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Modelling Competition – Assignment 6

1. Pre-processing

The data was downloaded using the link given in the prompt and then split into train, eval and dev with a 85%, 10% and 5 % split. The below code was used for the splitting.

Splitting the dataset

In [7]:
```
import pandas as pd
import numpy as np
```

In [14]:
```
tweet_file = pd.read_csv("training.full.csv")
```

In [15]:
```
#shuffle and split
from sklearn.utils import shuffle
tweet_file = shuffle(tweet_file)
```

In [16]:
```
from sklearn.model_selection import train_test_split
train, test = train_test_split(tweet_file, test_size=0.15)
```

In [17]:
```
dev, eval = train_test_split(test, test_size=0.3333)
```

In [18]:
```
train.to_csv("train.csv", sep=',', encoding='utf-8', index = False)
dev.to_csv("dev.csv", sep=',', encoding='utf-8', index = False)
eval.to_csv("eval.csv", sep=',', encoding='utf-8', index = False)
```

In [19]:
```
train
```

Out[19]:

	Sentiment	TwitterID	Date	QueryType	UserID	Tweet
1041580	4	1957099141	Thu May 28 23:30:54 PDT 2009	NO_QUERY	rehamc	Fact of the day: If I don't know you and you a...
115691	0	1827188268	Sun May 17 10:10:47 PDT 2009	NO_QUERY	MitaliandMe	@siobhanvivian Haha. My mom does that all the ...
90718	0	1759124979	Sun May 10 18:31:03 PDT 2009	NO_QUERY	beckuhk	@teamalexxxx oh, is he talking bout iza?
82332	0	1753020982	Sat May 09 23:49:44 PDT 2009	NO_QUERY	sheswtheband	Flaw: Putting too much faith in people.
1366604	4	2050228781	Fri Jun 05 18:17:38 PDT 2009	NO_QUERY	definatalie	@caitliness I think so. I have no idea. They c...
1423574	4	2058709235	Sat Jun 06 16:28:39 PDT 2009	NO_QUERY	chimmini	Clint and Emily - the wedding was beautiful. W...
735962	0	2264908111	Sun Jun 21 06:16:28 PDT 2009	NO_QUERY	dandnell	@mrsmiddleweek bit worried about travelling do...

This split csv file was uploaded on the S3 bucket and then we ran crawlers on them to make tables on AWS.

Services Resource Groups

Tables A table is the metadata definition that represents your data, including its schema. A table can be used as a source or target in a job definition.

Add tables | Action | Filter by attributes or search by keyword

Name	Database	Location	Classification
dev	devdb	s3://group16-assignment-6/data/dev/	csv
eval	evaldb	s3://group16-assignment-6/data/eval/	csv
train	traindb	s3://group16-assignment-6/data/train/	csv

Integrating the code on our Git with TravisCI

Pylint and Pytest of the Preprocessing code

We were able to achieve a Pylint score of 10/10 after many iterations of updating the code and having the correct variables as well the correct alignment for each of the functions which are a part of our code.

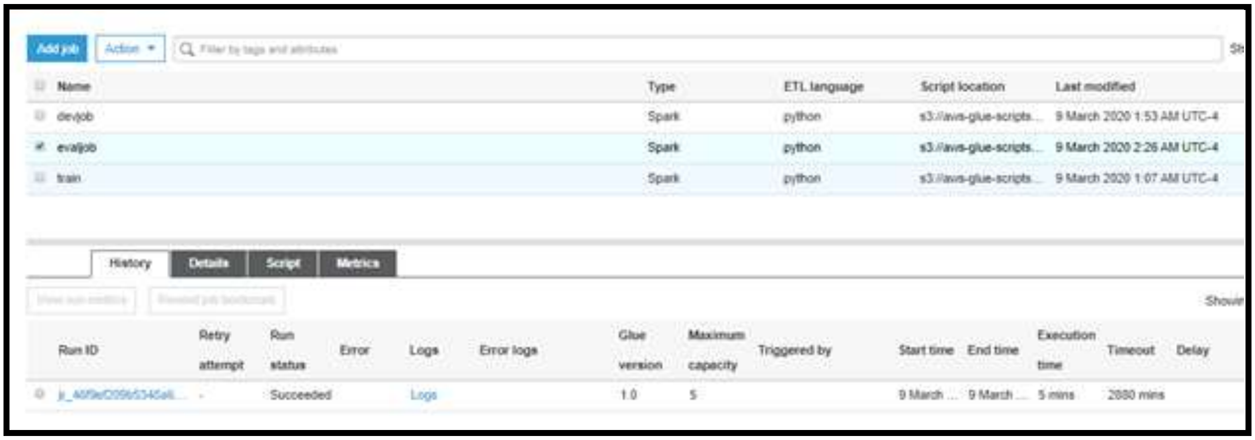
```
============================== 4 passed in 1.08s ===============================
The command "pytest --cov ./" exited with 0.
$ pylint ./twitter_file.py

------------------------------------
Your code has been rated at 10.00/10

The command "pylint ./twitter_file.py" exited with 0.
$ pylint ./twitter_file_test.py

------------------------------------
Your code has been rated at 10.00/10

The command "pylint ./twitter_file_test.py" exited with 0.
```

Coverage of the preprocessing code: We were able to get a coverage of 82% for our code. The images below report the coverage of our code:

```
twitter_file_test.py ....                                                [100%]

============================== 4 passed in 1.16s ===============================
The command "pytest" exited with 0.
$ pytest --cov ./
============================= test session starts ==============================
platform linux -- Python 3.7.1, pytest-5.3.5, py-1.7.0, pluggy-0.13.1
rootdir: /home/travis/build/umeshbodhwani/Twitter-Sentiment-Analysis-on-AWS
plugins: cov-2.8.1
collected 4 items
```

```
Name                     Stmts   Miss  Cover
--------------------------------------------
nltoolkit.py                56     24    57%
twitter_file.py             59      2    97%
twitter_file_test.py        29      0   100%
--------------------------------------------
TOTAL                      144     26    82%
```

We then ran ETL jobs on them to make JSON files.



2. **Tensorflow model using CNN**

In order to do this step, we used the following code to -

- Load embedding into a dictionary and then making an embeddings matrix.
- Made a CNN model which will be trained on our data and saved it.
- The simple CNN model using Adam optimizer was taking around 2.5 hours for just 1 epoch on local system and around 1 hour on SageMaker.
- We did some research to reduce the computation time and found other optimizers such as SGD which runs in significantly lesser time.
- However, our accuracy was compromised while fitting the model on such large dataset
- Below is the change we did for SGD and our corresponding results.

