Importing Packages

```
import numpy as np
import pandas as pd
import string
import collections
import tensorflow as tf
from keras.preprocessing.text import Tokenizer
from keras.preprocessing.sequence import pad_sequences
from keras.layers import Embedding
from keras.layers import LSTM
from keras.layers import GRU, Input, Dense, TimeDistributed
from keras.models import Model, Sequential
from keras.layers import Activation
from keras.optimizers import Adam
from keras.losses import sparse_categorical_crossentropy
import matplotlib.pyplot as plt
```

Loading the Data - English and Tamil

```
with open('Data/English.txt','r',encoding="utf8") as file:
    english_data = file.readlines()
    file.close()

english_data = english_data[-1000:]

english_data[0] = english_data[0].strip('\ufeff')

with open('Data/Tamil.txt','r',encoding="utf8") as file:
    tamil_data = file.readlines()
    file.close()

tamil_data[0] = tamil_data[0].strip('\ufeff')

tamil_data = tamil_data[-1000:]
```

Text Pre-Processing

```
exclude = set(string.punctuation)
for i in range(0,len(english_data)):
    english_data[i] = english_data[i].strip('\n')
    english_data[i] = ''.join(ch for ch in english_data[i] if ch not
in exclude)

exclude = set(string.punctuation)
for i in range(0,len(tamil_data)):
    tamil_data[i] = tamil_data[i].strip('\n')
    tamil_data[i] = ''.join(ch for ch in tamil_data[i] if ch not in
exclude)

len(english_data),len(tamil_data)
```

```
(1000, 1000)
```

```
print(f"English Text: {english_data[9]}\nTamil Text: {tamil_data[9]}")
```

```
English Text: Brown has insisted that this time round such a
catastrophic devaluation would not occur due to careful economic
management on his part and the greater flexibility of British workers
his government had achieved  a reference to diminution of workers
rights and lower wage rates in comparison with many western European
countries
Tamil Text: தனது பங்கைப் பொறுத்தவரையில் பொருளாதார நிர்வாகம்
அக்கறையுடன் கவனிக்கப்படுகிறது என்பதாலும் பிரிட்டிஷ்
தொழிலாளர்களின் நெகிழ்வு தன்மையை அவர்களுடைய அரசாங்கம்
சாதித்திருப்பதாலும் இந்தத் தடவை அவ்வாறு பேரழிவு நிலைக்கு பவுண்ட்
மதிப்புக் குறைவு தோன்றாது என்று பிரௌன் வலியுறுத்தி இருக்கிறார்
```

```
english_words_list = []
for i in range(len(english_data)):
    english_words_list.append(english_data[i].split())

english_words_list = [j for sub in english_words_list for j in sub]

tamil_words_list = []
for i in range(0,len(tamil_data)):
    tamil_words_list.append(tamil_data[i].split())

tamil_words_list = [j for sub in tamil_words_list for j in sub]

print(f"Number of Unique Tamil Words: {len(set(tamil_words_list))}\
nNumber of Unique English Words: {len(set(english_words_list))}")
```

```
Number of Unique Tamil Words: 9413
Number of Unique English Words: 5858
```

```
tamilvocab = len(set(tamil_words_list))
engvocab = len(set(english_words_list))

english_words_counter = collections.Counter([word for sentence in
english_data for word in sentence.split()])
tamil_words_counter = collections.Counter([word for sentence in
tamil_data for word in sentence.split()])
```

Most Common Words

```
english_words_counter.most_common(10)
```

```
[('the', 1765),
 ('of', 879),
 ('and', 747),
 ('to', 654),
 ('in', 529),
```

```
 ('a', 395),
 ('that', 284),
 ('is', 274),
 ('for', 201),
 ('The', 182)]
```

```
tamil_words_counter.most_common(10)
```

```
[('ஒரு', 165),
 ('மற்றும்', 143),
 ('என்று', 126),
 ('இந்த', 79),
 ('என்ற', 70),
 ('அவர்', 68),
 ('அவர்கள்', 53),
 ('அது', 52),
 ('என', 49),
 ('அரசியல்', 47)]
```

