```
#Phạm Minh Tuấn
from pandas import read_csv, DataFrame
from sklearn.preprocessing import MinMaxScaler
from sklearn.model_selection import train_test_split
from sklearn.metrics import r2_score, mean_absolute_error, mean_squared_error
from sklearn.linear_model import LinearRegression
from tensorflow.keras import Sequential
from tensorflow.keras.layers import Dense, LSTM, Dropout
from tensorflow.keras.callbacks import History
from tensorflow.keras.optimizers import Adam, SGD
from matplotlib import pyplot
from numpy import array
from google.colab.drive import mount
from numpy import concatenate


mount('/content/drive', force_remount=True)
```

```
Mounted at /content/drive
```

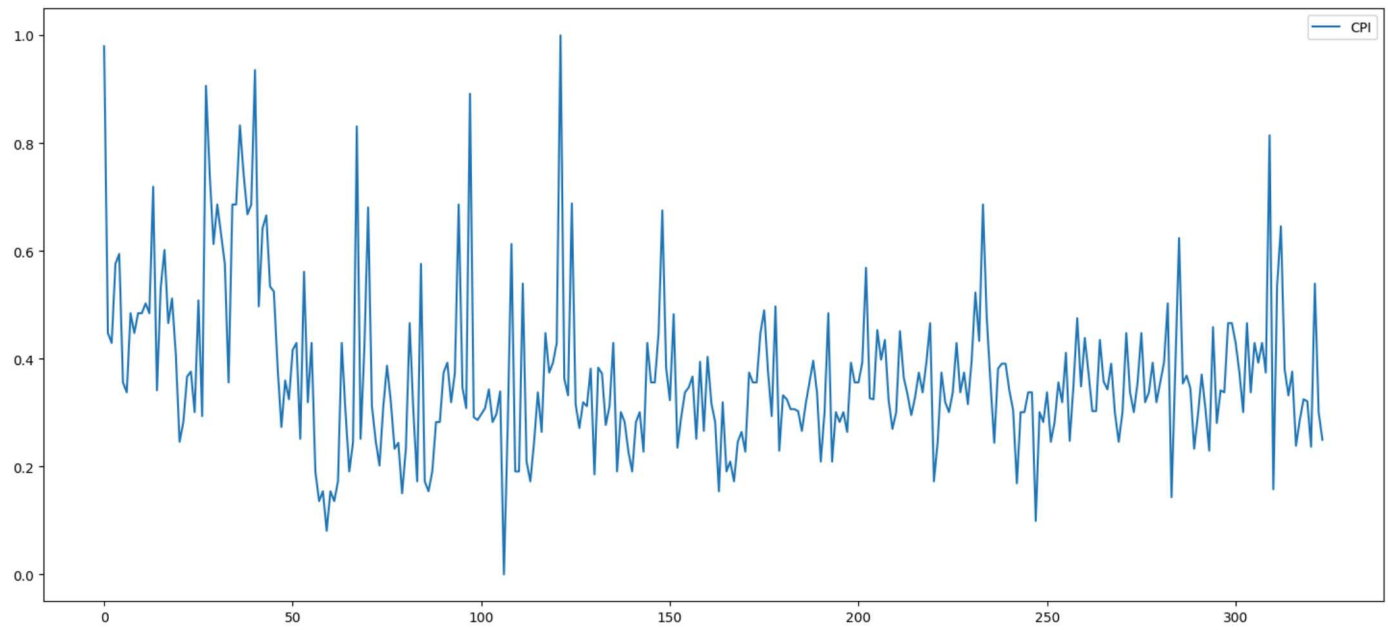
+ Mã + Văn bản

```
df = read_csv('/content/cpi.csv', usecols=['Date','CPI'])
df.head()
```

	Date	CPI
0	1995-1	103.8
1	1996-1	100.9
2	1997-1	100.8
3	1998-1	101.6
4	1999-1	101.7

```
min = df['CPI'].min()
max = df['CPI'].max()
df['CPI'] = (df['CPI'] - min) / (max - min)


df.plot(figsize = (18, 8))
pyplot.show()
```



```
def split_sequence(arr, n_steps):
    X = []
    for i in range(len(arr) - n_steps):
        X.append(arr[i:i + n_steps])
    return array(X), array(arr[n_steps:])


n_steps = 6
X, y = split_sequence(df['CPI'].values, n_steps)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.25, shuffle=False)


# scaler = MinMaxScaler()
# X_train = scaler.fit_transform(X_train)
# X_test = scaler.transform(X_test)
X_train = X_train.reshape(X_train.shape[0], 1, X_train.shape[1])
X_test = X_test.reshape(X_test.shape[0], 1, X_test.shape[1])
model = Sequential()
model.add(LSTM(32, input_shape=(X_train.shape[1], X_train.shape[2]), return_sequences=True))
model.add(Dense(1))
model.compile(optimizer = Adam(learning_rate = 0.001),loss = 'mse', metrics=['mse'])
#model.compile(optimizer = 'adam',loss = 'mse', metrics=['mse'])
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 lstm (LSTM)                 (None, 1, 32)             4992

 dense (Dense)               (None, 1, 1)              33

=================================================================
Total params: 5025 (19.63 KB)
Trainable params: 5025 (19.63 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

```
result = model.fit(X_train, y_train, epochs = 1000, batch_size=1, validation_data=(X_test, y_test))
```

```
238/238 [==============================] - 1s 2ms/step - loss: 0.0133 - mse: 0.0133 - val_loss: 0.0114 - val_mse: 0.0114
Epoch 913/1000
238/238 [==============================] - 1s 2ms/step - loss: 0.0133 - mse: 0.0133 - val_loss: 0.0113 - val_mse: 0.0113
Epoch 914/1000
238/238 [==============================] - 0s 2ms/step - loss: 0.0134 - mse: 0.0134 - val_loss: 0.0118 - val_mse: 0.0118
Epoch 915/1000
238/238 [==============================] - 0s 2ms/step - loss: 0.0134 - mse: 0.0134 - val_loss: 0.0113 - val_mse: 0.0113
Epoch 916/1000
238/238 [==============================] - 0s 2ms/step - loss: 0.0131 - mse: 0.0131 - val_loss: 0.0116 - val_mse: 0.0116
Epoch 917/1000
238/238 [==============================] - 1s 2ms/step - loss: 0.0131 - mse: 0.0131 - val_loss: 0.0114 - val_mse: 0.0114
Epoch 918/1000
238/238 [==============================] - 0s 2ms/step - loss: 0.0132 - mse: 0.0132 - val_loss: 0.0114 - val_mse: 0.0114
Epoch 919/1000
238/238 [==============================] - 0s 2ms/step - loss: 0.0128 - mse: 0.0128 - val_loss: 0.0115 - val_mse: 0.0115
Epoch 920/1000
```

```
y_pred = model.predict(X_test)
```

```
3/3 [==============================] - 0s 3ms/step
```

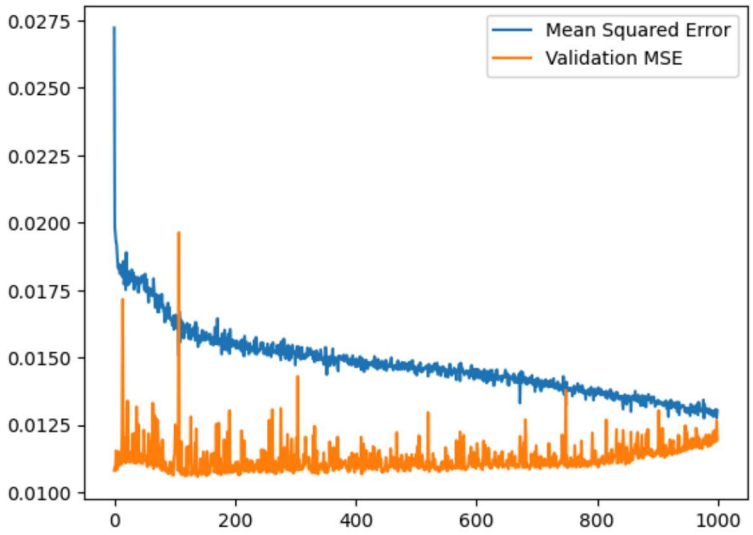
```
y_pred = y_pred.flatten()
mean_squared_error(y_test, y_pred)
```

