In [ ]:

```
!pip install keras
```

```
Requirement already satisfied: keras in /usr/local/lib/python3.7/dist-packages (2.7.0)
```

Load Saved X & Y

In [4]:

```
import pandas as pd
X_train = pd.read_csv("data_x_train.csv")
X_test = pd.read_csv("data_x_test.csv")
Y_train = pd.read_csv("data_y_train.csv")
Y_test = pd.read_csv("data_y_test.csv")
X_train.sample(10)
```

Out[4]:

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	2
262	1238	74	25	110	154	97	1052	39	399	118	113	154	5	952	150	1763	374	154	301	118	154	52	952	34
2940	136	12	21	81	7	9	46	3	123	163	0	0	0	0	0	0	0	0	0	0	0	0	0	
6434	118	642	106	195	185	60	17	28	5	205	509	15	28	15	29	374	60	177	0	0	0	0	0	
1526	115	19	125	5	74	22	29	119	74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3340	2	51	1	533	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1246	115	27	6	78	115	121	74	71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5065	1	104	34	22	172	698	556	460	32	42	34	218	35	9	0	0	0	0	0	0	0	0	0	
2980	30	66	5	89	13	37	148	25	60	418	100	6	606	138	30	435	265	187	28	293	27	6	42	9
623	2	12	21	4	10	9	8	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3885	2	36	125	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

In [5]:

```
print('Shape of data tensor of train: ', X_train.shape)
print('Shape of data tensor of test: ', X_test.shape)
print('Shape of label tensor of train: ', Y_train.shape)
print('Shape of label tensor of test: ', Y_test.shape)
```

```
Shape of data tensor of train:  (6897, 50)
Shape of data tensor of test:  (767, 50)
Shape of label tensor of train:  (6897, 2)
Shape of label tensor of test:  (767, 2)
```

In [6]:

```
VOCABULARY_SIZE = X_train.to_numpy().max() + 1

print("Vocalbulary size: ", VOCABULARY_SIZE)
```

```
Vocalbulary size:  4621
```

Build Model

In [7]:

```
from keras.models import Sequential
from keras.layers import Embedding, Bidirectional, Dropout, SpatialDropout1D, LSTM, Dens
```

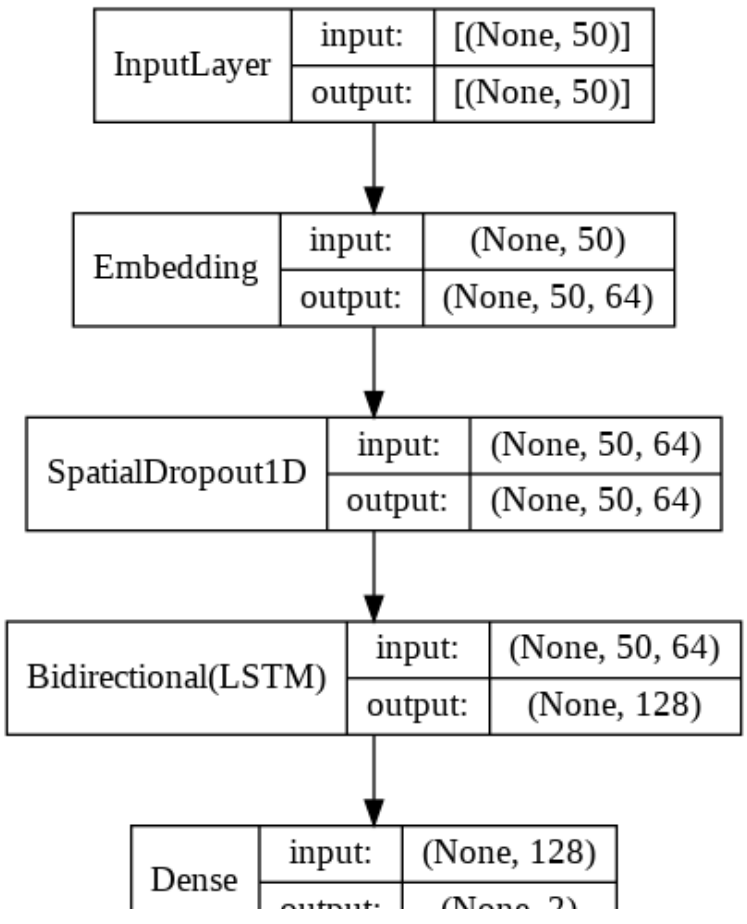
```
e, Conv1D, MaxPooling1D, GRU, Flatten
from keras.regularizers import l2

EMBEDDING_DIMENSION = 64

model = Sequential()
model.add(Embedding(VOCABULARY_SIZE, EMBEDDING_DIMENSION, input_length=X_train.shape[1]))
model.add(SpatialDropout1D(0.2))
model.add(Bidirectional(LSTM(EMBEDDING_DIMENSION, dropout=0.2)))
model.add(Dense(Y_train.shape[1], activation='softmax'))

model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])

model.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
 Layer (type)                 Output Shape              Param #
=================================================================
 embedding (Embedding)        (None, 50, 64)            295744

 spatial_dropout1d (SpatialD  (None, 50, 64)            0
 ropout1D)

 bidirectional (Bidirectiona  (None, 128)               66048
 l)

 dense (Dense)                (None, 2)                 258

=================================================================
Total params: 362,050
Trainable params: 362,050
Non-trainable params: 0
_________________________________________________________________
```