Tokenizer and Padding

```
def tokenize(x):
    tokenizer = Tokenizer()
    tokenizer.fit_on_texts(x)
    return tokenizer.texts_to_sequences(x), tokenizer

##Sample
print(tokenize(tamil_data[99])[0])
```

```
[[9], [10], [1], [11], [7], [15], [9], [], [4], [14], [1], [14], [8],
[13], [1], [13], [3], [9], [1], [], [9], [13], [12], [], [7], [22],
[10], [8], [11], [8], [7], [1], [7], [3], [5], [1], [5], [7], [6],
[11], [7], [3], [], [11], [6], [10], [2], [1], [2], [23], [2], [1],
[2], [6], [2], [], [2], [16], [3], [4], [12], [17], [6], [14], [],
[4], [15], [6], [7], [19], [1], [2], [5], [3], [2], [1], [2], [8],
[16], [12], [17], [8], [19], [1], [], [9], [8], [2], [1], [2], [8],
[17], [8], [10], [3], [18], [1], [7], [], [4], [2], [1], [2], [5],
[1], [], [4], [3], [2], [6], [4], [1], [2], [5], [3], [2], [1], [2],
[3], [], [11], [18], [1], [7], [16], [12], [18], [1], [7], [3], [5],
[1], [5], [6], [10], [1], [2], [5], [1], [], [24], [11], [10], [1],
[2], [5], [1], [], [25], [10], [3], [11], [15], [5], [12], [], [4],
[15], [6], [9], [4], [6], [2], [], [2], [6], [17], [4], [16], [12],
[18], [1], [7], [3], [], [13], [15], [6], [9], [6], [2], [1], [2],
[8], [14], [1], [20], [8], [], [13], [19], [11], [26], [14], [4],
[16], [12], [18], [1], [7], [3], [], [4], [20], [1], [20], [3], [4],
[1], [], [4], [14], [], [21], [5], [12], [9], [1], [9], [19], [3],
[2], [1], [2], [3], [], [21], [5], [1], [5], [6], [2], [8], [17], [8],
[10], [3], [13], [1], [13], [10], [1]]
```

```
def pad(x, length=None):
    return pad_sequences(x, maxlen=length, padding='post')

### Wrapping and putting together in a single function
def preprocess(x, y):
    preprocess_x, x_tk = tokenize(x)
    preprocess_y, y_tk = tokenize(y)

    preprocess_x = pad(preprocess_x)
    preprocess_y = pad(preprocess_y)

    print('shape before: ', preprocess_y.shape)
    preprocess_y = preprocess_y.reshape(*preprocess_y.shape, 1)
    print('shape after: ', preprocess_y.shape)

    return preprocess_x, preprocess_y, x_tk, y_tk

preprocess_x, x_tk = tokenize(tamil_data)

preprocess_x = pad(preprocess_x)

preprocess_x.shape
```

```
(1000, 54)
```

```
preproc_tamil_sentences, preproc_english_sentences, tamil_tokenizer,
english_tokenizer = preprocess(tamil_data, english_data)
```

```
shape before:  (1000, 74)
shape after:  (1000, 74, 1)
```

```
list(tamil_tokenizer.word_index.items())[:2]
```

```
[('ஒரு', 1), ('மற்றும்', 2)]
```

```
list(english_tokenizer.word_index.items())[:2]
```

```
[('the', 1), ('of', 2)]
```

Logits To Text

```
def logits_to_text(logits, tokenizer):

    index_to_words = {id: word for word, id in
tokenizer.word_index.items()}
    index_to_words[0] = '<PAD>'

    return ' '.join([index_to_words[prediction] for prediction in
np.argmax(logits, 1)])
```

Data Shapes

```
print("Tamil Sentences Shape: ", preproc_english_sentences.shape)
print("English Sentences  Shape: ", preproc_tamil_sentences.shape)
print('Output Sequence Length: ', preproc_english_sentences.shape[1])
```

```
Tamil Sentences Shape:  (1000, 74, 1)
English Sentences  Shape:  (1000, 54)
Output Sequence Length:  74
```

