21BDS0340

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Deep Learning Lab

<div align="center">Assignment – V</div>

Procedure:
1. Import the required packages
2. Load the dataset locally
3. Split the training data into train and validation datasets
4. Use text vectorization to convert the text into values
5. Build the TensorFlow model
6. Evaluate the model with the test datasets
7. Plot the model accuracy vs validation accuracy
8. Plot the model loss vs validation loss

Interactive Python Notebook on the following pages:

21BDS0340 - Abhinav Dinesh Srivatsa

```python
In [1]: import tensorflow as tf
        import pandas as pd
        import numpy as np
        import matplotlib.pyplot as plt
```

```python
In [2]: train = pd.read_csv("train.csv", header=None)
        test = pd.read_csv("test.csv", header=None)
        train.columns = ["Score", "Review"]
        test.columns = train.columns
        train
```

Out[2]:

	Score	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

```python
In [3]: # selecting random 1% of data due to large data size
        reviews = train["Review"].values
        ratings = (train["Score"] - 1).values

        np.random.seed(42)
        sample_size = int(0.01 * len(reviews))
        random_indices = np.random.choice(len(reviews), size=sample_size, replace

        sampled_reviews = reviews[random_indices]
        sampled_ratings = ratings[random_indices]

        reviews
```

Out[3]: array(["Unfortunately, the frustration of being Dr. Goldberg's patient i
s a repeat of the experience I've had with so many other doctors in NYC
-- good doctor, terrible staff. It seems that his staff simply never an
swers the phone. It usually takes 2 hours of repeated calling to get an
answer. Who has time for that or wants to deal with it? I have run int
o this problem with many other doctors and I just don't get it. You hav
e office workers, you have patients with medical needs, why isn't anyone
answering the phone? It's incomprehensible and not work the aggravatio
n. It's with regret that I feel that I have to give Dr. Goldberg 2 star
s.",
        "Been going to Dr. Goldberg for over 10 years. I think I was one
of his 1st patients when he started at MHMG. He's been great over the ye
ars and is really all about the big picture. It is because of him, not m
y now former gyn Dr. Markoff, that I found out I have fibroids. He explo
res all options with you and is very patient and understanding. He does
n't judge and asks all the right questions. Very thorough and wants to b
e kept in the loop on every aspect of your medical health and your lif
e.",
        "I don't know what Dr. Goldberg was like before moving to Arizon
a, but let me tell you, STAY AWAY from this doctor and this office. I wa
s going to Dr. Johnson before he left and Goldberg took over when Johnso
n left. He is not a caring doctor. He is only interested in the co-pay a
nd having you come in for medication refills every month. He will not gi
ve refills and could less about patients's financial situations. Trying
to get your 90 days mail away pharmacy prescriptions through this guy is
a joke. And to make matters even worse, his office staff is incompetent.
90% of the time when you call the office, they'll put you through to a v
oice mail, that NO ONE ever answers or returns your call. Both my adult
children and husband have decided to leave this practice after experienc
ing such frustration. The entire office has an attitude like they are do
ing you a favor. Give me a break! Stay away from this doc and the practi
ce. You deserve better and they will not be there when you really need t
hem. I have never felt compelled to write a bad review about anyone unti
l I met this pathetic excuse for a doctor who is all about the money.",
        ...,
        'Phone calls always go to voicemail and messages are not returne
d. Stupid way to do business.',
        'Looks like all of the good reviews have gone to their head at th
is place! Jason and Ryan came out last fall and did a wonderful job pru
ning, etc. Called them to come back this spring and no response after f
irst call. After second call, I was told they could only come on a Mond
ay. I work Mondays, and left a message what days would work for me. NEV
ER heard back from them! After 3 calls, nothing. Very UNRELIABLE and U
NACCOMMODATING..',
        "Ryan Rocks! I called him this morning for some sprinkler help an
d some potential landscaping for my backyard. He showed up to my house w
ithin an hour and answered all of my questions! When I showed him how my
irrigation box was leaking, he knew right away what to do - he went a gr
abbed a new part out of his truck, put it on, and it was fixed! He then
set up my watering timer and we talked about some landscaping and pricin
g. His prices seemed great and I will definitely use him in the future!
To top it all off, when I asked him what I owed him for fixing my irriga
tion leak and his time, he said don't worry about it! I was shocked and
couldn't believe his service! Thank you so much Ryan!"],
        dtype=object)

In [4]:
```python
encoder = tf.keras.layers.TextVectorization(max_tokens=10000)
encoder.adapt(reviews)
```

```python
vocab = encoder.get_vocabulary()
vocab
```

```
2024-10-02 16:07:21.346933: I metal_plugin/src/device/metal_device.cc:115
4] Metal device set to: Apple M1 Pro
2024-10-02 16:07:21.346959: I metal_plugin/src/device/metal_device.cc:296]
systemMemory: 16.00 GB
2024-10-02 16:07:21.346964: I metal_plugin/src/device/metal_device.cc:313]
maxCacheSize: 5.33 GB
2024-10-02 16:07:21.347003: I tensorflow/core/common_runtime/pluggable_dev
ice/pluggable_device_factory.cc:303] Could not identify NUMA node of platf
orm GPU ID 0, defaulting to 0. Your kernel may not have been built with NU
MA support.
2024-10-02 16:07:21.347016: I tensorflow/core/common_runtime/pluggable_dev
ice/pluggable_device_factory.cc:269] Created TensorFlow device (/job:local
host/replica:0/task:0/device:GPU:0 with 0 MB memory) -> physical Pluggable
Device (device: 0, name: METAL, pci bus id: <undefined>)
2024-10-02 16:07:21.511610: I tensorflow/core/grappler/optimizers/custom_g
raph_optimizer_registry.cc:114] Plugin optimizer for device_type GPU is en
abled.
```

```
Out[4]:  ['',
          '[UNK]',
          'the',
          'and',
          'i',
          'to',
          'a',
          'was',
          'of',
          'it',
          'for',
          'in',
          'is',
          'that',
          'my',
          'we',
          'this',
          'with',
          'but',
          'they',
          'you',
          'on',
          'not',
          'have',
          'had',
          'at',
          'were',
          'so',
          'are',
          'be',
          'food',
          'place',
          'me',
          'there',
          'as',
          'good',
          'out',
          'like',
          'if',
          'all',
          'just',
          'our',
          'very',
          'get',
          'one',
          'here',
          'when',
          'its',
          'from',
          'time',
          'or',
          'up',
          'would',
          'great',
          'service',
          'their',
          'about',
          'back',
          'no',
          'go',
```

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'an',
'what',
'really',
'he',
'she',
'will',
'which',
'some',
'been',
'only',
'us',
'your',
'because',
'dont',
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'more',
'can',
'by',
'them',
'got',
'other',
'after',
'do',
'didnt',
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'im',
'too',
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'did',
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'than',
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'then',
'came',
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'said',
'restaurant',
'ive',
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'make',
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                    'friends',
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                    'look',
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                    'through',
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                    'clean',
                    'least',
                    'used',
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                    'review',
                    'beer',
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                    'water',
                    'show',
                    'finally',
                    'favorite',
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```

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'immediately',
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'space',
'hungry',
'wow',
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'25',
'month',
'hostess',
'bottle',
'comfortable',
'lobster',
'choose',
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'issue',
'hear',
'45',
'city',
'within',
'sometimes',
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'seat',
'waste',
'butter',
'salmon',
'cup',
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'bed',
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'middle',
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'low',
'50',
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'arent',
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'supposed',
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'mention',
'recently',
'beers',
'crowd',
'asking',
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'disappointing',
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'recommended',
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'stand',
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'lack',
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'sent',
'tiny',
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'sad',
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'ni',
'changed',
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'mouth',
'nthe',
'box',
'avoid',
'brunch',
'finish',
'whatever',
'pricey',
'40',
'worked',
'cannot',
'mac',
'crust',
'mine',
'date',
'specials',
'scottsdale',
'interesting',
'authentic',
'pleasant',
'greeted',
'woman',
'mall',
'barely',
'single',
'forward',
'tuna',
'finished',
'cute',
'tomato',
'delivery',
'dark',
'professional',
'wall',
'flavorful',
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'dollars',
'sort',
'cook',
'clearly',
'above',
'cash',
'nails',
'dogs',
'face',
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'weird',
'soft',
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'running',
'tender',
'sausage',
'min',
'downtown',
'sides',
'level',
'massage',
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'serving',
'bucks',
'anyway',
'tv',
'item',
'thin',
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'salt',
'greasy',
'forgot',
'lettuce',
'dance',
'standard',
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'bag',
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'rib',
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'entrees',
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'crazy',
'corn',
'ribs',
'tasting',
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'dr',
'onions',
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'matter',
'young',
'treat',
'airport',
'speak',
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'expecting',
'turn',
'dressing',
'eye',
'share',
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'establishment',
'groupon',
'book',
'salads',
'playing',
'mix',
'employee',
```

