.model['b1'],self.model['b2'],self.model['b3']

        z1 = np.dot(x,W1)+b1
        a1 = np.tanh(z1)

        z2 = np.dot(a1,W2)+b2
        a2 = np.tanh(z2)

        z3 = np.dot(a2,W3)+b3
        y_ = softmax(z3)

        self.activation_outputs = (a1,a2,y_)
        return y_

    def backward(self,x,y,learning_rate=0.001):

        W1,W2,W3 = self.model['W1'],self.model['W2'],self.model['W3']
        b1,b2,b3 = self.model['b1'],self.model['b2'],self.model['b3']
        a1,a2,y_ = self.activation_outputs
        m = x.shape[0]

        delta3 = y_-y
        dw3 = np.dot(a2.T,delta3)
        db3 = np.sum(delta3,axis=0)

        delta2 = (1-np.square(a2))*np.dot(delta3,W3.T)
        dw2 = np.dot(a1.T,delta2)
        db2 = np.sum(delta2,axis=0)

        delta1 = (1-np.square(a1))*np.dot(delta2,W2.T)
        dw1 = np.dot(x.T,delta1)
        db1 = np.sum(delta1,axis=0)

        #update the Model parameters using gradient descent

        self.model['W1'] -= learning_rate*dw1
        self.model['b1'] -= learning_rate*db1

        self.model['W2'] -= learning_rate*dw2
        self.model['b2'] -= learning_rate*db2

        self.model['W3'] -= learning_rate*dw3
        self.model['b3'] -= learning_rate*db3

    def predict(self,x):
        y_out =self.forward(x)
        return np.argmax(y_out,axis=1)

    def summary(self):
        W1,W2,W3 = self.model['W1'],self.model['W2'],self.model['W3']
        a1,a2,y_ = self.activation_outputs
```

```
        print("W1",W1.shape)
        print("A1",a1.shape)

        print("W2",W2.shape)
        print("A2",a2.shape)

        print("W3",W3.shape)
        print("Y_",y_.shape)
```

In [ ]:
```
def loss(y_oht,p):
    l = -np.mean(y_oht*np.log(p))
    return l

def one_hot(y,depth):

    m = y.shape[0]
    y_oht = np.zeros((m,depth))
    y_oht[np.arange(m),y] = 1

    return y_oht
```

In [ ]:
```
model = NeuralNetwork(input_size=2,layers=[10,5],output_size=2)
```

In [ ]:
```
def train(X,Y,model,epochs,learning_rate,logs=True):
    training_loss = []

    classes=2
    y_hot = one_hot(Y,classes)

    for ix in range(epochs):

        Y_ = model.forward(X)
        l = loss(y_hot,Y_)
        training_loss.append(l)
        model.backward(X,y_hot,learning_rate)

        if(logs):
            print("Epoch %d Loss %.4f"%(ix,l))

    return training_loss
```

In [ ]:
```
losses = train(X,Y,model,500,0.001)
```

```
Epoch 0 Loss 0.3571
Epoch 1 Loss 0.3554
Epoch 2 Loss 0.2593
Epoch 3 Loss 0.2407
Epoch 4 Loss 0.2258
Epoch 5 Loss 0.2132
Epoch 6 Loss 0.2020
Epoch 7 Loss 0.1919
Epoch 8 Loss 0.1827
Epoch 9 Loss 0.1742
```

```
Epoch 10 Loss 0.1664
Epoch 11 Loss 0.1593
Epoch 12 Loss 0.1527
Epoch 13 Loss 0.1467
Epoch 14 Loss 0.1411
Epoch 15 Loss 0.1360
Epoch 16 Loss 0.1313
Epoch 17 Loss 0.1270
Epoch 18 Loss 0.1230
Epoch 19 Loss 0.1193
Epoch 20 Loss 0.1159
Epoch 21 Loss 0.1127
Epoch 22 Loss 0.1098
Epoch 23 Loss 0.1070
Epoch 24 Loss 0.1045
Epoch 25 Loss 0.1021
Epoch 26 Loss 0.0999
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```
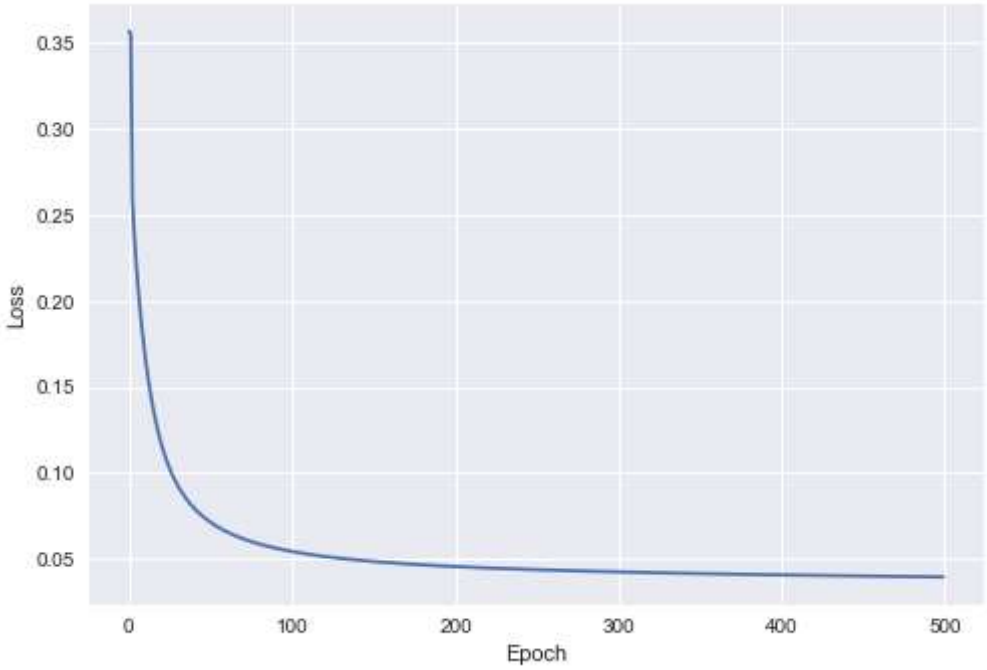

In [ ]:

```
plt.plot(losses)
plt.xlabel("Epoch")
plt.ylabel("Loss")
plt.show()
```



In [ ]:

```
outputs = model.predict(X)
print(outputs)
```

```
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```

In [ ]:

```
print(outputs.shape)
```

```
(500,)
```

In [ ]:

```
training_accuracy = np.sum(outputs==Y)/Y.shape[0]
print(training_accuracy)
```

```
0.97
```

In [ ]: