

```
In [1]: from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Embedding, GRU, LSTM, Dropout
from tensorflow.keras import utils
from tensorflow.keras.preprocessing.sequence import pad_sequences
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.callbacks import ModelCheckpoint, ReduceLROnPlateau
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

```
In [2]: from google.colab import drive
drive.mount('/content/drive')
```

Mounted at /content/drive

```
In [3]: num_words = 10000
max_review_len = 200
```

```
In [4]: train = pd.read_csv('/content/drive/MyDrive/A6/train.csv',
                             header=None,
                             names=['Label', 'Review'])
test = pd.read_csv('/content/drive/MyDrive/A6/test.csv',
                    header=None,
                    names=['Label', 'Review'])
```

```
In [5]: train
```

```
Out[5]:
```

	Label	Review
0	1	Unfortunately, the frustration of being Dr. Go...
1	2	Been going to Dr. Goldberg for over 10 years. ...
2	1	I don't know what Dr. Goldberg was like before...
3	1	I'm writing this review to give you a heads up...
4	2	All the food is great here. But the best thing...
...	...	...
559995	2	Ryan was as good as everyone on yelp has claim...
559996	2	Professional \nFriendly\nOn time AND affordabl...
559997	1	Phone calls always go to voicemail and message...
559998	1	Looks like all of the good reviews have gone t...
559999	2	Ryan Rocks! I called him this morning for some...

560000 rows × 2 columns

```
In [6]: y_train, y_test = train['Label'] - 1, test['Label'] - 1
```

```
In [7]: reviews = train['Review']  
reviews[:5]
```

```
Out[7]: 0    Unfortunately, the frustration of being Dr. Go...  
1    Been going to Dr. Goldberg for over 10 years. ...  
2    I don't know what Dr. Goldberg was like before...  
3    I'm writing this review to give you a heads up...  
4    All the food is great here. But the best thing...  
Name: Review, dtype: object
```

```
In [8]: tokenizer = Tokenizer(num_words=num_words)  
tokenizer.fit_on_texts(reviews)  
tokenizer.word_index
```

```
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        'at': 1096,  
        'from': 1097,  
        'by': 
```

```
In [10]: index = 42
print(reviews[index])
print(sequences[index])
```

Some of the worst pizza I've ever had. We used a coupon from the paper for a 2 topping 8 cut Sicilian. First of all the pizza wasn't even cut through, and the sad attempt at cutting was so uneven that 4 of the slices were about an inch wide, while the others were about 4" each. The toppings were scarce, they used mini pepperoni and put maybe 8 on the whole pizza. The onions were huge chunks and the mushrooms were straight from a can. The worst part though was the thick doughy crust that tasted more like a fishy sourdough roll. I'm serious... It was so noticeable that it made me wonder if the dough was bad or if they for some weird reason put fish sauce in it. It was gross. \n\nWe also ordered steak and Italian hoagies. The veggies were old and wilted, and there was no dressing on either. The Italian had deli meat that was clearly bottom of the line and not very generous. The \"steak\" (if you can call it that) was greyish instead of brown and looked like it was a processed meat chopped into pieces. No flavor or seasoning and the texture was reminiscent of spam. It was so bad that I only ate 1/4 of it and tossed the rest. \n\nI have ordered from here in the past and always been disappointed. I thought I would give them another try since I'd never ordered a Sicilian pizza from there. What a mistake. I will never order from them again!

```
[67, 7, 1, 384, 171, 112, 151, 24, 15, 299, 5, 1073, 50, 1, 1090, 9, 5, 1
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12, 166, 1, 674, 26, 56, 202, 304, 1, 1027, 26, 9651, 19, 299, 1301, 215
0, 2, 271, 273, 479, 21, 1, 375, 171, 1, 949, 26, 323, 2138, 2, 1, 1174,
26, 1193, 50, 5, 75, 1, 384, 377, 195, 6, 1, 1076, 4608, 881, 13, 321, 7
3, 38, 5, 3163, 4442, 527, 93, 1610, 8, 6, 27, 6270, 13, 8, 138, 32, 145
9, 39, 1, 2046, 6, 143, 49, 39, 19, 9, 67, 892, 435, 271, 383, 181, 10,
8, 8, 6, 982, 12, 261, 84, 89, 309, 2, 678, 1, 995, 26, 254, 2, 4716, 2,
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269, 38, 8, 6, 5, 3871, 258, 2196, 178, 767, 57, 279, 49, 1789, 2, 1, 128
0, 6, 5415, 7, 5604, 8, 6, 27, 143, 13, 3, 68, 506, 200, 202, 7, 8, 2, 30
00, 1, 615, 12, 85, 23, 89, 50, 45, 10, 1, 546, 2, 128, 69, 337, 3, 252,
3, 53, 163, 76, 157, 121, 167, 364, 88, 89, 5, 7487, 171, 50, 33, 60, 5,
1002, 3, 66, 88, 96, 50, 76, 108]
```

```
In [11]: print(tokenizer.word_index['some'])
print(tokenizer.word_index['of'])
print(tokenizer.word_index['the'])
print(tokenizer.word_index['worst'])
```

