In [ ]:
```
# Install TensorFlow
# !pip install -q tensorflow-gpu==2.0.0-beta1

try:
  %tensorflow_version 2.x  # Colab only.
except Exception:
  pass

import tensorflow as tf
print(tf.__version__)
```

```
`%tensorflow_version` only switches the major version: `1.x` or `2.x`.
You set: `2.x  # Colab only.`. This will be interpreted as: `2.x`.


TensorFlow 2.x selected.
2.0.0-beta1
```

In [ ]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split

from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences
from tensorflow.keras.layers import Dense, Input, GlobalMaxPooling1D
from tensorflow.keras.layers import LSTM, Embedding
from tensorflow.keras.models import Model
```

In [ ]:
```
# Unfortunately this URL doesn't work directly with pd.read_csv
!wget -nc https://lazyprogrammer.me/course_files/spam.csv
```

```
--2019-08-02 21:15:36--  https://lazyprogrammer.me/course_files/spam.csv
Resolving lazyprogrammer.me (lazyprogrammer.me)... 104.31.81.48, 104.31.80.48, 2606:470
0:30::681f:5130, ...
Connecting to lazyprogrammer.me (lazyprogrammer.me)|104.31.81.48|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 503663 (492K) [text/csv]
Saving to: ‘spam.csv.3’

spam.csv.3          100%[===================>] 491.86K  --.-KB/s    in 0.02s

2019-08-02 21:15:36 (23.7 MB/s) - ‘spam.csv.3’ saved [503663/503663]
```

In [ ]:
```
!head spam.csv
```

```
---------------------------------------------------------------------------
UnicodeDecodeError                        Traceback (most recent call last)
<ipython-input-52-c10fe1856d2b> in <module>()
----> 1 get_ipython().system('head spam.csv')

/usr/local/lib/python3.6/dist-packages/google/colab/_shell.py in system(self, *args, **k
wargs)
     82       kwargs.update({'also_return_output': True})
     83
---> 84     output = _system_commands._system_compat(self, *args, **kwargs)  # pylint:di
```

```
sable=protected-access
     85
     86     if pip_warn:

/usr/local/lib/python3.6/dist-packages/google/colab/_system_commands.py in _system_compa
t(shell, cmd, also_return_output)
    436   # stack.
    437   result = _run_command(
--> 438       shell.var_expand(cmd, depth=2), clear_streamed_output=False)
    439   shell.user_ns['_exit_code'] = result.returncode
    440   if -result.returncode in _INTERRUPTED_SIGNALS:

/usr/local/lib/python3.6/dist-packages/google/colab/_system_commands.py in _run_command
(cmd, clear_streamed_output)
    193       os.close(child_pty)
    194
--> 195       return _monitor_process(parent_pty, epoll, p, cmd, update_stdin_widget)
    196   finally:
    197     epoll.close()

/usr/local/lib/python3.6/dist-packages/google/colab/_system_commands.py in _monitor_proc
ess(parent_pty, epoll, p, cmd, update_stdin_widget)
    220   while True:
    221     try:
--> 222       result = _poll_process(parent_pty, epoll, p, cmd, decoder, state)
    223       if result is not None:
    224         return result

/usr/local/lib/python3.6/dist-packages/google/colab/_system_commands.py in _poll_process
(parent_pty, epoll, p, cmd, decoder, state)
    273       output_available = True
    274       raw_contents = os.read(parent_pty, _PTY_READ_MAX_BYTES_FOR_TEST)
--> 275       decoded_contents = decoder.decode(raw_contents)
    276
    277       sys.stdout.write(decoded_contents)

/usr/lib/python3.6/codecs.py in decode(self, input, final)
    319         # decode input (taking the buffer into account)
    320         data = self.buffer + input
--> 321         (result, consumed) = self._buffer_decode(data, self.errors, final)
    322         # keep undecoded input until the next call
    323         self.buffer = data[consumed:]