```
            'mentioned',
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            'salon',
            'nnmy',
            'considering',
            'none',
            'fair',
            'school',
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            'seeing',
            'station',
            'gotten',
            'weve',
            'fee',
            'mom',
            'smell',
            'returning',
            'veggies',
            'explained',
            'yeah',
            'kinda',
            'included',
            'pulled',
            'issues',
            'value',
            'elsewhere',
            'forever',
            'typical',
            'pm',
            'ridiculous',
            'true',
            'toast',
            'pie',
            'nights',
            ...]
```

In [5]:
```python
encoded = encoder(sampled_reviews)
encoded
```

Out[5]:
```
<tf.Tensor: shape=(5600, 979), dtype=int64, numpy=
array([[ 16,  31,  12, ...,    0,   0,    0],
       [  2, 152,  49, ...,    0,   0,    0],
       [  4,  89,  22, ...,    0,   0,    0],
       ...,
       [  1, 413,  36, ...,    0,   0,    0],
       [  4, 241,  37, ...,    0,   0,    0],
       [ 24, 314,  45, ...,    0,   0,    0]])>
```

In [9]:
```python
model = tf.keras.Sequential([
    encoder,
    tf.keras.layers.Embedding(len(encoder.get_vocabulary()), 64, mask_zer
    tf.keras.layers.Bidirectional(tf.keras.layers.LSTM(64, return_sequenc
    tf.keras.layers.Bidirectional(tf.keras.layers.LSTM(32)),
    tf.keras.layers.Dense(64, activation="relu"),
```

```python
        tf.keras.layers.Dense(1, activation="sigmoid")
])

model.compile(
    optimizer="adam",
    loss="binary_crossentropy",
    metrics=["accuracy"]
)

history = model.fit(sampled_reviews, sampled_ratings, epochs=5, validatio
```

Epoch 1/5

2024-10-02 16:13:00.842093: I tensorflow/core/grappler/optimizers/custom_g
raph_optimizer_registry.cc:114] Plugin optimizer for device_type GPU is en
abled.
2024-10-02 16:13:01.886003: I tensorflow/core/grappler/optimizers/custom_g
raph_optimizer_registry.cc:114] Plugin optimizer for device_type GPU is en
abled.
2024-10-02 16:13:02.068467: I tensorflow/core/grappler/optimizers/custom_g
raph_optimizer_registry.cc:114] Plugin optimizer for device_type GPU is en
abled.
2024-10-02 16:13:02.452735: I tensorflow/core/grappler/optimizers/custom_g
raph_optimizer_registry.cc:114] Plugin optimizer for device_type GPU is en
abled.
2024-10-02 16:13:02.643069: I tensorflow/core/grappler/optimizers/custom_g
raph_optimizer_registry.cc:114] Plugin optimizer for device_type GPU is en
abled.
2024-10-02 16:13:03.357863: I tensorflow/core/grappler/optimizers/custom_g
raph_optimizer_registry.cc:114] Plugin optimizer for device_type GPU is en
abled.
2024-10-02 16:13:03.592013: I tensorflow/core/grappler/optimizers/custom_g
raph_optimizer_registry.cc:114] Plugin optimizer for device_type GPU is en
abled.
2024-10-02 16:13:04.137167: I tensorflow/core/grappler/optimizers/custom_g
raph_optimizer_registry.cc:114] Plugin optimizer for device_type GPU is en
abled.
2024-10-02 16:13:04.324451: I tensorflow/core/grappler/optimizers/custom_g
raph_optimizer_registry.cc:114] Plugin optimizer for device_type GPU is en
abled.

140/140 [==============================] - ETA: 0s - loss: 0.6937 - accura
cy: 0.5069

2024-10-02 16:14:16.860701: I tensorflow/core/grappler/optimizers/custom_g
raph_optimizer_registry.cc:114] Plugin optimizer for device_type GPU is en
abled.
2024-10-02 16:14:17.452221: I tensorflow/core/grappler/optimizers/custom_g
raph_optimizer_registry.cc:114] Plugin optimizer for device_type GPU is en
abled.
2024-10-02 16:14:17.559372: I tensorflow/core/grappler/optimizers/custom_g
raph_optimizer_registry.cc:114] Plugin optimizer for device_type GPU is en
abled.
2024-10-02 16:14:17.961393: I tensorflow/core/grappler/optimizers/custom_g
raph_optimizer_registry.cc:114] Plugin optimizer for device_type GPU is en
abled.
2024-10-02 16:14:18.067883: I tensorflow/core/grappler/optimizers/custom_g
raph_optimizer_registry.cc:114] Plugin optimizer for device_type GPU is en
abled.