The image below shows the CNN model with SGD optimizer.

```
model = Sequential()
model.add(Embedding(config['embeddings_dictionary_size'], config['embeddings_vector_size'], weights=[matrix_emb], n
model.add(Conv1D(filters = 100, kernel_size = 2, activation = 'relu', padding = 'valid', strides = 1,))
model.add(GlobalMaxPool1D())
model.add(Dense(100, activation = 'relu'))
model.add(Dense(1, activation = 'sigmoid', name ='score'))
model.compile(optimizer='sgd', loss='binary_crossentropy', metrics=['accuracy'])
cnn_model = model
return cnn_model
```

The Result of this code on running locally was as follows:

```
(base) dyn-160-39-142-39:model127 umeshbodhwani$ python sentiment_training.py --train "data/train/*" --dev "data/dev/*" --eval "data/eval/*" --num_epoch 40 --config "training_config.json" --model_output_dir "."
Entering training file
Entering dataset file
Entering model cnn file
Preparing for training...
Fetching train data...
WARNING:tensorflow:From /Users/umeshbodhwani/anaconda3/lib/python3.7/site-packages/tensorflow/python/data/util/random_seed.py:58: add_dispatch_support.<locals>.wrapper (from tensorflow.python.ops.array_ops) :
ill be removed in a future version.
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
WARNING:tensorflow:From /Users/umeshbodhwani/Desktop/Canvas/AI_Cloud/twitter6/twitter_compressed/model127/sentiment_dataset.py:85: DatasetV1.make_one_shot_iterator (from tensorflow.python.data.ops.dataset_op
d will be removed in a future version.
Instructions for updating:
Use `for ... in dataset:` to iterate over a dataset. If using `tf.estimator`, return the `Dataset` object directly from your input function. As a last resort, you can use `tf.compat.v1.data.make_one_shot_ite
Fetching dev data...
Fetching eval data...
WARNING:tensorflow:From /Users/umeshbodhwani/anaconda3/lib/python3.7/site-packages/tensorflow/python/keras/initializers.py:119: calling RandomUniform.__init__ (from tensorflow.python.ops.init_ops) with dtype
will be removed in a future version.
Instructions for updating:
Call initializer instance with the dtype argument instead of passing it to the constructor
2020-03-09 13:29:51.734423: I tensorflow/core/platform/cpu_feature_guard.cc:142] Your CPU supports instructions that this TensorFlow binary was not compiled to use: AVX2 FMA
WARNING:tensorflow:From /Users/umeshbodhwani/anaconda3/lib/python3.7/site-packages/tensorflow/python/ops/init_ops.py:1251: calling VarianceScaling.__init__ (from tensorflow.python.ops.init_ops) with dtype is
l be removed in a future version.
Instructions for updating:
Call initializer instance with the dtype argument instead of passing it to the constructor
Starting training...
Epoch 1/40
13600/13600 [==============================] - 101s 7ms/step - loss: 0.6879 - acc: 0.5440 - val_loss: 0.6839 - val_acc: 0.5586
Epoch 2/40
13600/13600 [==============================] - 49s 4ms/step - loss: 0.6811 - acc: 0.5695 - val_loss: 0.6793 - val_acc: 0.5743
Epoch 3/40
13600/13600 [==============================] - 48s 4ms/step - loss: 0.6773 - acc: 0.5797 - val_loss: 0.6762 - val_acc: 0.5809
Epoch 4/40
13600/13600 [==============================] - 47s 3ms/step - loss: 0.6745 - acc: 0.5850 - val_loss: 0.6739 - val_acc: 0.5857
Epoch 5/40
13600/13600 [==============================] - 48s 4ms/step - loss: 0.6724 - acc: 0.5889 - val_loss: 0.6719 - val_acc: 0.5885
Epoch 6/40
13600/13600 [==============================] - 50s 4ms/step - loss: 0.6706 - acc: 0.5919 - val_loss: 0.6702 - val_acc: 0.5915
```

```
Epoch 7/40
13600/13600 [==============================] - 49s 4ms/step - loss: 0.6690 - acc: 0.5937 - val_loss: 0.6688 - val_acc: 0.5936
Epoch 8/40
13600/13600 [==============================] - 49s 4ms/step - loss: 0.6676 - acc: 0.5956 - val_loss: 0.6675 - val_acc: 0.5951
Epoch 9/40
13600/13600 [==============================] - 50s 4ms/step - loss: 0.6664 - acc: 0.5975 - val_loss: 0.6664 - val_acc: 0.5968
Epoch 10/40
13600/13600 [==============================] - 51s 4ms/step - loss: 0.6653 - acc: 0.5987 - val_loss: 0.6654 - val_acc: 0.5981
Epoch 11/40
13600/13600 [==============================] - 50s 4ms/step - loss: 0.6644 - acc: 0.5995 - val_loss: 0.6645 - val_acc: 0.5988
Epoch 12/40
13600/13600 [==============================] - 51s 4ms/step - loss: 0.6636 - acc: 0.6004 - val_loss: 0.6636 - val_acc: 0.6000
Epoch 13/40
13600/13600 [==============================] - 52s 4ms/step - loss: 0.6628 - acc: 0.6011 - val_loss: 0.6630 - val_acc: 0.6004
Epoch 14/40
13600/13600 [==============================] - 50s 4ms/step - loss: 0.6622 - acc: 0.6016 - val_loss: 0.6624 - val_acc: 0.6012
Epoch 15/40
13600/13600 [==============================] - 51s 4ms/step - loss: 0.6616 - acc: 0.6020 - val_loss: 0.6618 - val_acc: 0.6020
Epoch 16/40
13600/13600 [==============================] - 51s 4ms/step - loss: 0.6611 - acc: 0.6026 - val_loss: 0.6613 - val_acc: 0.6023
Epoch 17/40
13600/13600 [==============================] - 52s 4ms/step - loss: 0.6606 - acc: 0.6031 - val_loss: 0.6609 - val_acc: 0.6023
Epoch 18/40
13600/13600 [==============================] - 52s 4ms/step - loss: 0.6602 - acc: 0.6035 - val_loss: 0.6605 - val_acc: 0.6030
Epoch 19/40
13600/13600 [==============================] - 150s 11ms/step - loss: 0.6598 - acc: 0.6040 - val_loss: 0.6601 - val_acc: 0.603
Epoch 20/40
13600/13600 [==============================] - 48s 4ms/step - loss: 0.6595 - acc: 0.6043 - val_loss: 0.6597 - val_acc: 0.6041
Epoch 21/40
13600/13600 [==============================] - 53s 4ms/step - loss: 0.6591 - acc: 0.6046 - val_loss: 0.6594 - val_acc: 0.6044
Epoch 22/40
13600/13600 [==============================] - 54s 4ms/step - loss: 0.6588 - acc: 0.6048 - val_loss: 0.6591 - val_acc: 0.6048
Epoch 23/40
13600/13600 [==============================] - 54s 4ms/step - loss: 0.6585 - acc: 0.6052 - val_loss: 0.6588 - val_acc: 0.6052
Epoch 24/40
13600/13600 [==============================] - 55s 4ms/step - loss: 0.6582 - acc: 0.6056 - val_loss: 0.6585 - val_acc: 0.6055
Epoch 25/40
13600/13600 [==============================] - 55s 4ms/step - loss: 0.6580 - acc: 0.6058 - val_loss: 0.6582 - val_acc: 0.6055
Epoch 26/40
13600/13600 [==============================] - 56s 4ms/step - loss: 0.6577 - acc: 0.6061 - val_loss: 0.6579 - val_acc: 0.6058
Epoch 27/40
13600/13600 [==============================] - 55s 4ms/step - loss: 0.6575 - acc: 0.6063 - val_loss: 0.6577 - val_acc: 0.6061
Epoch 28/40
13600/13600 [==============================] - 55s 4ms/step - loss: 0.6572 - acc: 0.6066 - val_loss: 0.6575 - val_acc: 0.6061
```

```
Epoch 29/40
13600/13600 [==============================] - 55s 4ms/step - loss: 0.6570 - acc: 0.6068 - val_loss: 0.6573 - val_acc: 0.6062
Epoch 30/40
13600/13600 [==============================] - 57s 4ms/step - loss: 0.6568 - acc: 0.6072 - val_loss: 0.6570 - val_acc: 0.6065
Epoch 31/40
13600/13600 [==============================] - 53s 4ms/step - loss: 0.6566 - acc: 0.6074 - val_loss: 0.6568 - val_acc: 0.6067
Epoch 32/40
13600/13600 [==============================] - 270s 20ms/step - loss: 0.6564 - acc: 0.6076 - val_loss: 0.6566 - val_acc: 0.6069
Epoch 33/40
13600/13600 [==============================] - 49s 4ms/step - loss: 0.6562 - acc: 0.6079 - val_loss: 0.6564 - val_acc: 0.6078
Epoch 34/40
13600/13600 [==============================] - 50s 4ms/step - loss: 0.6560 - acc: 0.6083 - val_loss: 0.6562 - val_acc: 0.6080
Epoch 35/40
13600/13600 [==============================] - 55s 4ms/step - loss: 0.6558 - acc: 0.6085 - val_loss: 0.6561 - val_acc: 0.6083
Epoch 36/40
13600/13600 [==============================] - 56s 4ms/step - loss: 0.6556 - acc: 0.6089 - val_loss: 0.6558 - val_acc: 0.6086
Epoch 37/40
13600/13600 [==============================] - 57s 4ms/step - loss: 0.6554 - acc: 0.6089 - val_loss: 0.6557 - val_acc: 0.6087
Epoch 38/40
13600/13600 [==============================] - 55s 4ms/step - loss: 0.6552 - acc: 0.6092 - val_loss: 0.6555 - val_acc: 0.6091
Epoch 39/40
13600/13600 [==============================] - 60s 4ms/step - loss: 0.6551 - acc: 0.6094 - val_loss: 0.6553 - val_acc: 0.6093
Epoch 40/40
13598/13600 [============================>.] - ETA: 0s - loss: 0.6549 - acc: 0.6097WARNING:tensorflow:Your dataset iterator ran out
_steps * epochs` batches (in this case, 1601 batches). You may need touse the repeat() function when building your dataset.
13600/13600 [==============================] - 52s 4ms/step - loss: 0.6549 - acc: 0.6097 - val_loss: 0.6388 - val_acc: 0.6094
Test loss:0.6535608787089586
Test accuracy:0.6125375032424927
Saving model...
2020-03-09 12:12:00.059053: W tensorflow/python/util/util.cc:280] Sets are not currently considered sequences, but this may change i
WARNING:tensorflow:Entity <function Function._initialize_uninitialized_variables.<locals>.initialize_variables at 0x62d93cd08> could
n filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting
3cd08>: AttributeError: module 'gast' has no attribute 'Num'
WARNING:tensorflow:Entity <function canonicalize_signatures.<locals>.signature_wrapper at 0x62d93cd08> could not be transformed and
e verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <function canonicalize_s
Name: 3, expecting 4
WARNING:tensorflow:Entity <function Function._initialize_uninitialized_variables.<locals>.initialize_variables at 0x647378c80> could
n filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting
78c80>: AttributeError: module 'gast' has no attribute 'Num'
Model successfully saved at: ./sentiment_model.h5
```