UnicodeDecodeError: 'utf-8' codec can't decode bytes in position 606-607: invalid contin
uation byte
```

In [ ]:
```
df = pd.read_csv('spam.csv', encoding='ISO-8859-1')
```

In [ ]:
```
df.head()
```

Out[ ]:

	v1	v2	Unnamed: 2	Unnamed: 3	Unnamed: 4
0	ham	Go until jurong point, crazy.. Available only ...	NaN	NaN	NaN
1	ham	Ok lar... Joking wif u oni...	NaN	NaN	NaN
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	NaN	NaN	NaN
3	ham	U dun say so early hor... U c already then say...	NaN	NaN	NaN
4	ham	Nah I don't think he goes to usf, he lives aro...	NaN	NaN	NaN

In [ ]:
```
# drop unnecessary columns
df = df.drop(["Unnamed: 2", "Unnamed: 3", "Unnamed: 4"], axis=1)
```

In [ ]:
```
df.head()
```

Out[ ]:

	v1	v2
0	ham	Go until jurong point, crazy.. Available only ...
1	ham	Ok lar... Joking wif u oni...
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...
3	ham	U dun say so early hor... U c already then say...
4	ham	Nah I don't think he goes to usf, he lives aro...

In [ ]:
```
# rename columns to something better
df.columns = ['labels', 'data']
```

In [ ]:
```
df.head()
```

Out[ ]:

	labels	data
0	ham	Go until jurong point, crazy.. Available only ...
1	ham	Ok lar... Joking wif u oni...
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...
3	ham	U dun say so early hor... U c already then say...
4	ham	Nah I don't think he goes to usf, he lives aro...

In [ ]:
```
# create binary labels
df['b_labels'] = df['labels'].map({'ham': 0, 'spam': 1})
Y = df['b_labels'].values
```

In [ ]:
```
# split up the data
df_train, df_test, Ytrain, Ytest = train_test_split(df['data'], Y, test_size=0.33)
```

In [ ]:
```
# Convert sentences to sequences
MAX_VOCAB_SIZE = 20000
tokenizer = Tokenizer(num_words=MAX_VOCAB_SIZE)
tokenizer.fit_on_texts(df_train)
sequences_train = tokenizer.texts_to_sequences(df_train)
sequences_test = tokenizer.texts_to_sequences(df_test)
```

In [ ]:
```
# get word -> integer mapping
word2idx = tokenizer.word_index
```

```
V = len(word2idx)
print('Found %s unique tokens.' % V)
```

```
Found 7309 unique tokens.
```

In [ ]:

```
# pad sequences so that we get a N x T matrix
data_train = pad_sequences(sequences_train)
print('Shape of data train tensor:', data_train.shape)

# get sequence length
T = data_train.shape[1]
```

```
Shape of data train tensor: (3733, 189)
```

In [ ]:

```
data_test = pad_sequences(sequences_test, maxlen=T)
print('Shape of data test tensor:', data_test.shape)
```

```
Shape of data test tensor: (1839, 189)
```

In [ ]:

```
# Create the model

# We get to choose embedding dimensionality
D = 20

# Hidden state dimensionality
M = 15

# Note: we actually want to the size of the embedding to (V + 1) x D,
# because the first index starts from 1 and not 0.
# Thus, if the final index of the embedding matrix is V,
# then it actually must have size V + 1.

i = Input(shape=(T,))
x = Embedding(V + 1, D)(i)
x = LSTM(M, return_sequences=True)(x)
x = GlobalMaxPooling1D()(x)
x = Dense(1, activation='sigmoid')(x)

model = Model(i, x)
```

In [ ]:

```
# Compile and fit
model.compile(
  loss='binary_crossentropy',
  optimizer='adam',
  metrics=['accuracy']
)


print('Training model...')
r = model.fit(
  data_train,
  Ytrain,
  epochs=10,
  validation_data=(data_test, Ytest)
)
```

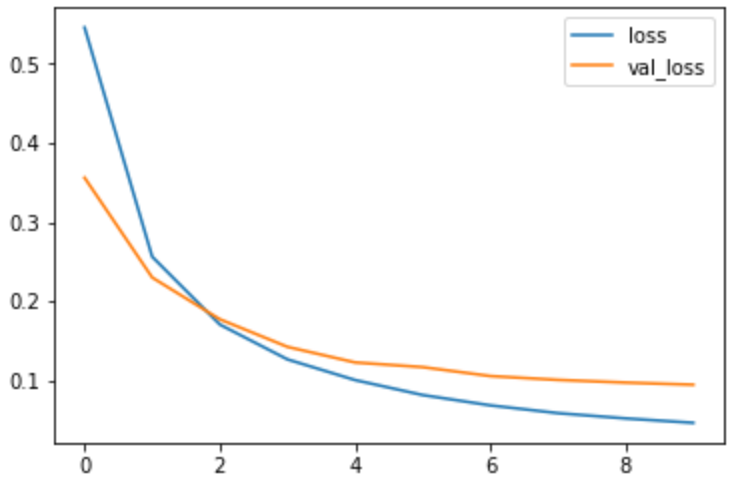
```
Training model...
Train on 3733 samples, validate on 1839 samples
Epoch 1/10
3733/3733 [==============================] - 6s 1ms/sample - loss: 0.5457 - accuracy: 0.
8205 - val_loss: 0.3560 - val_accuracy: 0.8613
Epoch 2/10
3733/3733 [==============================] - 4s 1ms/sample - loss: 0.2561 - accuracy: 0.
8679 - val_loss: 0.2299 - val_accuracy: 0.8613
Epoch 3/10
3733/3733 [==============================] - 4s 1ms/sample - loss: 0.1705 - accuracy: 0.
9263 - val_loss: 0.1772 - val_accuracy: 0.9674
Epoch 4/10
3733/3733 [==============================] - 4s 1ms/sample - loss: 0.1265 - accuracy: 0.
9914 - val_loss: 0.1424 - val_accuracy: 0.9766
Epoch 5/10
3733/3733 [==============================] - 4s 1ms/sample - loss: 0.1004 - accuracy: 0.
9933 - val_loss: 0.1227 - val_accuracy: 0.9799
Epoch 6/10
3733/3733 [==============================] - 4s 1ms/sample - loss: 0.0815 - accuracy: 0.
9954 - val_loss: 0.1168 - val_accuracy: 0.9804
Epoch 7/10
3733/3733 [==============================] - 4s 1ms/sample - loss: 0.0685 - accuracy: 0.
9968 - val_loss: 0.1055 - val_accuracy: 0.9810
Epoch 8/10
3733/3733 [==============================] - 4s 1ms/sample - loss: 0.0586 - accuracy: 0.
9976 - val_loss: 0.1006 - val_accuracy: 0.9821
Epoch 9/10
3733/3733 [==============================] - 4s 1ms/sample - loss: 0.0520 - accuracy: 0.
9979 - val_loss: 0.0972 - val_accuracy: 0.9810
Epoch 10/10
3733/3733 [==============================] - 4s 1ms/sample - loss: 0.0464 - accuracy: 0.
9979 - val_loss: 0.0945 - val_accuracy: 0.9815
```

In [ ]:

```
# Plot loss per iteration
import matplotlib.pyplot as plt
plt.plot(r.history['loss'], label='loss')
plt.plot(r.history['val_loss'], label='val_loss')
plt.legend()
```

Out[ ]:

```
<matplotlib.legend.Legend at 0x7f0cb026bef0>
```



In [ ]:

```
# Plot accuracy per iteration
plt.plot(r.history['accuracy'], label='acc')
plt.plot(r.history['val_accuracy'], label='val_acc')
plt.legend()
```

Out[ ]: <matplotlib.legend.Legend at 0x7f0cb0250128>