```
67
7
1
384
```

```
In [12]: x_train = pad_sequences(sequences, maxlen=max_review_len)
x_train[0]
```

```
Out[12]: array([[ 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,  0,  0,  0,  0,  0,
                  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,
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                  10, 2636, 34, 1416, 462, 129, 8, 519, 13, 177, 129,
                  803, 88, 3812,  1, 446,  8, 392, 841, 115, 360,  7,
                4136, 1438,  4,  43,  59, 1266, 118, 95, 46,  9, 13,
                  49, 1687,  4, 418, 18,  8,  3, 23, 563, 178, 16,
                460, 18, 189, 80, 3128,  2,  3, 40, 78, 43,  8,
                  20, 23, 644, 1343, 20, 23, 3252, 18, 2921, 637, 227,
                430, 476, 4312,  1, 446, 63,  2, 22, 215,  1, 63,
                  18, 2269, 13,  3, 249, 13,  3, 23,  4, 163, 939,
                115, 237], dtype=int32)
```

```
In [13]: model = Sequential()
model.add(Embedding(num_words, 64, input_length=max_review_len))
model.add(GRU(128))
model.add(Dense(1, activation='sigmoid'))
```

```
In [14]: model.compile(optimizer='adam',
                      loss='binary_crossentropy',
                      metrics=['accuracy'])
```

```
In [15]: model_save_path = '/content/best_model.h5'
checkpoint_callback = ModelCheckpoint(model_save_path,
                                     monitor='val_accuracy',
                                     save_best_only=True,
                                     verbose=1)
```

```
In [16]: history = model.fit(x_train,
                             y_train,
                             epochs=5,
                             batch_size=128,
                             validation_split=0.1,
                             callbacks=[checkpoint_callback])
```

```
Epoch 1/5
3938/3938 [=====] - ETA: 0s - loss: 0.1882 - acc
uracy: 0.9245
Epoch 00001: val_accuracy improved from -inf to 0.95968, saving model to
/content/best_model.h5
3938/3938 [=====] - 164s 40ms/step - loss: 0.188
2 - accuracy: 0.9245 - val_loss: 0.1060 - val_accuracy: 0.9597
Epoch 2/5
3937/3938 [=====>.] - ETA: 0s - loss: 0.1185 - acc
uracy: 0.9546
Epoch 00002: val_accuracy improved from 0.95968 to 0.96548, saving model
to /content/best_model.h5
3938/3938 [=====] - 158s 40ms/step - loss: 0.118
5 - accuracy: 0.9546 - val_loss: 0.0918 - val_accuracy: 0.9655
Epoch 3/5
3937/3938 [=====>.] - ETA: 0s - loss: 0.0964 - acc
uracy: 0.9638
Epoch 00003: val_accuracy did not improve from 0.96548
3938/3938 [=====] - 158s 40ms/step - loss: 0.096
4 - accuracy: 0.9638 - val_loss: 0.0912 - val_accuracy: 0.9654
Epoch 4/5
3937/3938 [=====>.] - ETA: 0s - loss: 0.0791 - acc
uracy: 0.9709
Epoch 00004: val_accuracy did not improve from 0.96548
3938/3938 [=====] - 158s 40ms/step - loss: 0.079
2 - accuracy: 0.9709 - val_loss: 0.0970 - val_accuracy: 0.9643
Epoch 5/5
3938/3938 [=====] - ETA: 0s - loss: 0.0633 - acc
uracy: 0.9772
Epoch 00005: val_accuracy did not improve from 0.96548
3938/3938 [=====] - 158s 40ms/step - loss: 0.063
3 - accuracy: 0.9772 - val_loss: 0.1061 - val_accuracy: 0.9641
```

```
In [17]: model.load_weights(model_save_path)
```

```
In [18]: test_sequences = tokenizer.texts_to_sequences(test['Review'])
x_test = pad_sequences(test_sequences, maxlen=max_review_len)
x_test[0]
```

```
Out[18]: array([[ 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,
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137, 18, 289, 38, 8346, 2311, 257, 511, 28, 1167,  2,
113, 60, 568, 520, 1426, 16, 11, 44, 31, 13,  3,
 82, 22, 249, 38,  3, 144, 173, 694, 2235,  7, 40,
 72,  7, 14, 80, 2540, 5951, 23, 69,  9, 21, 14,
  7, 1558,  2, 23, 1696, 14, 1894, 1775, 470, 17, 45,
 14, 52,  2, 1346, 5923, 95, 37, 69, 91, 1024,  2,
311, 48,  4, 32,  4, 1480, 1037, 19, 40, 4124,  1,
317, 127,  8, 562,  5, 203, 114, 99,  8, 90, 10,
1168, 274], dtype=int32)
```

```
In [19]: scores = model.evaluate(x_test, y_test, verbose=1)
print("The percent of correct answers:", round(scores[1] * 100, 4))
```

```
1188/1188 [=====] - 20s 17ms/step - loss: 0.1138
- accuracy: 0.9569
The percent of correct answers: 95.6868
```

```
In [ ]:
```