```
import warnings
import re
import pickle
import pandas as pd
import numpy as np
import matplotlib.pyplot as  plt
%matplotlib inline
import seaborn as sns


import tensorflow as tf
from tensorflow import keras
from keras.layers import Dense, Flatten, BatchNormalization, Dropout, Bidirectional, LSTM, GRU, Embedding
from keras.models import Model, Sequential
from keras.callbacks import EarlyStopping
from keras.utils import plot_model
from keras.preprocessing.text import Tokenizer
from keras.preprocessing.sequence import pad_sequences


from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import TfidfVectorizer, CountVectorizer


import nltk


nltk.download('all')
```

```
[nltk_data]    | Downloading package ycoe to /root/nltk_data...
[nltk_data]    |   Unzipping corpora/ycoe.zip.
[nltk_data]    |
[nltk_data]  Done downloading collection all
True
```

```
df = pd.read_csv("/content/eng_fr.csv")
```

```
df.head()
```

	English words/sentences	French words/sentences
0	Hi.	Salut!
1	Run!	Cours !
2	Run!	Courez !
3	Who?	Qui ?
4	Wow!	Ça alors !

```
df.rename(columns = {'English words/sentences':'English', 'French words/sentences':'French'}, inplace=True)
```

```
df.head()
```

	English	French
0	Hi.	Salut!
1	Run!	Cours !
2	Run!	Courez !
3	Who?	Qui ?
4	Wow!	Ça alors !

```
df.shape
```

```
(175621, 2)
```

```
df.isna().sum()
```

```
English    0
French     0
dtype: int64
```

```
df.duplicated().sum()
```

```
0
```

```
df2 = df.sample(frac = 1)
```

```
df.shape
```

```
(175621, 2)
```

```
df.head()
```

	English	French
0	Hi.	Salut!
1	Run!	Cours !
2	Run!	Courez !
3	Who?	Qui ?
4	Wow!	Ça alors !

```
df2.shape
```

```
(175621, 2)
```

```
df2.head()
```

	English	French
109390	I never stop thinking about you.	Je ne cesse de penser à toi.
9972	Are you winning?	Tu gagnes ?
33529	Dating is exhausting.	Sortir avec des garçons est épuisant.
117653	We must take care of the elderly.	On doit prendre soin des personnes âgées.
58185	What happens after that?	Que s'est-il passé après cela ?

```
df2.reset_index(inplace = True, drop = True)
```

```
df2.head()
```

	English	French
0	I never stop thinking about you.	Je ne cesse de penser à toi.
1	Are you winning?	Tu gagnes ?
2	Dating is exhausting.	Sortir avec des garçons est épuisant.
3	We must take care of the elderly.	On doit prendre soin des personnes âgées.
4	What happens after that?	Que s'est-il passé après cela ?

```
english = df2['English'][:50000]
french = df2['French'][:50000]
```

```
english.shape
```

```
(50000,)
```

```
def cleaning_process(text):
  text = text.lower()
  text = re.sub(re.compile("[^a-z!?',]"), '', text)
  text = nltk.word_tokenize(text)
  text = " ".join([i.strip() for i in text])
  return text
```

```
english_cleaned = english.apply(lambda x: cleaning_process(x))
french_cleaned = french.apply(lambda x: cleaning_process(x))
```

```
store_eng = set()
store_french = set()

for x in english:
  for word in x.split(' '):
