Ex No: 6 **A RECURRENT NEURAL NETWORK**

Aim:

To build a recurrent neural network with Keras/TensorFlow.

Procedure:

1. Download and load the dataset.
2. Perform analysis and preprocessing of the dataset.
3. Build a simple neural network model using Keras/TensorFlow.
4. Compile and fit the model.
5. Perform prediction with the test dataset.
6. Calculate performance metrics.

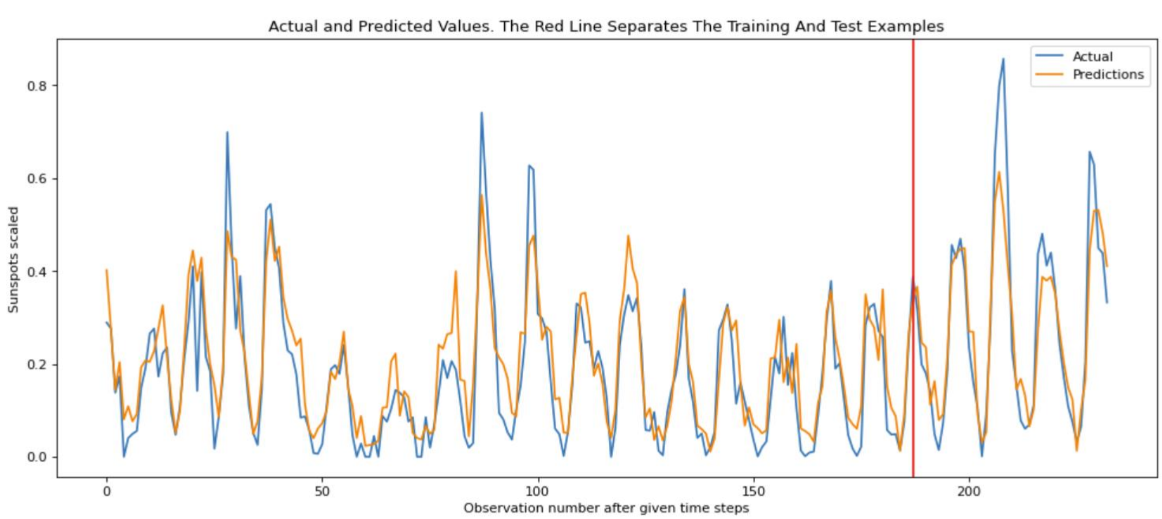
Program:

```
# Parameter split_percent defines the ratio of training examples
def get_train_test(url, split_percent=0.8):
    df = read_csv(url, usecols=[1], engine='python')
    data = np.array(df.values.astype('float32'))
    scaler = MinMaxScaler(feature_range=(0, 1))
    data = scaler.fit_transform(data).flatten()
    n = len(data)
    # Point for splitting data into train and test
    split = int(n*split_percent)
    train_data = data[range(split)]
    test_data = data[split:]
    return train_data, test_data, data

sunspots_url = 'https://raw.githubusercontent.com/jbrownlee/Datasets/master/monthly-
sunspots.csv'
train_data, test_data, data = get_train_test(sunspots_url)
```

```
# Prepare the input X and target Y
def get_XY(dat, time_steps):
    # Indices of target array
    Y_ind = np.arange(time_steps, len(dat), time_steps)
    Y = dat[Y_ind]
    # Prepare X
    rows_x = len(Y)
    X = dat[range(time_steps*rows_x)]
    X = np.reshape(X, (rows_x, time_steps, 1))
    return X, Y

time_steps = 12
trainX, trainY = get_XY(train_data, time_steps)
testX, testY = get_XY(test_data, time_steps)

model = create_RNN(hidden_units=3, dense_units=1, input_shape=(time_steps,1),
                   activation=['tanh', 'tanh'])
model.fit(trainX, trainY, epochs=20, batch_size=1, verbose=2)
def print_error(trainY, testY, train_predict, test_predict):
    # Error of predictions
    train_rmse = math.sqrt(mean_squared_error(trainY, train_predict))
    test_rmse = math.sqrt(mean_squared_error(testY, test_predict))
    # Print RMSE
    print('Train RMSE: %.3f RMSE' % (train_rmse))
    print('Test RMSE: %.3f RMSE' % (test_rmse))

# make predictions
train_predict = model.predict(trainX)
```

```
test_predict = model.predict(testX)
# Mean square error
print_error(trainY, testY, train_predict, test_predict)
# Plot the result
def plot_result(trainY, testY, train_predict, test_predict):
    actual = np.append(trainY, testY)
    predictions = np.append(train_predict, test_predict)
    rows = len(actual)
    plt.figure(figsize=(15, 6), dpi=80)
    plt.plot(range(rows), actual)
    plt.plot(range(rows), predictions)
    plt.axvline(x=len(trainY), color='r')
    plt.legend(['Actual', 'Predictions'])
    plt.xlabel('Observation number after given time steps')
    plt.ylabel('Sunspots scaled')
    plt.title('Actual and Predicted Values. The Red Line Separates The Training And Test
Examples')
plot_result(trainY, testY, train_predict, test_predict)
```

Output:



```
187/187 - 1s - 4ms/step - loss: 0.0050
Epoch 11/20
187/187 - 1s - 4ms/step - loss: 0.0048
Epoch 12/20
187/187 - 1s - 4ms/step - loss: 0.0047
Epoch 13/20
187/187 - 1s - 4ms/step - loss: 0.0048
Epoch 14/20
187/187 - 1s - 4ms/step - loss: 0.0046
Epoch 15/20
187/187 - 1s - 4ms/step - loss: 0.0047
Epoch 16/20
187/187 - 1s - 4ms/step - loss: 0.0047
Epoch 17/20
187/187 - 1s - 4ms/step - loss: 0.0045
Epoch 18/20
187/187 - 1s - 4ms/step - loss: 0.0046
Epoch 19/20
187/187 - 1s - 4ms/step - loss: 0.0046
Epoch 20/20
187/187 - 1s - 4ms/step - loss: 0.0045
6/6 ━━━━━━━━━━━━━━━━━━━━ 1s 56ms/step
2/2 ━━━━━━━━━━━━━━━━━━━━ 0s 0s/step
Train RMSE: 0.070 RMSE
Test RMSE: 0.089 RMSE
```

RESULT:

A simple RNN has been successfully created using timeseries data.