We got a Test accuracy of 61.2% with this SGD Optimization in our CNN Model.

We also tried to increase the number of layers and changed the optimizer to Adadelta this time.

Below is our modified code and the corresponding results.

```
model = Sequential()
model.add(Embedding(config['embeddings_dictionary_size'], config['embeddings_vector_size'], weights=[matrix_emb], name='embedding', input_length=
model.add(Conv1D(filters = 100, kernel_size = 2,activation = 'relu', padding = 'valid', strides = 1,))
# model.add(GlobalMaxPool1D )
model.add(Conv1D(filters = 50, kernel_size = 3,activation = 'relu', padding = 'valid', strides =1,))
model.add(Conv1D(filters = 20, kernel_size = 2,activation = 'relu', padding = 'valid', strides =1,))
model.add(Flatten())
model.add(Dense(100, activation = 'relu'))
model.add(Dense(1, activation = 'sigmoid', name ='score'))
model.compile(optimizer='adadelta', loss='binary_crossentropy', metrics=['accuracy'])
cnn_model = model
return cnn_model
```

```
(base) dyn-160-39-142-39:model127 umeshbodhwani$
(base) dyn-160-39-142-39:model127 umeshbodhwani$ python sentiment_training.py --train "data/train/" --dev "data/dev/" --eval "data/eval/" --num_epoch 40 --config "training_config.json" --model_output_dir "."
Entering training file
Entering dataset file
Entering model cnn file
Preparing for training...
Fetching train data...
WARNING:tensorflow:From /Users/umeshbodhwani/anaconda3/lib/python3.7/site-packages/tensorflow/python/data/util/random_seed.py:58: add_dispatch_support.<locals>.wrapper (from tensorflow.python.ops.array_ops) is depre
ill be removed in a future version.
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
WARNING:tensorflow:From /Users/umeshbodhwani/Desktop/Canvas/AI_Cloud/twitter6/twitter_compressed/model127/sentiment_dataset.py:85: DatasetV1.make_one_shot_iterator (from tensorflow.python.data.ops.dataset_ops) is de
d will be removed in a future version.
Instructions for updating:
Use `for ... in dataset:` to iterate over a dataset. If using `tf.estimator`, return the `Dataset` object directly from your input function. As a last resort, you can use `tf.compat.v1.data.make_one_shot_iterator(da
Fetching dev data...
Fetching eval data...
WARNING:tensorflow:From /Users/umeshbodhwani/anaconda3/lib/python3.7/site-packages/tensorflow/python/keras/initializers.py:119: calling RandomUniform.__init__ (from tensorflow.python.ops.init_ops) with dtype is depr
will be removed in a future version.
Instructions for updating:
Call initializer instance with the dtype argument instead of passing it to the constructor
2020-03-09 13:34:43.972077: I tensorflow/core/platform/cpu_feature_guard.cc:142] Your CPU supports instructions that this TensorFlow binary was not compiled to use: AVX2 FMA
WARNING:tensorflow:From /Users/umeshbodhwani/anaconda3/lib/python3.7/site-packages/tensorflow/python/ops/init_ops.py:1251: calling VarianceScaling.__init__ (from tensorflow.python.ops.init_ops) with dtype is depreca
l be removed in a future version.
Instructions for updating:
Call initializer instance with the dtype argument instead of passing it to the constructor
Starting training...
Epoch 1/40
13600/13600 [==============================] - 216s 16ms/step - loss: 0.6916 - acc: 0.5274 - val_loss: 0.6897 - val_acc: 0.5546
Epoch 2/40
13600/13600 [==============================] - 167s 12ms/step - loss: 0.6885 - acc: 0.5565 - val_loss: 0.6871 - val_acc: 0.5596
Epoch 3/40
13600/13600 [==============================] - 171s 13ms/step - loss: 0.6859 - acc: 0.5603 - val_loss: 0.6846 - val_acc: 0.5632
Epoch 4/40
13600/13600 [==============================] - 172s 13ms/step - loss: 0.6836 - acc: 0.5664 - val_loss: 0.6824 - val_acc: 0.5701
Epoch 5/40
13600/13600 [==============================] - 173s 13ms/step - loss: 0.6813 - acc: 0.5715 - val_loss: 0.6801 - val_acc: 0.5736
Epoch 6/40
13600/13600 [==============================] - 173s 13ms/step - loss: 0.6790 - acc: 0.5753 - val_loss: 0.6779 - val_acc: 0.5774
Epoch 7/40
13600/13600 [==============================] - 171s 13ms/step - loss: 0.6767 - acc: 0.5802 - val_loss: 0.6756 - val_acc: 0.5841
Epoch 8/40
13600/13600 [==============================] - 172s 13ms/step - loss: 0.6745 - acc: 0.5861 - val_loss: 0.6734 - val_acc: 0.5875
Epoch 9/40
13600/13600 [==============================] - 173s 13ms/step - loss: 0.6723 - acc: 0.5905 - val_loss: 0.6714 - val_acc: 0.5929
Epoch 10/40
13600/13600 [==============================] - 172s 13ms/step - loss: 0.6702 - acc: 0.5936 - val_loss: 0.6695 - val_acc: 0.5952
Epoch 11/40
13600/13600 [==============================] - 175s 13ms/step - loss: 0.6684 - acc: 0.5963 - val_loss: 0.6679 - val_acc: 0.5970
```

```
Epoch 12/40
13600/13600 [==============================] - 176s 13ms/step - loss: 0.6667 - acc: 0.5985 - val_loss: 0.6663 - val_acc: 0.5990
Epoch 13/40
13600/13600 [==============================] - 176s 13ms/step - loss: 0.6653 - acc: 0.6004 - val_loss: 0.6650 - val_acc: 0.6006
Epoch 14/40
13600/13600 [==============================] - 173s 13ms/step - loss: 0.6640 - acc: 0.6019 - val_loss: 0.6639 - val_acc: 0.6024
Epoch 15/40
13600/13600 [==============================] - 174s 13ms/step - loss: 0.6629 - acc: 0.6033 - val_loss: 0.6630 - val_acc: 0.6037
Epoch 16/40
13600/13600 [==============================] - 182s 13ms/step - loss: 0.6620 - acc: 0.6042 - val_loss: 0.6621 - val_acc: 0.6042
Epoch 17/40