    if word not in store_eng:
      store_eng.add(word)


for x in french:
  for word in x.split(' '):
    if word not in store_french:
      store_french.add(word)
```

```
len(store_eng)
```

```
16528
```

```
len(store_french)
```

```
26559
```

```
english_sent = english.apply(lambda x: len(x.split()))
french_sent = french.apply(lambda x: len(x.split()))


max_english_sent = max(english_sent)
max_french_sent = max(french_sent)


print("english: ", max_english_sent)
print("french: ", max_french_sent)
```

```
english:  44
french:  55
```

```
english_vocab = 16370
french_vocab = 26310
english_sentence_max = 50
french_sentence_max = 50


make_tokens = Tokenizer()
make_tokens.fit_on_texts(english)
encoded_english = make_tokens.texts_to_sequences(english)
padded_english = pad_sequences(encoded_english, maxlen=english_sentence_max, padding='post')


padded_english
```

```
array([[   1,   95,  198, ...,    0,    0,    0],
       [  20,    2, 1780, ...,    0,    0,    0],
       [1689,    6, 4391, ...,    0,    0,    0],
       ...,
       [  73,   75,    2, ...,    0,    0,    0],
       [   1,   55,  848, ...,    0,    0,    0],
       [  22,    5,  299, ...,    0,    0,    0]], dtype=int32)
```

```
padded_english.shape
```

```
(50000, 50)
```

```
make_tokens.fit_on_texts(french)
encoded_french = make_tokens.texts_to_sequences(french)
padded_french = pad_sequences(encoded_french, maxlen=french_sentence_max, padding='post')


padded_french
```

```
array([[    3,    13,  2528, ...,     0,     0,     0],
       [   16, 18085,     0, ...,     0,     0,     0],
       [  643,    79,    63, ...,     0,     0,     0],
       ...,
       [    3,    72,  4325, ...,     0,     0,     0],
       [    3, 26025,    12, ...,     0,     0,     0],
       [  267,   397,   878, ...,     0,     0,     0]], dtype=int32)
```

```
padded_french.shape
```

```
(50000, 50)
```

```
X_train, X_test, y_train, y_test = train_test_split(padded_english, padded_french, test_size = 0.2, shuffle = True, random_state = 100)


X_train.shape
```

```
(40000, 50)
```

```
y_train.shape
```

```
(40000, 50)
```

```
X_train
```

```
array([[  35,  131, 7399, ...,    0,    0,    0],
       [  72,  141,    8, ...,    0,    0,    0],
       [  23,  220,    1, ...,    0,    0,    0],
       ...,
       [  13,    6,    4, ...,    0,    0,    0],
```

```
            [  26,  190,    4, ...,    0,    0,    0],
            [  86,    2,   74, ...,    0,    0,    0]], dtype=int32)
```

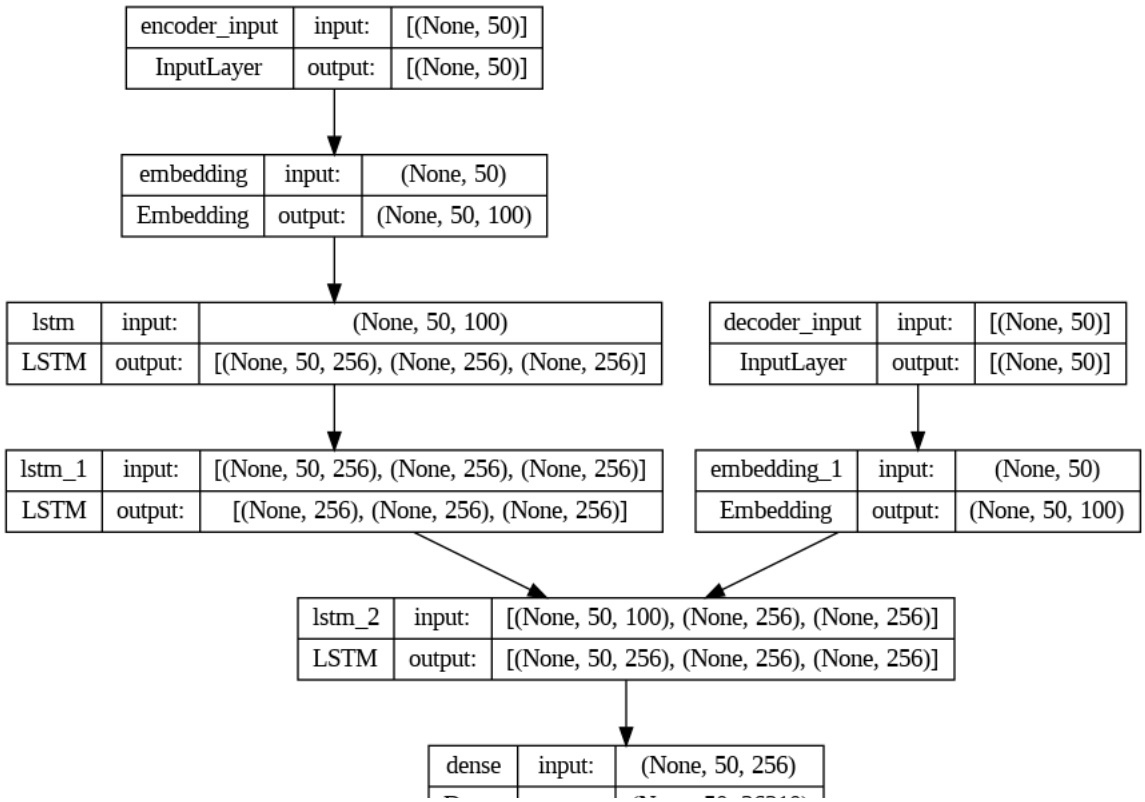
```
y_train
```

```
     array([[  242,     6,   748, ...,     0,     0,     0],
            [  839,    17,   803, ...,     0,     0,     0],
            [    3,    43, 22959, ...,     0,     0,     0],
            ...,
            [   54,    15,  1037, ...,     0,     0,     0],
            [   54,    24,    62, ...,     0,     0,     0],
            [  914,    10,    18, ...,     0,     0,     0]], dtype=int32)
```

```
max_len = 50

#encoder layer
encoder_input = keras.Input(shape=(max_len,), name = "encoder_input")
embedd = Embedding(input_dim=english_vocab, output_dim=100, input_length= english_sentence_max)(encoder_input)
encoder_lstm = LSTM(256,activation="tanh",return_sequences=True,return_state=True)(embedd)
encoder_lstm2 = LSTM(256,activation="tanh",return_state=True)(encoder_lstm)
_, state_h , state_c = encoder_lstm2
encoder_states = [state_h , state_c]


#decoder layer
decoder_input = keras.Input(shape=(max_len,), name="decoder_input")
decoder_embed = Embedding(input_dim=french_vocab, output_dim = 100, input_length = french_sentence_max)(decoder_input)
decoder_lstm = LSTM(256, activation="tanh", return_sequences=True, return_state=True)
decoder_outputs , _ , _ = decoder_lstm(decoder_embed, initial_state = encoder_states)
decoder_dense = Dense(french_vocab, activation='softmax')
outputs = decoder_dense(decoder_outputs)


model = Model([encoder_input, decoder_input], outputs)


model.summary()
```

```
     Model: "model"
     __________________________________________________________________________________________________
      Layer (type)                Output Shape                 Param #   Connected to
     ==================================================================================================
      encoder_input (InputLayer)  [(None, 50)]                 0         []

      embedding (Embedding)       (None, 50, 100)              1637000   ['encoder_input[0][0]']

      decoder_input (InputLayer)  [(None, 50)]                 0         []

      lstm (LSTM)                 [(None, 50, 256),            365568    ['embedding[0][0]']
                                   (None, 256),
                                   (None, 256)]

      embedding_1 (Embedding)     (None, 50, 100)              2631000   ['decoder_input[0][0]']

      lstm_1 (LSTM)               [(None, 256),                525312    ['lstm[0][0]',
                                   (None, 256),                           'lstm[0][1]',
                                   (None, 256)]                           'lstm[0][2]']

      lstm_2 (LSTM)               [(None, 50, 256),            365568    ['embedding_1[0][0]',
                                   (None, 256),                           'lstm_1[0][1]',
                                   (None, 256)]                           'lstm_1[0][2]']

      dense (Dense)               (None, 50, 26310)            6761670   ['lstm_2[0][0]']

     ==================================================================================================
     Total params: 12286118 (46.87 MB)
     Trainable params: 12286118 (46.87 MB)
     Non-trainable params: 0 (0.00 Byte)
     __________________________________________________________________________________________________
```

```
call = EarlyStopping(patience=10)


compiled = model.compile(optimizer='rmsprop', loss='sparse_categorical_crossentropy', metrics=['accuracy'])


