CODE:

In [1]:
```
from keras.datasets import mnist
import numpy as np
import pandas as pd
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
```

In [2]:
```
data = load_iris()
X=data.data
y=data.target
y = pd.get_dummies(y).values
y[:3]
```

Out[2]:
```
array([[1, 0, 0],
       [1, 0, 0],
       [1, 0, 0]], dtype=uint8)
```

In [3]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=20,
                                                    random_state=4)
learning_rate = 0.1
iterations = 5000
N = y_train.size
input_size = 4
hidden_size = 2
output_size = 3
results = pd.DataFrame(columns=["mse", "accuracy"])
```

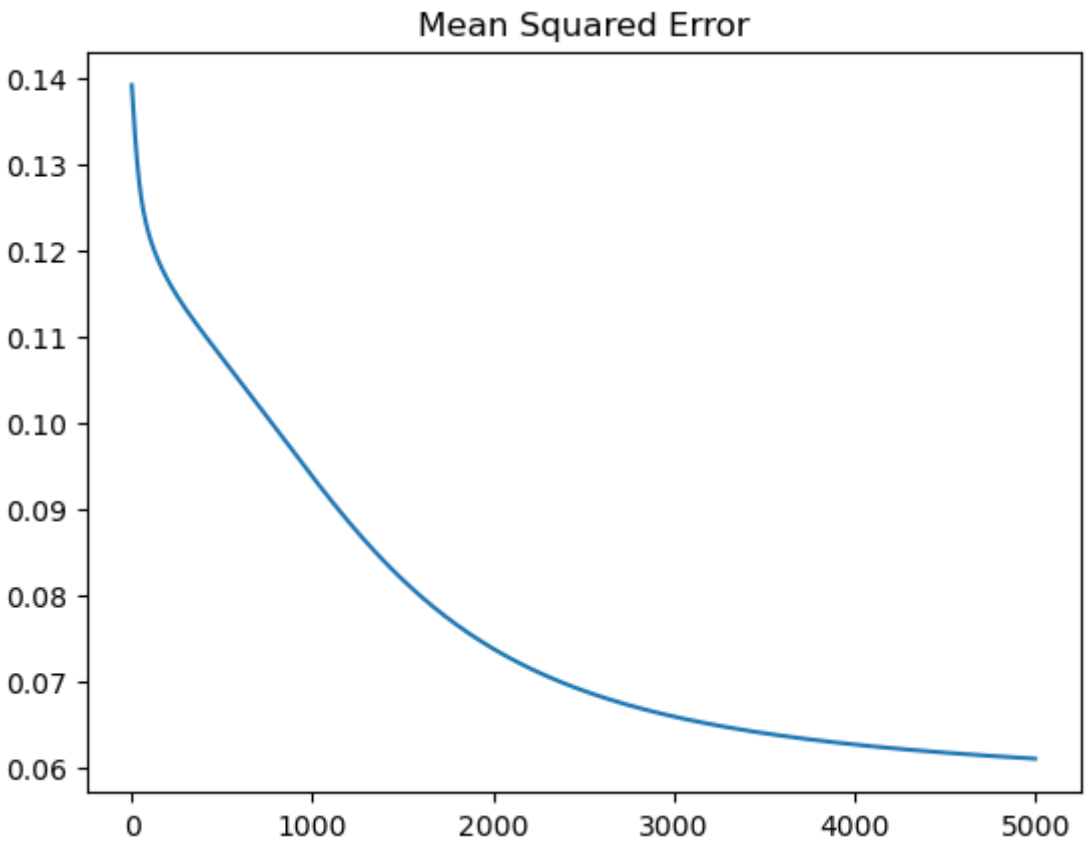
In [4]:
```
np.random.seed(10)
W1 = np.random.normal(scale=0.5, size=(input_size, hidden_size))
W2 = np.random.normal(scale=0.5, size=(hidden_size , output_size))
```

In [5]:
```
def sigmoid(x):
    return 1 / (1 + np.exp(-x))
def mean_squared_error(y_pred, y_true):
    return ((y_pred - y_true)**2).sum() / (2*y_pred.size)
def accuracy(y_pred, y_true):
    acc = y_pred.argmax(axis=1) == y_true.argmax(axis=1)
    return acc.mean()
```

In [6]:
```
import warnings