13600/13600 [==============================] - 181s 13ms/step - loss: 0.6612 - acc: 0.6050 - val_loss: 0.6614 - val_acc: 0.6056
Epoch 18/40
13600/13600 [==============================] - 176s 13ms/step - loss: 0.6605 - acc: 0.6057 - val_loss: 0.6608 - val_acc: 0.6058
Epoch 19/40
13600/13600 [==============================] - 177s 13ms/step - loss: 0.6599 - acc: 0.6062 - val_loss: 0.6602 - val_acc: 0.6068
Epoch 20/40
13600/13600 [==============================] - 176s 13ms/step - loss: 0.6594 - acc: 0.6067 - val_loss: 0.6598 - val_acc: 0.6071
Epoch 21/40
13600/13600 [==============================] - 194s 14ms/step - loss: 0.6590 - acc: 0.6072 - val_loss: 0.6594 - val_acc: 0.6078
Epoch 22/40
13600/13600 [==============================] - 181s 13ms/step - loss: 0.6586 - acc: 0.6076 - val_loss: 0.6590 - val_acc: 0.6080
Epoch 23/40
13600/13600 [==============================] - 175s 13ms/step - loss: 0.6582 - acc: 0.6079 - val_loss: 0.6586 - val_acc: 0.6083
Epoch 24/40
13600/13600 [==============================] - 183s 13ms/step - loss: 0.6579 - acc: 0.6084 - val_loss: 0.6583 - val_acc: 0.6086
Epoch 25/40
13600/13600 [==============================] - 177s 13ms/step - loss: 0.6576 - acc: 0.6086 - val_loss: 0.6580 - val_acc: 0.6091
Epoch 26/40
13600/13600 [==============================] - 175s 13ms/step - loss: 0.6573 - acc: 0.6089 - val_loss: 0.6577 - val_acc: 0.6092
Epoch 27/40
13600/13600 [==============================] - 176s 13ms/step - loss: 0.6570 - acc: 0.6091 - val_loss: 0.6574 - val_acc: 0.6098
Epoch 28/40
13600/13600 [==============================] - 176s 13ms/step - loss: 0.6568 - acc: 0.6094 - val_loss: 0.6572 - val_acc: 0.6099
Epoch 29/40
13600/13600 [==============================] - 180s 13ms/step - loss: 0.6565 - acc: 0.6096 - val_loss: 0.6569 - val_acc: 0.6104
Epoch 30/40
13600/13600 [==============================] - 192s 14ms/step - loss: 0.6563 - acc: 0.6099 - val_loss: 0.6567 - val_acc: 0.6108
Epoch 31/40
13600/13600 [==============================] - 190s 14ms/step - loss: 0.6560 - acc: 0.6101 - val_loss: 0.6565 - val_acc: 0.6103
Epoch 32/40
13600/13600 [==============================] - 181s 13ms/step - loss: 0.6558 - acc: 0.6103 - val_loss: 0.6562 - val_acc: 0.6109
Epoch 33/40
13600/13600 [==============================] - 186s 14ms/step - loss: 0.6556 - acc: 0.6105 - val_loss: 0.6560 - val_acc: 0.6112
Epoch 34/40
13600/13600 [==============================] - 198s 15ms/step - loss: 0.6554 - acc: 0.6107 - val_loss: 0.6558 - val_acc: 0.6113
Epoch 35/40
13600/13600 [==============================] - 207s 15ms/step - loss: 0.6552 - acc: 0.6110 - val_loss: 0.6556 - val_acc: 0.6113
Epoch 36/40
```

```
13600/13600 [==============================] - 186s 14ms/step - loss: 0.6556 - acc: 0.6105 - val_loss: 0.6560 - val_acc: 0.6112
Epoch 34/40
13600/13600 [==============================] - 198s 15ms/step - loss: 0.6554 - acc: 0.6107 - val_loss: 0.6558 - val_acc: 0.6113
Epoch 35/40
13600/13600 [==============================] - 207s 15ms/step - loss: 0.6552 - acc: 0.6110 - val_loss: 0.6556 - val_acc: 0.6113
Epoch 36/40
13600/13600 [==============================] - 247s 18ms/step - loss: 0.6550 - acc: 0.6110 - val_loss: 0.6553 - val_acc: 0.6116
Epoch 37/40
13600/13600 [==============================] - 236s 17ms/step - loss: 0.6548 - acc: 0.6112 - val_loss: 0.6552 - val_acc: 0.6115
Epoch 38/40
13600/13600 [==============================] - 174s 13ms/step - loss: 0.6546 - acc: 0.6114 - val_loss: 0.6549 - val_acc: 0.6119
Epoch 39/40
13600/13600 [==============================] - 172s 13ms/step - loss: 0.6544 - acc: 0.6115 - val_loss: 0.6547 - val_acc: 0.6121
Epoch 40/40
13597/13600 [============================>.] - ETA: 0s - loss: 0.6542 - acc: 0.6118WARNING:tensorflow:Your dataset iterator ran out of data; 
_steps * epochs` batches (in this case, 1601 batches). You may need touse the repeat() function when building your dataset.
13600/13600 [==============================] - 171s 13ms/step - loss: 0.6542 - acc: 0.6118 - val_loss: 0.6382 - val_acc: 0.6121
Test loss:0.6533593118190766
Test accuracy:0.6151624917984009
Saving model...
2020-03-09 15:37:33.748083: W tensorflow/python/util/util.cc:280] Sets are not currently considered sequences, but this may change in the futu
WARNING:tensorflow:Entity <function Function._initialize_uninitialized_variables.<locals>.initialize_variables at 0x62f861a60> could not be tr
n filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <function
61a60>: AttributeError: module 'gast' has no attribute 'Num'
WARNING:tensorflow:Entity <function canonicalize_signatures.<locals>.signature_wrapper at 0x62f861a60> could not be transformed and will be ex
e verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <function canonicalize_signatures.
Name: 3, expecting 4
WARNING:tensorflow:Entity <function Function._initialize_uninitialized_variables.<locals>.initialize_variables at 0x644ea6378> could not be tr
n filing the bug, set the verbosity to 10 (on Linux, `export AUTOGRAPH_VERBOSITY=10`) and attach the full output. Cause: converting <function
a6378>: AttributeError: module 'gast' has no attribute 'Num'
Model successfully saved at: ./sentiment_model.h5
(base) dyn-160-39-142-39:model127 umeshbodhwani$
```

Test accuracy at local system using Adadelta optimizer: 61.5%

While Adadelta took more time than SGD, the difference in their results was not significant.