```
0.01193376376004011
```

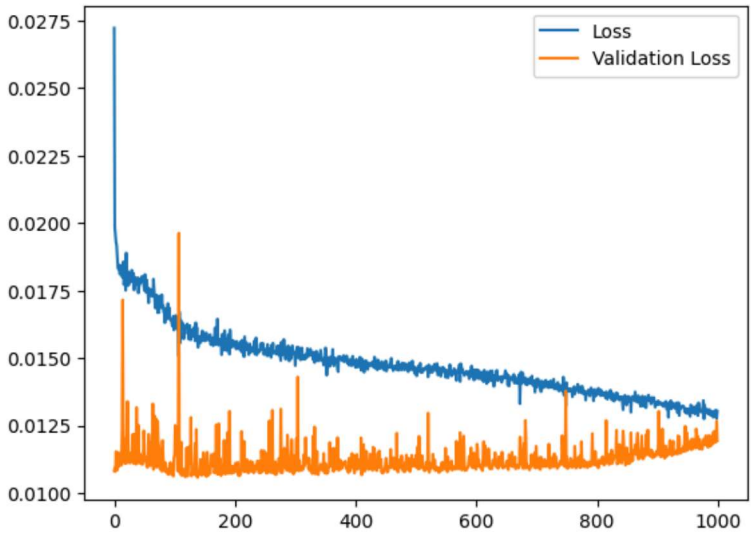
```
r2_score(y_test, y_pred)
```

```
-0.06869982673656527
```

```
#result.history.keys()
import numpy as np
pyplot.plot(result.history['mse'], label='Mean Squared Error')
pyplot.plot(result.history['val_mse'], label='Validation MSE')
pyplot.legend()
pyplot.show()
```




```
pyplot.plot(result.history['loss'], label='Loss')
pyplot.plot(result.history['val_loss'], label='Validation Loss')
pyplot.legend()
pyplot.show()
```




```
y_train_pred = model.predict(X_train)
y_test_pred = model.predict(X_test)
#y_train_pred.flatten()
pred = concatenate((y_train_pred.flatten(), y_test_pred.flatten())) * (max - min) + min
dic = {'Date': df.index[n_steps:], 'Actual': y * (min - max) + min, 'Pred': pred}
df_result = DataFrame(data = dic)
df_result.tail(10)
```

```
8/8 [==============================] - 0s 2ms/step
3/3 [==============================] - 0s 3ms/step
```

	Date	Actual	Pred
308	314	96.65	99.987305
309	315	96.41	100.287064
310	316	97.16	99.653389
311	317	96.90	100.369576
312	318	96.69	100.169907
313	319	96.71	100.188301
314	320	97.17	100.184532
315	321	95.52	100.272667
316	322	96.82	100.171860
317	323	97.10	100.423286

```
pyplot.plot(y_pred, label='Predict')
pyplot.plot(y_test, label='Actual')
pyplot.legend()
pyplot.show()
```


```
class WindowGenerator:
  def __init__(self, input_width, label_width, shift,
               train_df, val_df, test_df, label_columns=None):

    # Store the raw data.
    self.train_df = train_df
    self.val_df = val_df
    self.test_df = test_df

    # Work out the label column indices.
    self.label_columns = label_columns
    if label_columns is not None:
      self.label_columns_indices = {name: i for i, name in
                                    enumerate(label_columns)}
    self.column_indices = {name: i for i, name in
                           enumerate(train_df.columns)}

    # Work out the window parameters.
    self.input_width = input_width
    self.label_width = label_width
    self.shift = shift

    self.total_window_size = input_width + shift

    self.input_slice = slice(0, input_width)
    self.input_indices = np.arange(self.total_window_size)[self.input_slice]

    self.label_start = self.total_window_size - self.label_width
    self.labels_slice = slice(self.label_start, None)
    self.label_indices = np.arange(self.total_window_size)[self.labels_slice]

  def __repr__(self):
    return '\n'.join([
        f'Total window size: {self.total_window_size}',
        f'Input indices: {self.input_indices}',
        f'Label indices: {self.label_indices}',
        f'Label column name(s): {self.label_columns}'])
```