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Aim: Write a program to implement rnn on sunspot dataset. Compare it with LSTM. Find out the training and testing accuracy on number of timestamp as 5,8,12,15.

```
import numpy as np
import pandas as pd
from keras.models import Sequential
from keras.layers import Dense, SimpleRNN, LSTM
from sklearn.metrics import mean_squared_error
from sklearn.preprocessing import MinMaxScaler

data = pd.read_csv('/content/Sunspots.csv', usecols=[2])
date_range = pd.date_range(start='1749-01-31', periods=len(data), freq='M')
data.index = date_range

data = data.values

scaler = MinMaxScaler(feature_range=(0, 1))
data = scaler.fit_transform(data)

train_size = int(len(data) * 0.67)
test_size = len(data) - train_size
train, test = data[0:train_size,:], data[train_size:len(data),:]

def create_dataset(dataset, look_back=1):
    dataX, dataY = [], []
    for i in range(len(dataset)-look_back):
        dataX.append(dataset[i:(i+look_back), 0])
        dataY.append(dataset[i + look_back, 0])
    return np.array(dataX), np.array(dataY)

look_backs = [5, 8, 12, 15]

for look_back in look_backs:
    X_train, y_train = create_dataset(train, look_back)
    X_test, y_test = create_dataset(test, look_back)

    X_train = np.reshape(X_train, (X_train.shape[0], X_train.shape[1], 1))
    X_test = np.reshape(X_test, (X_test.shape[0], X_test.shape[1], 1))

    rnn_model = Sequential()
    rnn_model.add(SimpleRNN(units=32, input_shape=(look_back, 1)))
    rnn_model.add(Dense(units=1))
    rnn_model.compile(optimizer='adam', loss='mean_squared_error')

    lstm_model = Sequential()
    lstm_model.add(LSTM(units=32, input_shape=(look_back, 1)))
    lstm_model.add(Dense(units=1))
    lstm_model.compile(optimizer='adam', loss='mean_squared_error')

    rnn_model.fit(X_train, y_train, epochs=30, batch_size=32)
    lstm_model.fit(X_train, y_train, epochs=30, batch_size=32)

    rnn_train_score = rnn_model.evaluate(X_train, y_train, verbose=0)
    rnn_test_score = rnn_model.evaluate(X_test, y_test, verbose=0)
    lstm_train_score = lstm_model.evaluate(X_train, y_train, verbose=0)
    lstm_test_score = lstm_model.evaluate(X_test, y_test, verbose=0)

    print('For look_back =', look_back)
    print('RNN Train Score:', rnn_train_score)
    print('RNN Test Score:', rnn_test_score)
    print('LSTM Train Score:', lstm_train_score)
    print('LSTM Test Score:', lstm_test_score)
```

```
Epoch 1/30
69/69 [==============================] - 2s 3ms/step - loss: 0.0095
Epoch 2/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0054
Epoch 3/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0047
Epoch 4/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0044
```

```
Epoch 5/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0042
Epoch 6/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0043
Epoch 7/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0042
Epoch 8/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0041
Epoch 9/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0042
Epoch 10/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0041
Epoch 11/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0041
Epoch 12/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0042
Epoch 13/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0043
Epoch 14/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0042
Epoch 15/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0041
Epoch 16/30
69/69 [==============================] - 0s 4ms/step - loss: 0.0042
Epoch 17/30
69/69 [==============================] - 0s 4ms/step - loss: 0.0041
Epoch 18/30
69/69 [==============================] - 0s 4ms/step - loss: 0.0041
Epoch 19/30
69/69 [==============================] - 0s 4ms/step - loss: 0.0041
Epoch 20/30
69/69 [==============================] - 0s 4ms/step - loss: 0.0042
Epoch 21/30
69/69 [==============================] - 0s 4ms/step - loss: 0.0041
Epoch 22/30
69/69 [==============================] - 0s 4ms/step - loss: 0.0042
Epoch 23/30
69/69 [==============================] - 0s 4ms/step - loss: 0.0041
Epoch 24/30
69/69 [==============================] - 0s 4ms/step - loss: 0.0041
Epoch 25/30
69/69 [==============================] - 0s 4ms/step - loss: 0.0042
Epoch 26/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0041
Epoch 27/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0041
Epoch 28/30
69/69 [==============================] - 0s 3ms/step - loss: 0.0042
Epoch 29/30
```

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