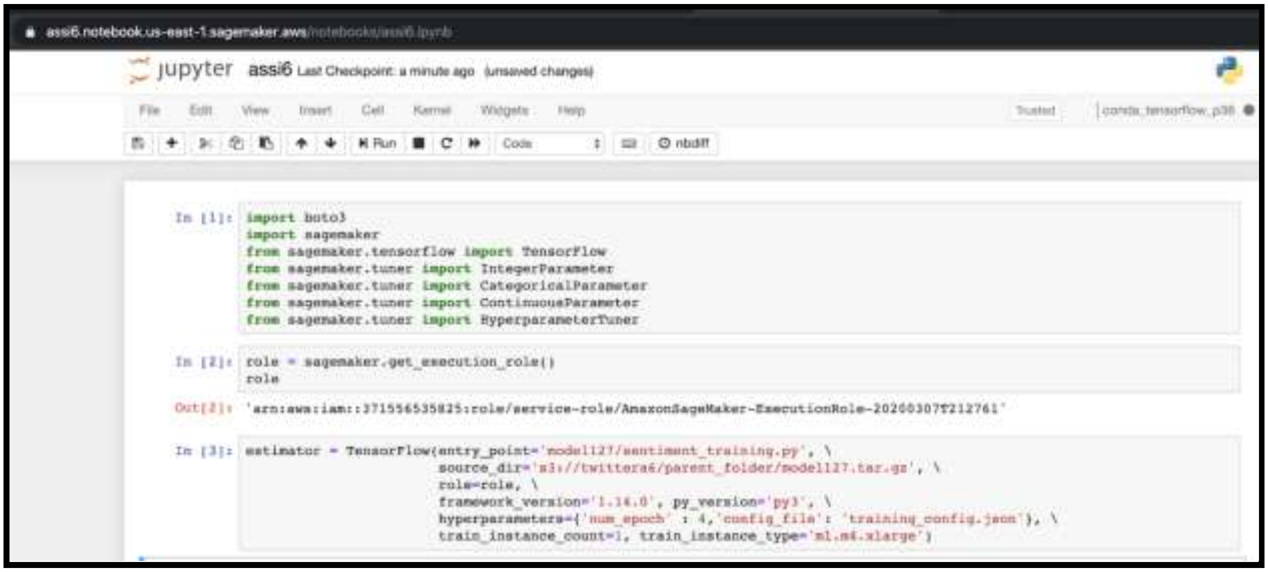
Our best model:

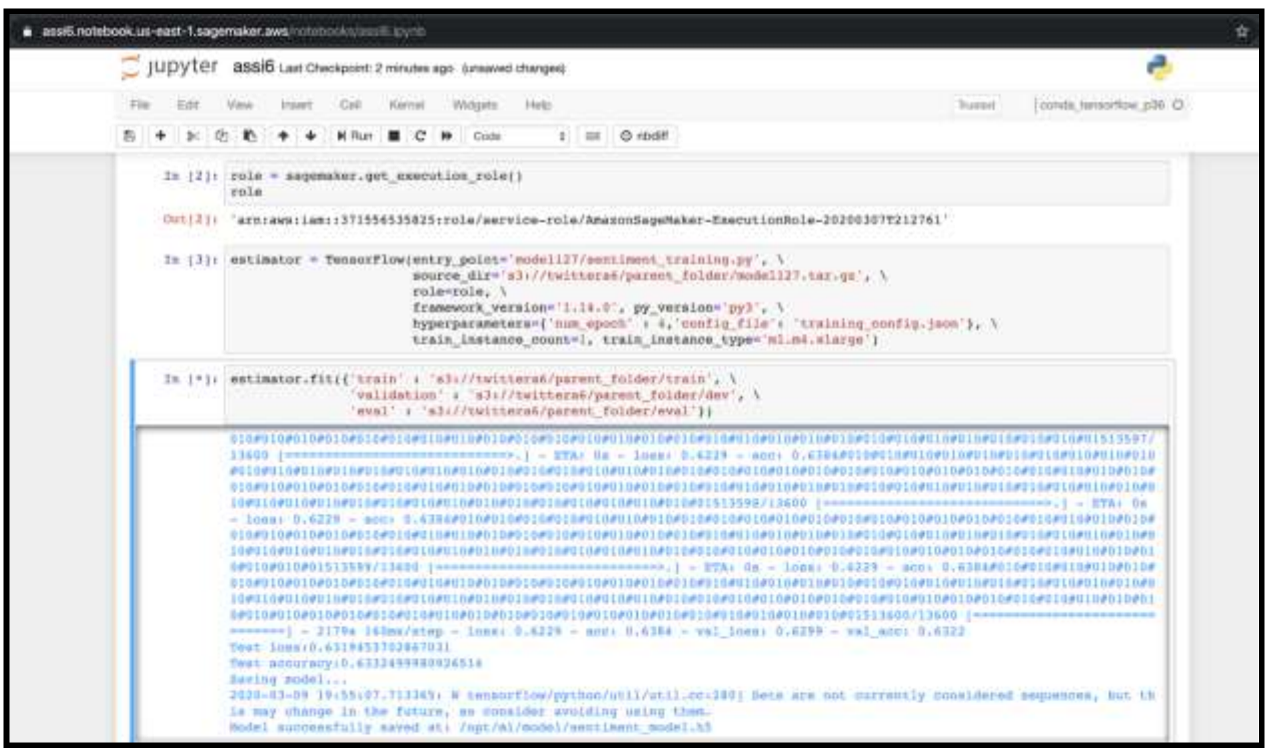
The best accuracy was obtained using the Adam optimizer with more hidden layers, but it took quite a lot time. Hence we decided to run the model on SageMaker with just 4 epochs.

1) We were able to run our model successfully on SageMaker.
2) We faced a lot of issues in running SageMaker with the Educate account. It runs when we upload all our files into SageMaker Jupyter, but even that fails given the huge amount of data for this assignment.
3) We did some research on this and found that the only way to run SageMaker on such huge data was that we save our data in S3 bucket and let SageMaker pick our data from there. For this, we used our personal account on AWS.

3. **Sagemaker Training**

As part of this step, we started a Notebook Instance (Jupyter) on AWS SageMaker and deployed our model.
While doing this through the Educate account, we were not able to get access to the required instances and hence we used a Private account in order to deploy our model on AWS SageMaker. With this we were able to successfully run our model on SageMaker.



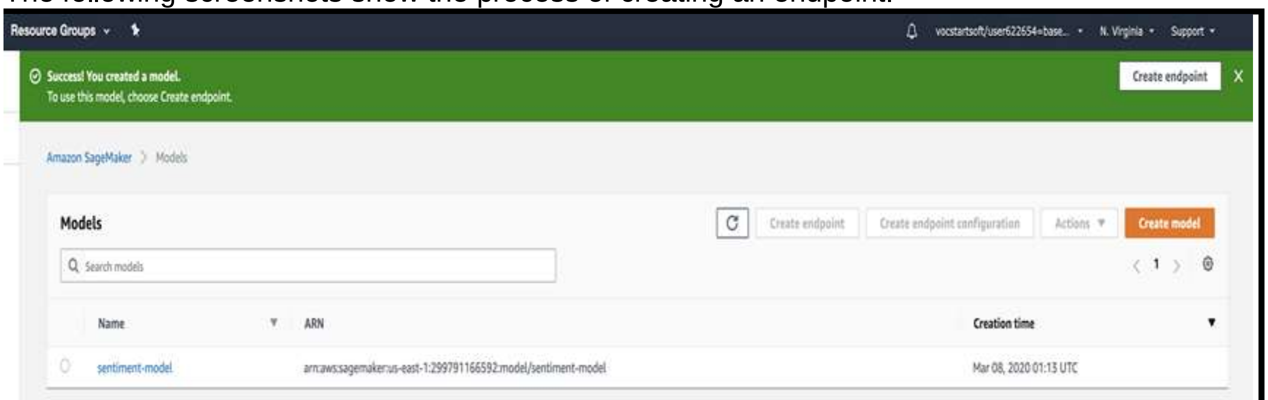


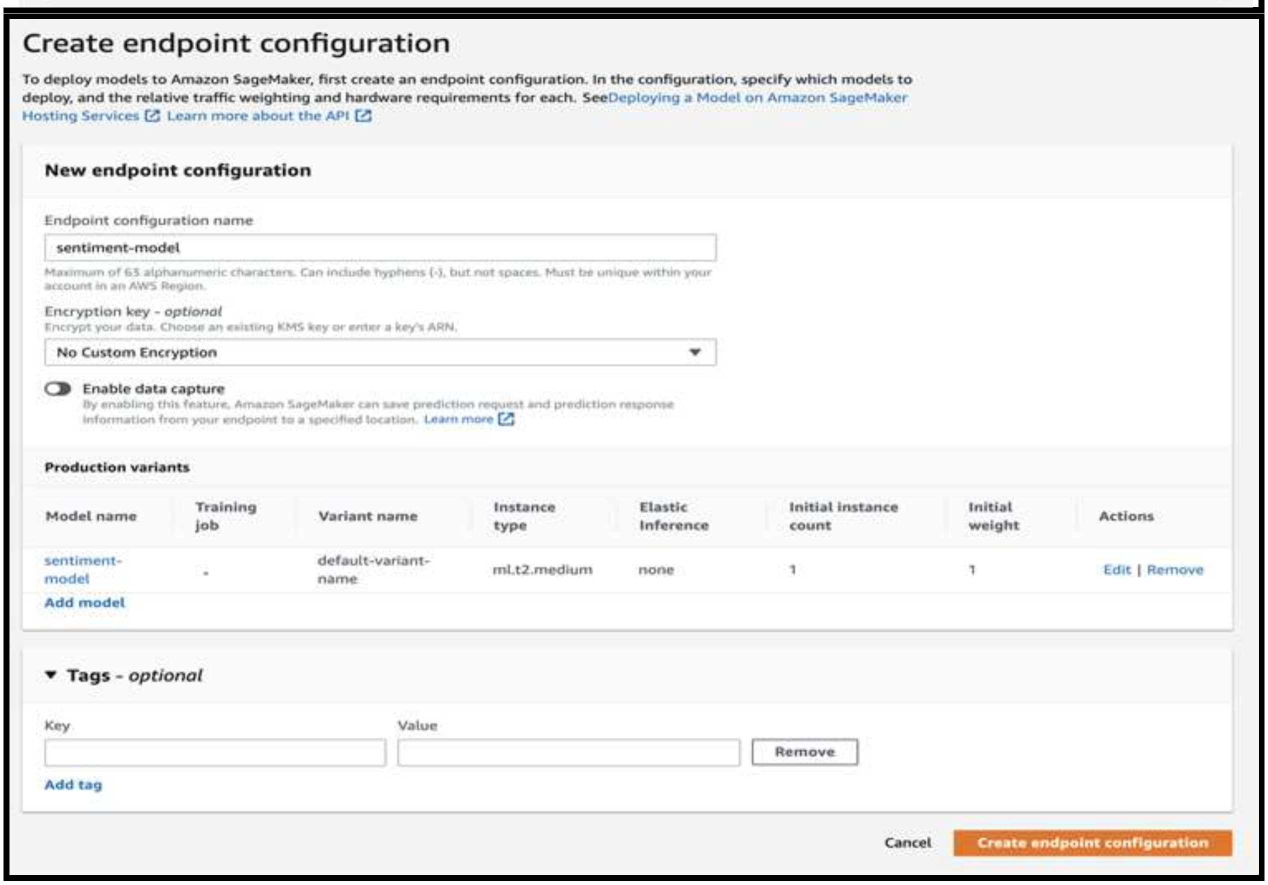
We used the Adam optimizer for training our model on SageMaker. We noticed that each epoch took around 1 hour to run. Hence we could only train our sagemaker model on 4 epochs and got an accuracy of around 64%.

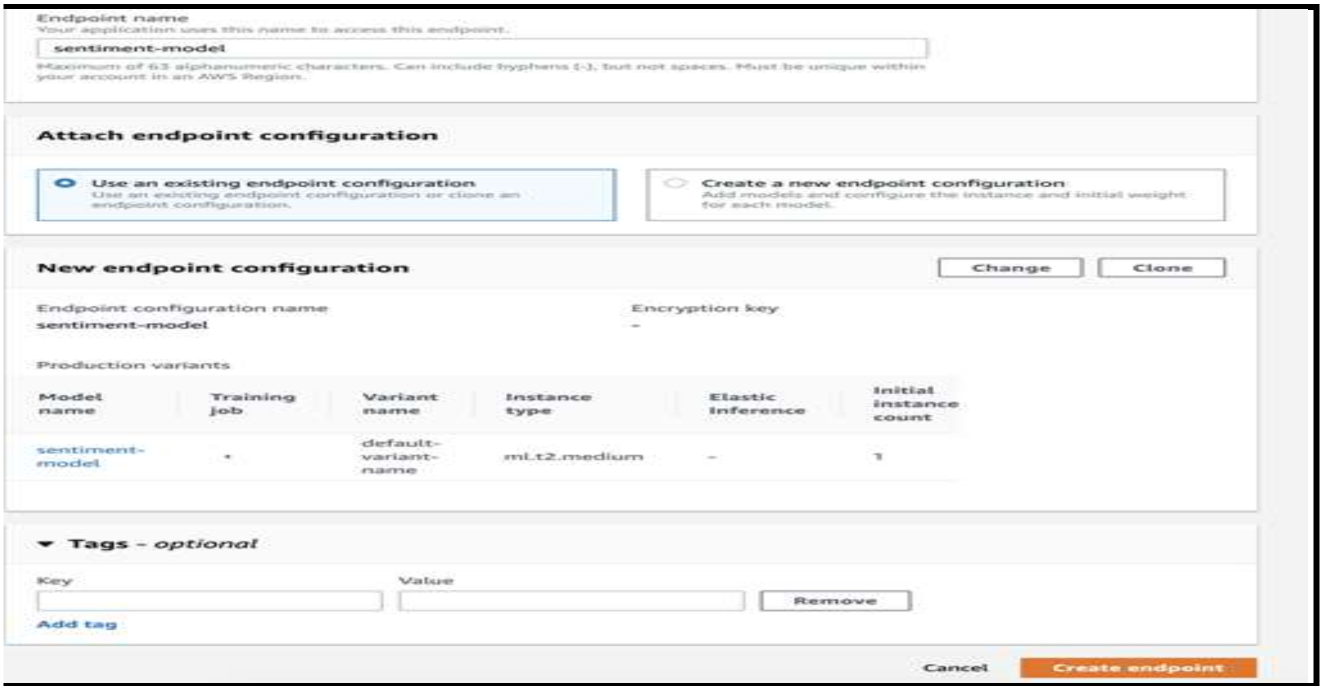
Had we been given more computation power, we would have run our CNN model on a larger number of epochs and achieved a better accuracy

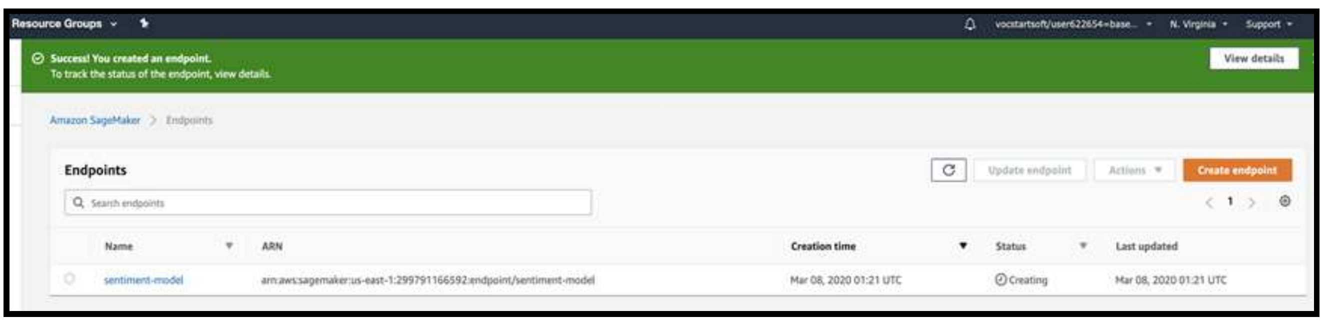
Sagemaker Inference

In this step, we then deployed our model as a SageMaker inference endpoint.
While doing this, in the endpoint configuration we used the cheapest instance “ml.t2.medium”.
The following screenshots show the process of creating an endpoint.






Endpoint name
sentiment-model
Attach endpoint configuration
Use an existing endpoint configuration
Create a new endpoint configuration
New endpoint configuration
Change
Clone
Endpoint configuration name
sentiment-model
Encryption key
Production variants
Model name
Training job
Variant name
Instance type
Elastic Inference
Initial instance count
sentiment-model
default-variant-name
ml.t2.medium
1
Tags - optional
Key
Value
Remove
Add tag
Cancel
Create endpoint


Resource Groups
Success! You created an endpoint.
To track the status of the endpoint, view details.
View details
Amazon SageMaker
Endpoints
Endpoints
Update endpoint
Actions
Create endpoint
Search endpoints
Name
ARN
Creation time
Status
Last updated
sentiment-model
arn:aws:sagemaker:us-east-1:299791166592:endpoint/sentiment-model
Mar 08, 2020 01:21 UTC
Creating
Mar 08, 2020 01:21 UTC

4**. Model Deployment**

As part of this step, we have made a Lambda Function that does the following:
• Pre-process with our code for the pipeline
• Model inference with the SageMaker endpoint
• Post processing
The lambda function takes JSON input with a “tweet” key and produces a JSON output with a “sentiment” key and a value that can either be “positive” or “negative” based on the model prediction.
In order to test this part, we are giving a sample tweet and then checking if its been identified as positive or negative.

lambda_function.py

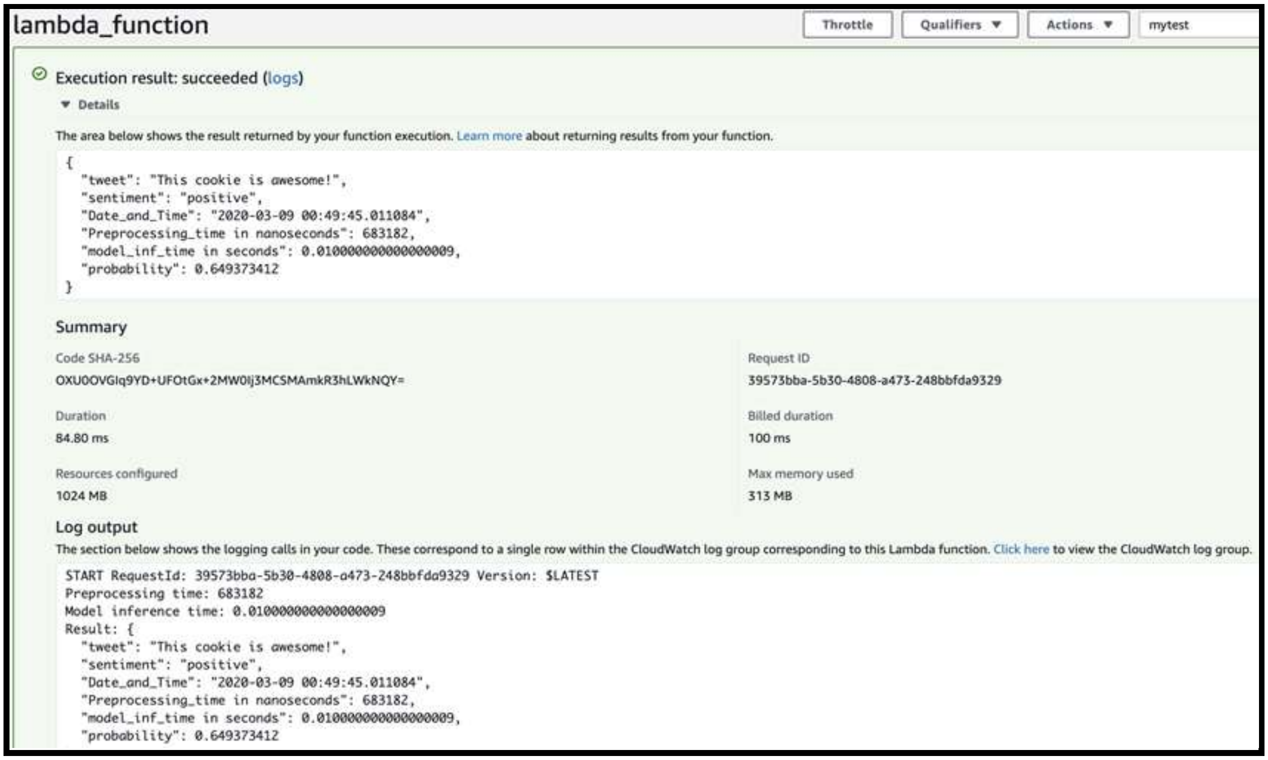
```python
from twitter_file import TwitterClass
tw = TwitterClass()

sage_maker_client = boto3.client("runtime.sagemaker")


def lambda_handler(event, context):

    now = datetime.datetime.now()
    Date_and_Time = str(now)


    initial_time = time.time_ns()

    tweet = event["tweet"]
    features = tw.processed(tweet)

    final_time = time.time_ns()
    Preprocessing_time = final_time-initial_time
    print('Preprocessing time:',Preprocessing_time)

    model_payload = {
        'embedding_input': features,
    }

    model_initial_time= time.clock()

    model_response = sage_maker_client.invoke_endpoint(
        EndpointName="sentiment-model",
        ContentType="application/json",
        Body=json.dumps(model_payload))

    model_final_time= time.clock()
    model_inf_time = model_final_time - model_initial_time
    print('Model inference time:',model_inf_time)


    result = json.loads(model_response["Body"].read().decode())

    response = {}

    response["tweet"] = tweet

    if result["predictions"][0][0] >= 0.5:
        response["sentiment"] = "positive"
    else:
        response["sentiment"] = "negative"

    response['Date_and_Time'] = Date_and_Time
    response['Preprocessing_time in nanoseconds'] = Preprocessing_time
    response['model_inf_time in seconds'] = model_inf_time
    response['probability'] = result["predictions"][0][0]


    print ("Result: " + json.dumps(response, indent = 2))
    # TODO implement
    return response
```