```
140/140 [==============================] – 92s 600ms/step – loss: 0.6937 –
accuracy: 0.5069 – val_loss: 0.6929 – val_accuracy: 0.5098
Epoch 2/5
Epoch 2/5
140/140 [==============================] – 81s 577ms/step – loss: 0.6923 –
accuracy: 0.5089 – val_loss: 0.6944 – val_accuracy: 0.4955
Epoch 3/5
140/140 [==============================] – 86s 613ms/step – loss: 0.6922 –
accuracy: 0.5007 – val_loss: 0.6932 – val_accuracy: 0.4946
Epoch 4/5
140/140 [==============================] – 83s 592ms/step – loss: 0.6924 –
accuracy: 0.5000 – val_loss: 0.7025 – val_accuracy: 0.4982
Epoch 5/5
140/140 [==============================] – 75s 536ms/step – loss: 0.6871 –
accuracy: 0.5013 – val_loss: 0.7007 – val_accuracy: 0.5116
```
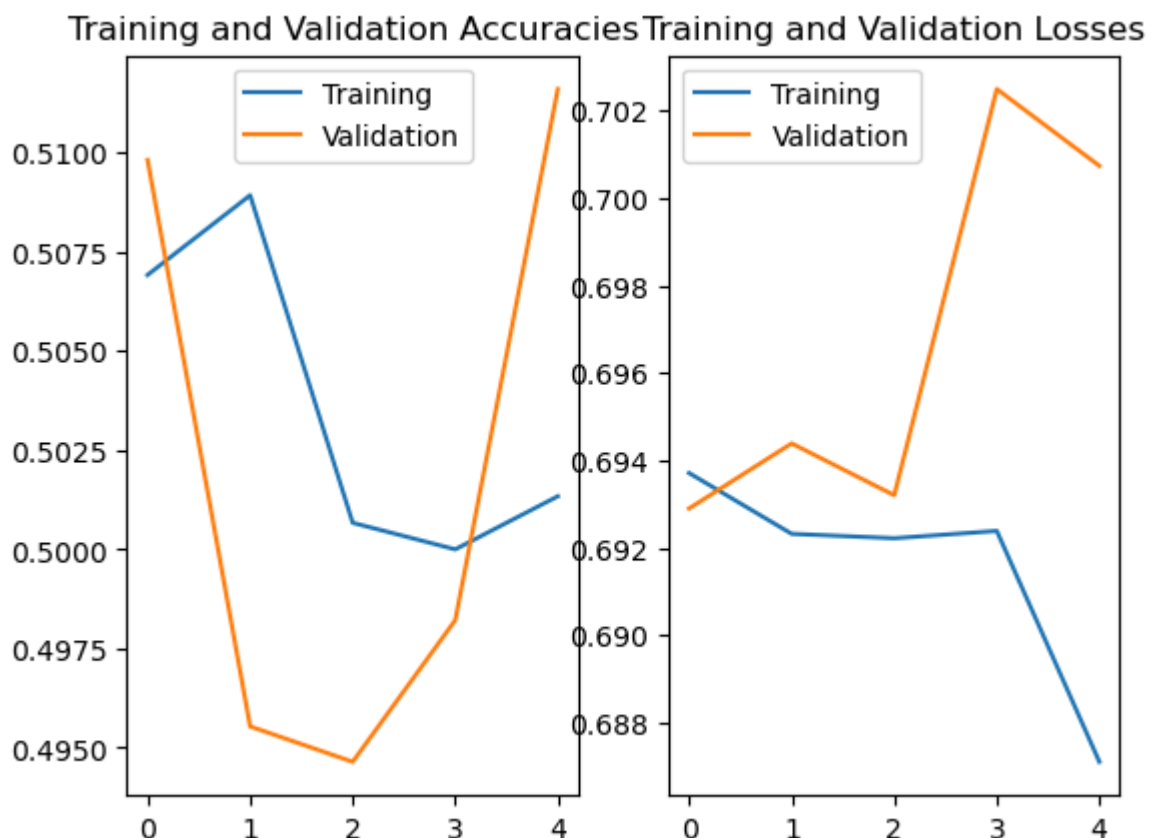
In [12]:
```python
acc = history.history["accuracy"]
val_acc = history.history["val_accuracy"]
loss = history.history["loss"]
val_loss = history.history["val_loss"]

plt.subplot(1, 2, 1)
plt.plot(acc)
plt.plot(val_acc)
plt.title("Training and Validation Accuracies")
plt.legend(["Training", "Validation"])

plt.subplot(1, 2, 2)
plt.plot(loss)
plt.plot(val_loss)
plt.title("Training and Validation Losses")
plt.legend(["Training", "Validation"])
```

Out[12]: <matplotlib.legend.Legend at 0x30f817f40>

In [14]:
```python
text = "Contrary to other reviews, I have zero complaints about the servi
pred = model.predict([text])
pred[0][0]
```

1/1 [==============================] - 1s 707ms/step

Out[14]: 0.026581043

In [ ]: