Artificial Neural Network | Backpropagartion Algorithm

```
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
```

Loading Dataset

Iris dataset using load_iris() function of scikit-learn library. This data set has three classes Iris-setosa, Iris-versicolor, and Iris-virginica.

```
df = load_iris()

# Get features and target
X=df.data
y=df.target


# Get dummy variable
y = pd.get_dummies(y).values

y[:3]
```

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

Split data into train and test data

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=20, random_state=4)
```

Intializing the hyperparameters such as learning rate, iterations, input size, number of hidden layers, and number of output layers.

```
# Initialize variables
learning_rate = 0.1
iterations = 6000
N = y_train.size

# number of input features
input_size = 4

# number of hidden layers neurons
hidden_size = 2
```

```
# number of neurons at the output layer
output_size = 3

results = pd.DataFrame(columns=["mse", "accuracy"])


# Initialize weights
np.random.seed(10)

# initializing weight for the hidden layer
W1 = np.random.normal(scale=0.5, size=(input_size, hidden_size))

# initializing weight for the output layer
W2 = np.random.normal(scale=0.5, size=(hidden_size , output_size))


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()
```

Loop iterate and execute the three steps

1. Feedforward propagation
2. Error calculation and,
3. Backpropagation phase

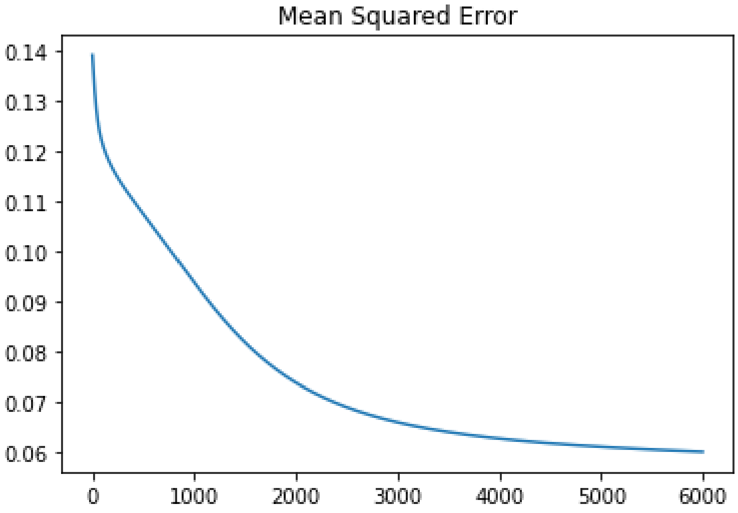
and update the weights in each iteration.

```
for itr in range(iterations):

    # feedforward propagation
    # on hidden layer
    Z1 = np.dot(X_train, W1)
    A1 = sigmoid(Z1)

    # on output layer
    Z2 = np.dot(A1, W2)
    A2 = sigmoid(Z2)


    # Calculating error
    mse = mean_squared_error(A2, y_train)
    acc = accuracy(A2, y_train)
    results=results.append({"mse":mse, "accuracy":acc},ignore_index=True )

    # backpropagation
    E1 = A2 - y_train
    dW1 = E1 * A2 * (1 - A2)
    E2 = np.dot(dW1, W2.T)
    dW2 = E2 * A1 * (1 - A1)


    # weight updates
    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
```

Mean squared error Plot

```
results.mse.plot(title="Mean Squared Error")
```

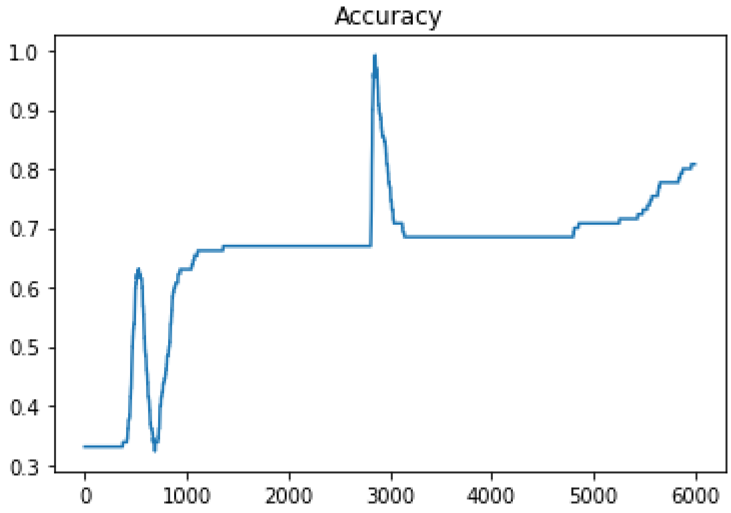
```
    <matplotlib.axes._subplots.AxesSubplot at 0x7f538153fa50>
```



Accuracy plot

```
results.accuracy.plot(title="Accuracy")
```

```
    <matplotlib.axes._subplots.AxesSubplot at 0x7f5381413910>
```



Prediction for the test data and assess the performance of Backpropagation neural network.

```
# feedforward
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: 0.85
```