warnings.filterwarnings("ignore", category=FutureWarning)
for itr in range(iterations):
    Z1 = np.dot(X_train, W1)
    A1 = sigmoid(Z1)
    Z2 = np.dot(A1, W2)
    A2 = sigmoid(Z2)
    mse = mean_squared_error(A2, y_train)
    acc = accuracy(A2, y_train)
    results=results.append({"mse":mse, "accuracy":acc},ignore_index=True )
    E1 = A2 - y_train
    dW1 = E1 * A2 * (1 - A2)
    E2 = np.dot(dW1, W2.T)
    dW2 = E2 * A1 * (1 - A1)
    W2_update = np.dot(A1.T, dW1) / N
    W1_update = np.dot(X_train.T, dW2) / N
    W2 = W2 - learning_rate * W2_update
    W1 = W1 - learning_rate * W1_update
```

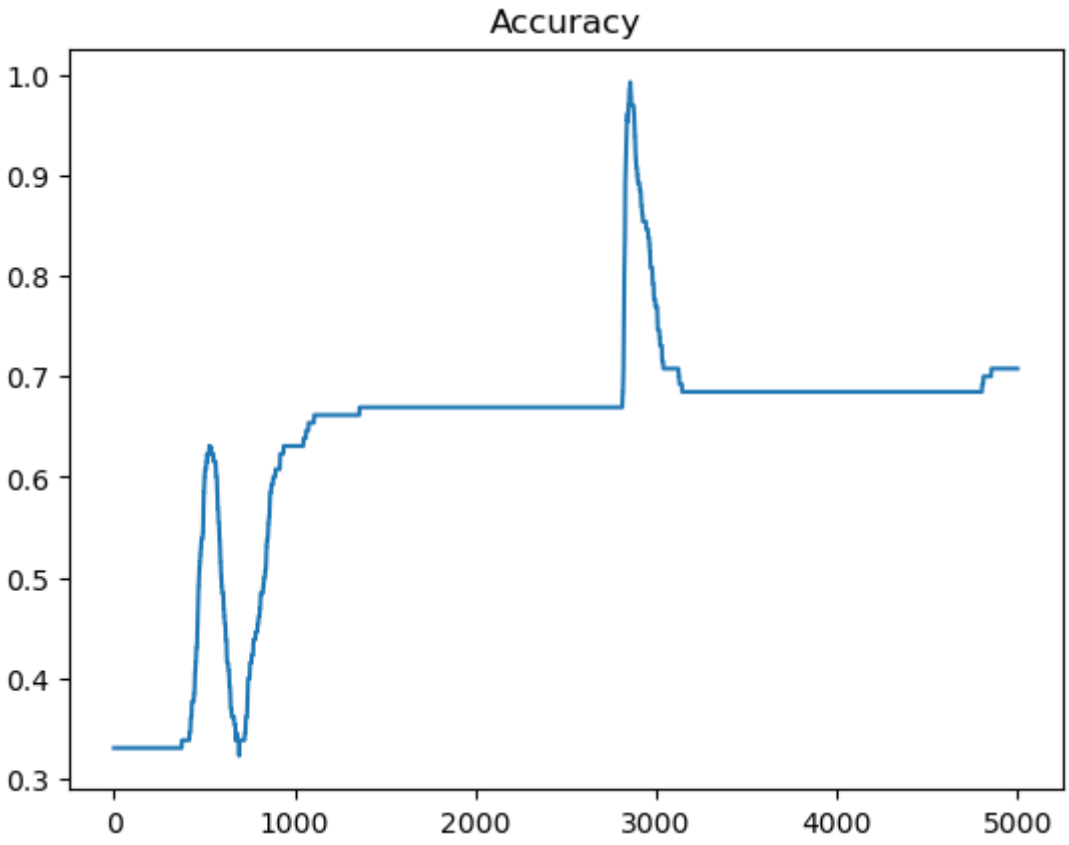
In [7]:
```
results.mse.plot(title="Mean Squared Error")
```

Out[7]: <AxesSubplot:title={'center':'Mean Squared Error'}>



In [8]:
```
results.accuracy.plot(title="Accuracy")
```

Out[8]: <AxesSubplot:title={'center':'Accuracy'}>



In [9]:
```
Z1 = np.dot(X_test, W1)
A1 = sigmoid(Z1)
Z2 = np.dot(A1, W2)
```

```
A2 = sigmoid(Z2)
acc = accuracy(A2, y_test)
print("Accuracy: {}".format(acc))
```

```
Accuracy: 0.8
```

RESULT:

Hence, we successfully implemented Backpropagation in Neural Network using MNIST.