plot_model(model, to_file='modelsummary.png', show_shapes=True, show_layer_names=True)
```




```
history = model.fit([X_train, X_train], y_train , validation_data=([X_test, X_test], y_test) ,epochs = 100, callbacks = call, verbose = True)
```

```
Epoch 1/100
1250/1250 [==============================] - 119s 87ms/step - loss: 1.0356 - accuracy: 0.8702 - val_loss: 0.9225 - val_accuracy: 0.87
Epoch 2/100
1250/1250 [==============================] - 102s 81ms/step - loss: 0.9094 - accuracy: 0.8736 - val_loss: 0.8944 - val_accuracy: 0.87
Epoch 3/100
1250/1250 [==============================] - 102s 81ms/step - loss: 0.8806 - accuracy: 0.8761 - val_loss: 0.8709 - val_accuracy: 0.87
Epoch 4/100
1250/1250 [==============================] - 100s 80ms/step - loss: 0.8575 - accuracy: 0.8795 - val_loss: 0.8528 - val_accuracy: 0.88
Epoch 5/100
1250/1250 [==============================] - 100s 80ms/step - loss: 0.8382 - accuracy: 0.8823 - val_loss: 0.8409 - val_accuracy: 0.88
Epoch 6/100
1250/1250 [==============================] - 93s 74ms/step - loss: 0.8221 - accuracy: 0.8839 - val_loss: 0.8310 - val_accuracy: 0.883
Epoch 7/100
1250/1250 [==============================] - 100s 80ms/step - loss: 0.8076 - accuracy: 0.8855 - val_loss: 0.8286 - val_accuracy: 0.88
Epoch 8/100
1250/1250 [==============================] - 100s 80ms/step - loss: 0.7983 - accuracy: 0.8861 - val_loss: 0.7989 - val_accuracy: 0.88
Epoch 9/100
1250/1250 [==============================] - 100s 80ms/step - loss: 0.7803 - accuracy: 0.8879 - val_loss: 0.7852 - val_accuracy: 0.88
Epoch 10/100
1250/1250 [==============================] - 101s 80ms/step - loss: 0.7657 - accuracy: 0.8895 - val_loss: 0.7722 - val_accuracy: 0.89
Epoch 11/100
1250/1250 [==============================] - 100s 80ms/step - loss: 0.7523 - accuracy: 0.8908 - val_loss: 0.7624 - val_accuracy: 0.89
Epoch 12/100
1250/1250 [==============================] - 100s 80ms/step - loss: 0.7392 - accuracy: 0.8920 - val_loss: 0.7533 - val_accuracy: 0.89
Epoch 13/100
1250/1250 [==============================] - 93s 74ms/step - loss: 0.7269 - accuracy: 0.8931 - val_loss: 0.7417 - val_accuracy: 0.893
Epoch 14/100
1250/1250 [==============================] - 93s 74ms/step - loss: 0.7152 - accuracy: 0.8941 - val_loss: 0.7356 - val_accuracy: 0.893
Epoch 15/100
1250/1250 [==============================] - 101s 81ms/step - loss: 0.7035 - accuracy: 0.8952 - val_loss: 0.7273 - val_accuracy: 0.89
Epoch 16/100
1250/1250 [==============================] - 93s 75ms/step - loss: 0.6921 - accuracy: 0.8961 - val_loss: 0.7145 - val_accuracy: 0.895
Epoch 17/100
1250/1250 [==============================] - 100s 80ms/step - loss: 0.6810 - accuracy: 0.8971 - val_loss: 0.7064 - val_accuracy: 0.89
Epoch 18/100
1250/1250 [==============================] - 101s 81ms/step - loss: 0.6701 - accuracy: 0.8982 - val_loss: 0.6993 - val_accuracy: 0.89
Epoch 19/100