Model Building

```
def embed_model(input_shape, output_sequence_length, tamil_vocab_size,
english_vocab_size, learning_rate=0.1):
    model = Sequential()
    model.add(Embedding(max(tamil_vocab_size, english_vocab_size) ,128
, input_length=output_sequence_length))
    model.add(LSTM(128, dropout=0.1, return_sequences=True))
    model.add(Dense(english_vocab_size, activation='softmax'))
    model.summary()
    model.compile(loss=sparse_categorical_crossentropy,
                  optimizer=Adam(learning_rate),
                  metrics=['accuracy'])

    return model

tmp_x = pad(preproc_tamil_sentences,
preproc_english_sentences.shape[1])

model = embed_model(
    tmp_x.shape,
    preproc_english_sentences.shape[1],
    len(tamil_tokenizer.word_index)+1,
    len(english_tokenizer.word_index)+1)
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 embedding (Embedding)       (None, 74, 128)           1204736

 lstm (LSTM)                 (None, 74, 128)           131584

 dense (Dense)               (None, 74, 5520)          712080

=================================================================
Total params: 2048400 (7.81 MB)
Trainable params: 2048400 (7.81 MB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

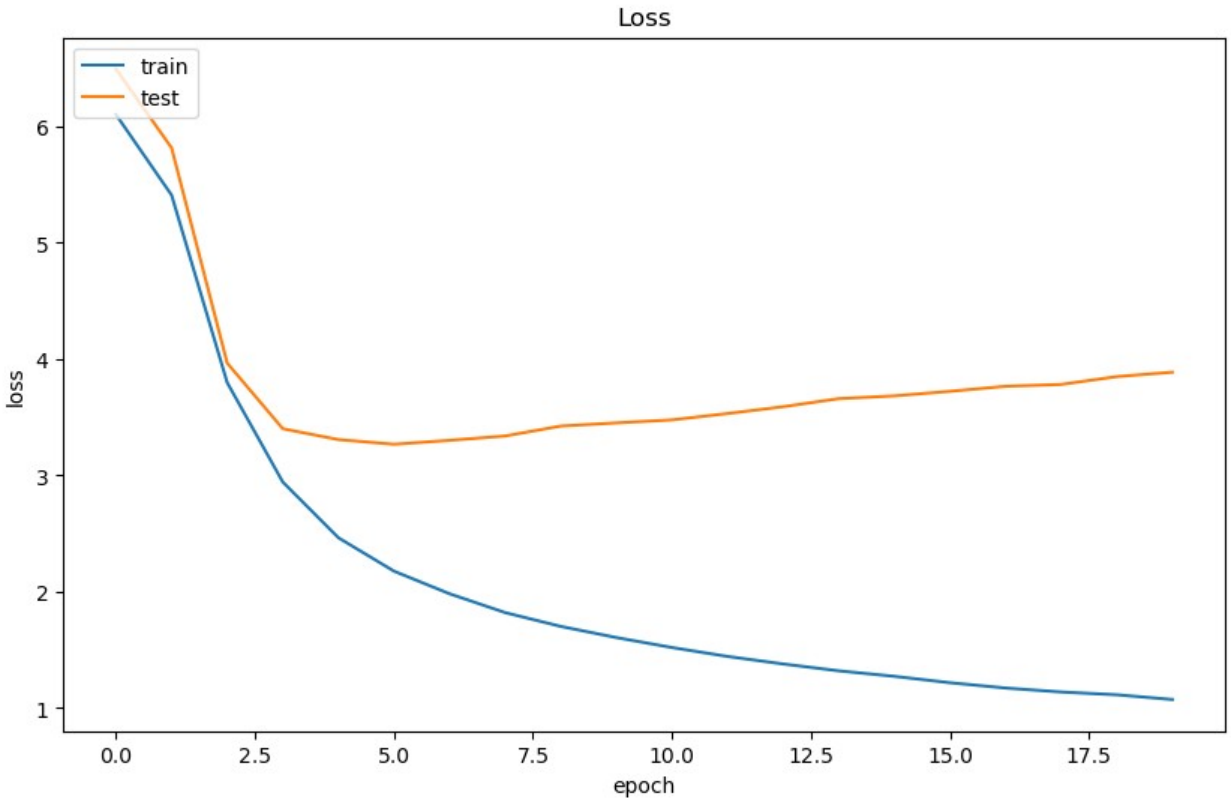
```
history = model.fit(tmp_x, preproc_english_sentences, batch_size=100,
epochs=20, validation_split=0.2)

Epoch 1/20
8/8 [==============================] - 5s 406ms/step - loss: 6.1018 -
accuracy: 0.5132 - val_loss: 6.4929 - val_accuracy: 0.6841
Epoch 2/20
8/8 [==============================] - 3s 364ms/step - loss: 5.4095 -
accuracy: 0.6812 - val_loss: 5.8156 - val_accuracy: 0.6700
Epoch 3/20
8/8 [==============================] - 3s 343ms/step - loss: 3.7978 -
accuracy: 0.6798 - val_loss: 3.9655 - val_accuracy: 0.6867
Epoch 4/20
8/8 [==============================] - 3s 341ms/step - loss: 2.9428 -
accuracy: 0.6866 - val_loss: 3.4010 - val_accuracy: 0.6874
Epoch 5/20
8/8 [==============================] - 3s 336ms/step - loss: 2.4639 -
accuracy: 0.6906 - val_loss: 3.3079 - val_accuracy: 0.6890
Epoch 6/20
8/8 [==============================] - 3s 340ms/step - loss: 2.1766 -
accuracy: 0.6935 - val_loss: 3.2678 - val_accuracy: 0.6885
Epoch 7/20
8/8 [==============================] - 3s 343ms/step - loss: 1.9823 -
accuracy: 0.6997 - val_loss: 3.3014 - val_accuracy: 0.6853
Epoch 8/20
8/8 [==============================] - 3s 340ms/step - loss: 1.8203 -
accuracy: 0.7095 - val_loss: 3.3388 - val_accuracy: 0.6851
Epoch 9/20
8/8 [==============================] - 3s 344ms/step - loss: 1.7017 -
accuracy: 0.7207 - val_loss: 3.4242 - val_accuracy: 0.6854
Epoch 10/20
8/8 [==============================] - 3s 340ms/step - loss: 1.6058 -
accuracy: 0.7275 - val_loss: 3.4514 - val_accuracy: 0.6785
Epoch 11/20
8/8 [==============================] - 3s 346ms/step - loss: 1.5201 -
accuracy: 0.7360 - val_loss: 3.4773 - val_accuracy: 0.6823
Epoch 12/20
8/8 [==============================] - 3s 339ms/step - loss: 1.4435 -
accuracy: 0.7442 - val_loss: 3.5319 - val_accuracy: 0.6821
Epoch 13/20
8/8 [==============================] - 3s 338ms/step - loss: 1.3788 -
accuracy: 0.7520 - val_loss: 3.5906 - val_accuracy: 0.6778
Epoch 14/20
8/8 [==============================] - 3s 343ms/step - loss: 1.3197 -
accuracy: 0.7596 - val_loss: 3.6599 - val_accuracy: 0.6789
Epoch 15/20
8/8 [==============================] - 3s 330ms/step - loss: 1.2725 -
accuracy: 0.7658 - val_loss: 3.6837 - val_accuracy: 0.6774
Epoch 16/20
8/8 [==============================] - 3s 328ms/step - loss: 1.2175 -
```