In [8]:

```
from keras.utils.vis_utils import plot_model

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

Out[8]:



	Output:	(None, 2)

Perform Model

Iterasi: 30\ Ukuran tiap iterasi: 256\ Iterasi akan berhenti ketika akurasi validasi tidak meningkat setelah 5 kali

In [ ]:

```
from keras.callbacks import ModelCheckpoint, EarlyStopping

filepath="./best_val_accuracy.hdf5"
stopping = EarlyStopping(monitor='val_accuracy', patience=5)
checkpoint = ModelCheckpoint(filepath, monitor='val_accuracy', verbose=1, save_best_only
=True, mode='max')
callbacks_list = [stopping]

epochs = 30
batch_size = 256

history = model.fit(
  X_train,
  Y_train,
  epochs=epochs,
  batch_size=batch_size,
  validation_data=(X_test, Y_test),
  callbacks=[callbacks_list],
  verbose=1
)
```

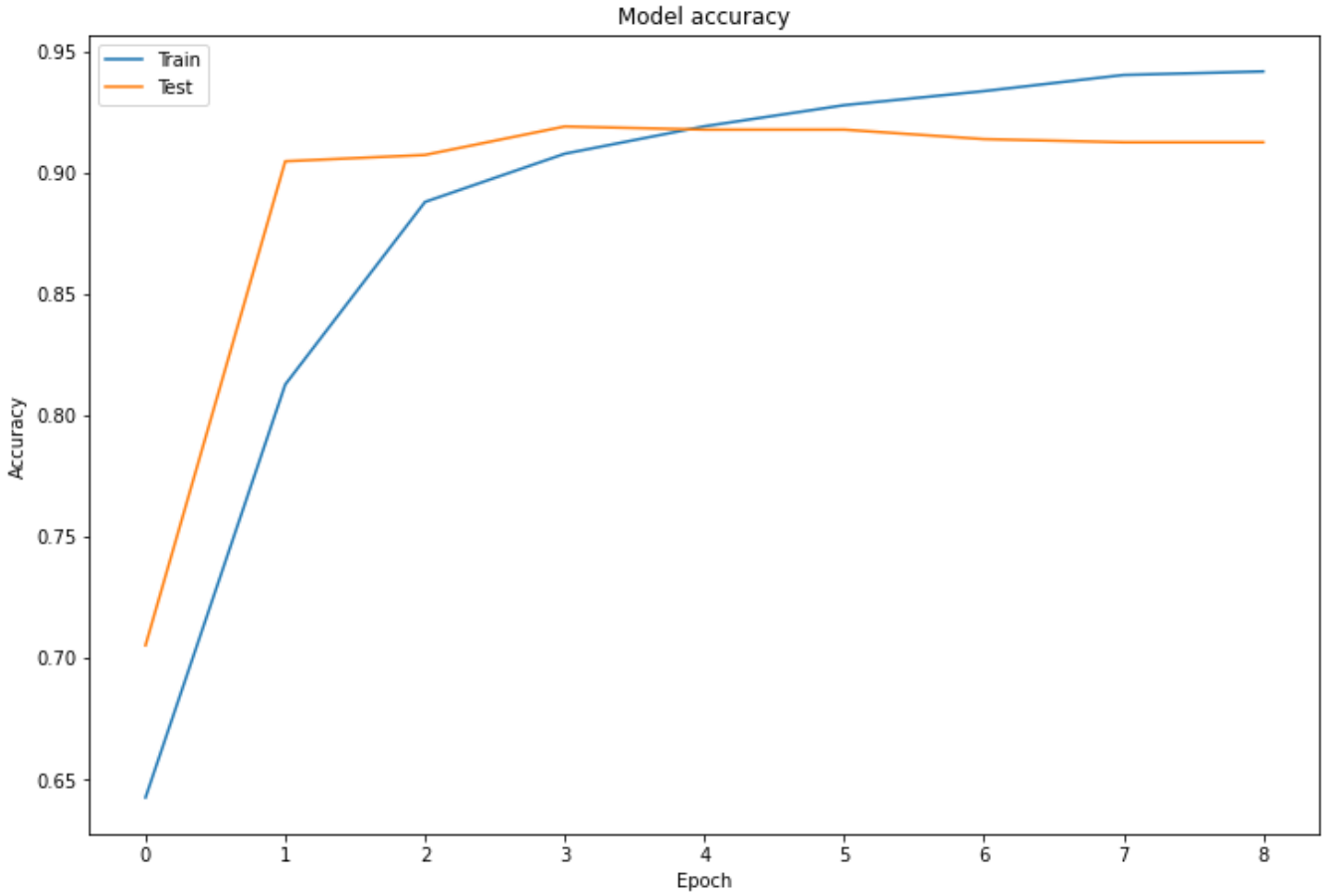
```
Epoch 1/30
27/27 [==============================] - 10s 81ms/step - loss: 0.6426 - accuracy: 0.6426
- val_loss: 0.5331 - val_accuracy: 0.7053
Epoch 2/30
27/27 [==============================] - 1s 35ms/step - loss: 0.4200 - accuracy: 0.8128 -
val_loss: 0.2895 - val_accuracy: 0.9048
Epoch 3/30
27/27 [==============================] - 1s 35ms/step - loss: 0.2996 - accuracy: 0.8881 -
val_loss: 0.2608 - val_accuracy: 0.9074
Epoch 4/30
27/27 [==============================] - 1s 34ms/step - loss: 0.2585 - accuracy: 0.9079 -
val_loss: 0.2337 - val_accuracy: 0.9192
Epoch 5/30
27/27 [==============================] - 1s 35ms/step - loss: 0.2289 - accuracy: 0.9192 -
val_loss: 0.2309 - val_accuracy: 0.9179
Epoch 6/30
27/27 [==============================] - 1s 34ms/step - loss: 0.2109 - accuracy: 0.9279 -
val_loss: 0.2296 - val_accuracy: 0.9179
Epoch 7/30
27/27 [==============================] - 1s 33ms/step - loss: 0.1932 - accuracy: 0.9337 -
val_loss: 0.2352 - val_accuracy: 0.9140
Epoch 8/30
27/27 [==============================] - 1s 33ms/step - loss: 0.1769 - accuracy: 0.9404 -
val_loss: 0.2433 - val_accuracy: 0.9126
Epoch 9/30
27/27 [==============================] - 1s 33ms/step - loss: 0.1656 - accuracy: 0.9419 -
val_loss: 0.2513 - val_accuracy: 0.9126
```

Visualize accuracy of model

In [ ]:

```
import matplotlib.pyplot as plt

plt.figure(figsize=(12,8))
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()
```



Dari visualisasi terlihat bahwa model sudah "fit" karena hasil test dan train saling mendekati dengan akurasi >90%

Confusion Matrix of Model

In [ ]:

```
from sklearn.metrics import classification_report, confusion_matrix
import numpy as np

Y_pred = model.predict(X_test)

Y_test_non_category = [ np.argmax(t) for t in Y_test.values]
Y_predict_non_category = [ np.argmax(t) for t in Y_pred ]

conf_mat = confusion_matrix(Y_test_non_category, Y_predict_non_category)
sum = conf_mat.sum(axis=1)
conf_mat = [[round(v / sum[i], 2) for v in a] for i, a in enumerate(conf_mat)]

import seaborn as sn
import pandas as pd
import matplotlib.pyplot as plt
from IPython.display import set_matplotlib_formats
set_matplotlib_formats('svg')

plt.rcParams['figure.dpi'] = 100
plt.rcParams['savefig.dpi'] = 100
sn.set(rc={"figure.dpi":100, 'savefig.dpi':100})
sn.set_context('notebook')
sn.set_style("ticks")

indexs = sorted([0, 1])
```

```
columns = [i for i in indexs[0:len(np.unique(Y_test_non_category))]]

df_cm = pd.DataFrame(conf_mat, index=columns, columns=columns)

plt.figure(figsize=(5, 5))
ax = sn.heatmap(df_cm, cmap='Oranges', annot=True, annot_kws={"fontsize":6})

plt.show()
```

In [ ]:

```
from sklearn.metrics import classification_report
Y_pred = model.predict(X_test)
Y_test_non_category = [ np.argmax(t) for t in Y_test.values]
Y_predict_non_category = [ np.argmax(t) for t in Y_pred ]

print(classification_report(Y_test_non_category,Y_predict_non_category))
```

```
              precision    recall  f1-score   support

           0       0.90      0.93      0.91       385
           1       0.93      0.90      0.91       382

    accuracy                           0.91       767
   macro avg       0.91      0.91      0.91       767
weighted avg       0.91      0.91      0.91       767
```

Hasil menunjukkan nilai f1-score pada akurasi mencapai 0.91, sehingga dapat disimpulkan bahwa model yang dibuat memiliki presisi dan recall yang sangat baik.

Final Accuracy

In [ ]:

```
# Final evaluation of the model
scores = model.evaluate(X_test, Y_test, verbose=1)
print("Accuracy: %.2f%%" % (scores[1]*100))
```

```
24/24 [==============================] - 0s 11ms/step - loss: 0.2513 - accuracy: 0.9126
Accuracy: 91.26%
```

Write Model

In [ ]:

```
model.save("/content/model.h5")
```