1250/1250 [==============================] - 100s 80ms/step - loss: 0.6594 - accuracy: 0.8990 - val_loss: 0.6894 - val_accuracy: 0.89
Epoch 20/100
1250/1250 [==============================] - 99s 79ms/step - loss: 0.6489 - accuracy: 0.9000 - val_loss: 0.6833 - val_accuracy: 0.899
Epoch 21/100
1250/1250 [==============================] - 92s 74ms/step - loss: 0.6386 - accuracy: 0.9007 - val_loss: 0.6806 - val_accuracy: 0.898
Epoch 22/100
1250/1250 [==============================] - 92s 74ms/step - loss: 0.6286 - accuracy: 0.9014 - val_loss: 0.6695 - val_accuracy: 0.900
Epoch 23/100
1250/1250 [==============================] - 92s 74ms/step - loss: 0.6189 - accuracy: 0.9021 - val_loss: 0.6648 - val_accuracy: 0.900
Epoch 24/100
```

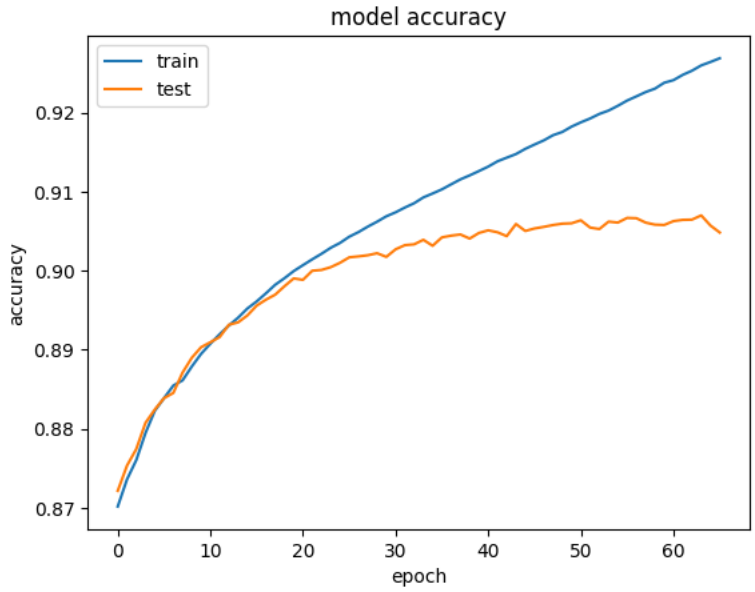
```
1250/1250 [==============================] - 99s 79ms/step - loss: 0.6095 - accuracy: 0.9029 - val_loss: 0.6587 - val_accuracy: 0.906
Epoch 25/100
1250/1250 [==============================] - 92s 74ms/step - loss: 0.6003 - accuracy: 0.9035 - val_loss: 0.6531 - val_accuracy: 0.901
Epoch 26/100
1250/1250 [==============================] - 99s 79ms/step - loss: 0.5914 - accuracy: 0.9043 - val_loss: 0.6517 - val_accuracy: 0.901
Epoch 27/100
1250/1250 [==============================] - 100s 80ms/step - loss: 0.5827 - accuracy: 0.9049 - val_loss: 0.6439 - val_accuracy: 0.90
Epoch 28/100
1250/1250 [==============================] - 92s 74ms/step - loss: 0.5741 - accuracy: 0.9056 - val_loss: 0.6402 - val_accuracy: 0.902
Epoch 29/100
```

```
model.save('my_model.keras')
```

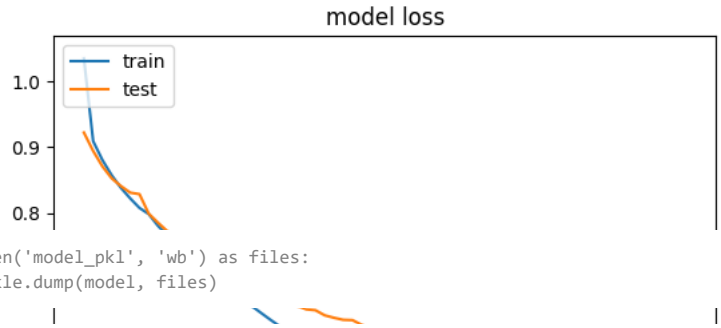
```
history.history.keys()
```

```
dict_keys(['loss', 'accuracy', 'val_loss', 'val_accuracy'])
```

```
# summarize history for accuracy
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.title('model accuracy')
plt.ylabel('accuracy')
plt.xlabel('epoch')
plt.legend(['train', 'test'], loc='upper left')
plt.show()
```




```
# summarize history for loss
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('model loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'test'], loc='upper left')
plt.show()
```




```
with open('model_pkl', 'wb') as files:
    pickle.dump(model, files)
```

```
def preprocess(lines):
  text = cleaning_process(str(lines))
  make_tokens.fit_on_texts(text)
  encoded_text = make_tokens.texts_to_sequences(text)
  padded_text = pad_sequences(encoded_text, maxlen=english_sentence_max, padding='post')
  prediction = model.predict([padded_text, padded_text])
  output_translation = np.argmax(prediction,axis=-1)


  output_sentence = []
  for i in output_translation[0]:
      if i in make_tokens.index_word:
          output_sentence.append(make_tokens.index_word[i])
      else:
          output_sentence.append(' ')
  return ' '.join(output_sentence)

input_sentence = "What happens after that?"
translated = preprocess(input_sentence)
print(f"Input: {input_sentence}")
print(f"Translated: {translated}")
```