```
accuracy: 0.7741 - val_loss: 3.7229 - val_accuracy: 0.6767
Epoch 17/20
8/8 [==============================] - 3s 328ms/step - loss: 1.1720 -
accuracy: 0.7797 - val_loss: 3.7661 - val_accuracy: 0.6773
Epoch 18/20
8/8 [==============================] - 3s 325ms/step - loss: 1.1378 -
accuracy: 0.7853 - val_loss: 3.7822 - val_accuracy: 0.6773
Epoch 19/20
8/8 [==============================] - 3s 328ms/step - loss: 1.1139 -
accuracy: 0.7909 - val_loss: 3.8494 - val_accuracy: 0.6806
Epoch 20/20
8/8 [==============================] - 3s 329ms/step - loss: 1.0732 -
accuracy: 0.7953 - val_loss: 3.8875 - val_accuracy: 0.6752
```

Loss Insights

```
plt.figure(figsize=(10,6))
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('Loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'test'], loc='upper left')
plt.show()
```



Eval and Inference

```
acc = model.evaluate(tmp_x, preproc_english_sentences, verbose=0)
print("Train accurancy: ", acc[1])
```

```
Train accurancy:  0.7912973165512085
```

```
### Inference
tamil_data[10]
```

'பள்ளி மாணவர்கள் மற்றும் பல்கலைக்கழக மாணவர்கள் பிரான்ஸ் நெடுகிலும் நெடுஞ்சாலைகள் வீதிகள் ஆகியவற்றை தடுப்புக்களுக்கு உட்படுத்திய வகையில் நேற்று இன்னும் கூடுதலான கைதுகள் நிகழ்த்தப்பட்டன'

```
desc_trans = logits_to_text(model.predict(tmp_x[:100])[10],
english_tokenizer)
```

```
4/4 [==============================] - 0s 36ms/step
```

```
desc_trans[:130]
```

```
'further arrests outlawing reported yesterday in high school in
university students blockaded for at the disrupting traffic across '
```

```
tmp_x[:100][10]
```

```
array([2066,  337,    2,  985,  337,  183, 2067, 2068, 2069,  625,
2070,
       2071,   26,  338,   58,  263, 2072, 2073,    0,    0,    0,
0,
          0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
0,
          0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
0,
          0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
0,
          0,    0,    0,    0,    0,    0,    0,    0,    0,    0,
0,
          0,    0,    0,    0,    0,    0,    0,    0])
```

Test Data

```
tamil_sentence = ['பள்ளி மாணவர்கள் மற்றும் பல்கலைக்கழக
மாணவர்கள் பிரான்ஸ் நெடுகிலும் நெடுஞ்சாலைகள் வீதிகள்
ஆகியவற்றை தடுப்புக்களுக்கு உட்படுத்திய வகையில் நேற்று இன்னும்
கூடுதலான கைதுகள் நிகழ்த்தப்பட்டன']

preprocess_x, x_tk = tokenize(tamil_sentence)

preprocess_x = pad(preprocess_x)
```

```
preprocess_x
```

```
array([[ 2,  1,  3,  4,  1,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14,
15,
        16, 17]])
```

```
translation_logits = model.predict(preprocess_x)
```

```
1/1 [==============================] - 0s 17ms/step
```