Payload Logging using Lambda Function

Here we modified the Lambda Function (above) created to calculate and display the following:

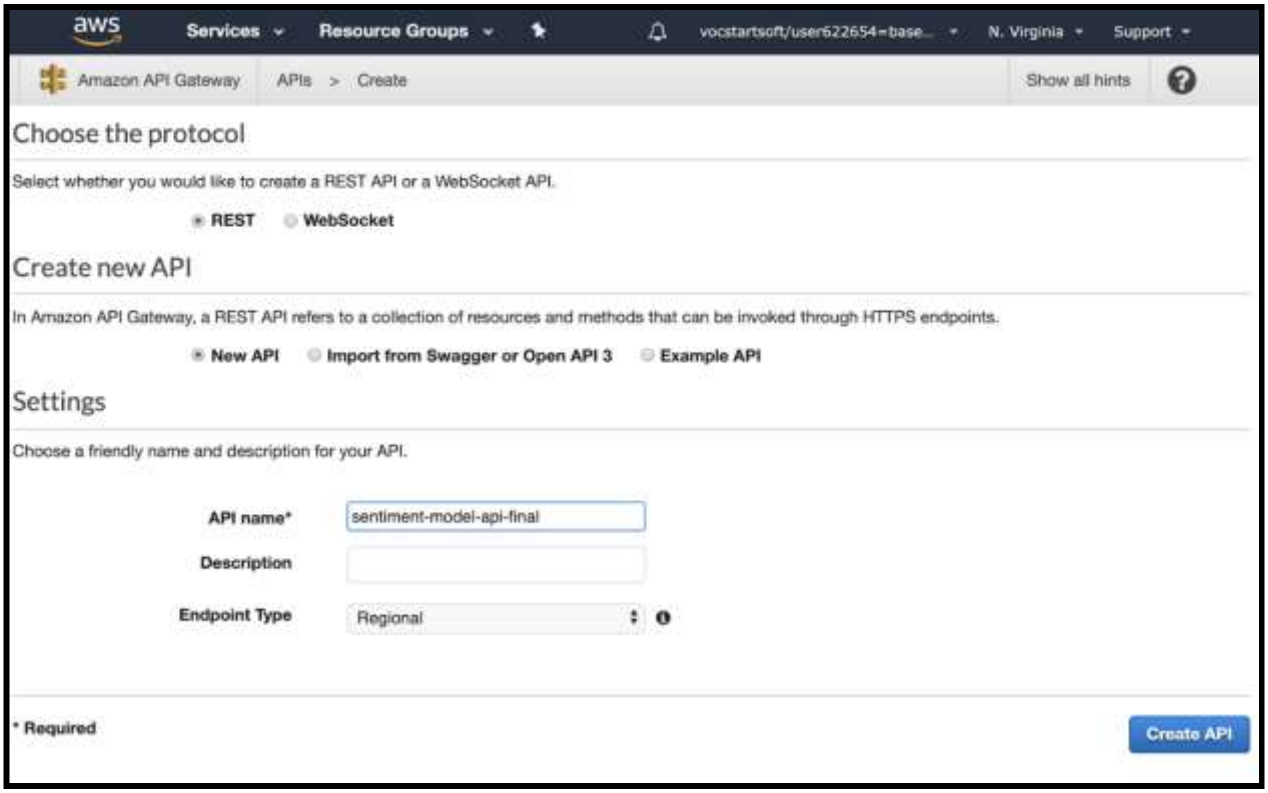
- Date and time of the request
- Tweet
- Sentiment
- Probability from the model
- Pre-processing time
- Model inference time

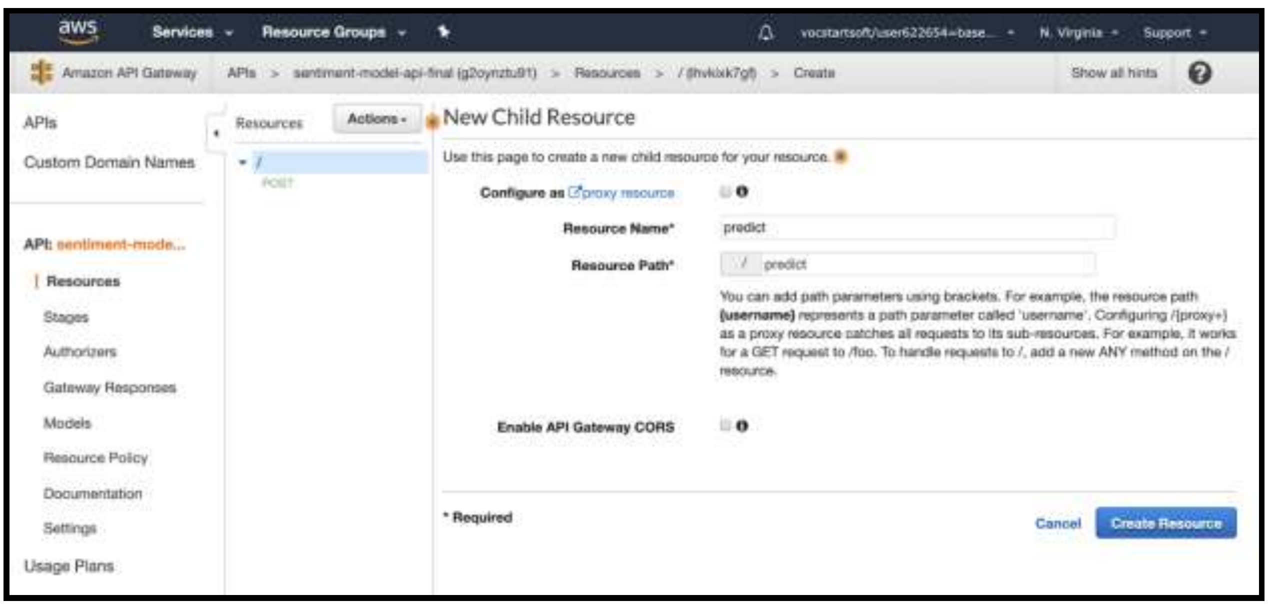
Then the lambda function logs a JSON object to the bucket in S3 with the above details.
The image below shows our result on AWS.

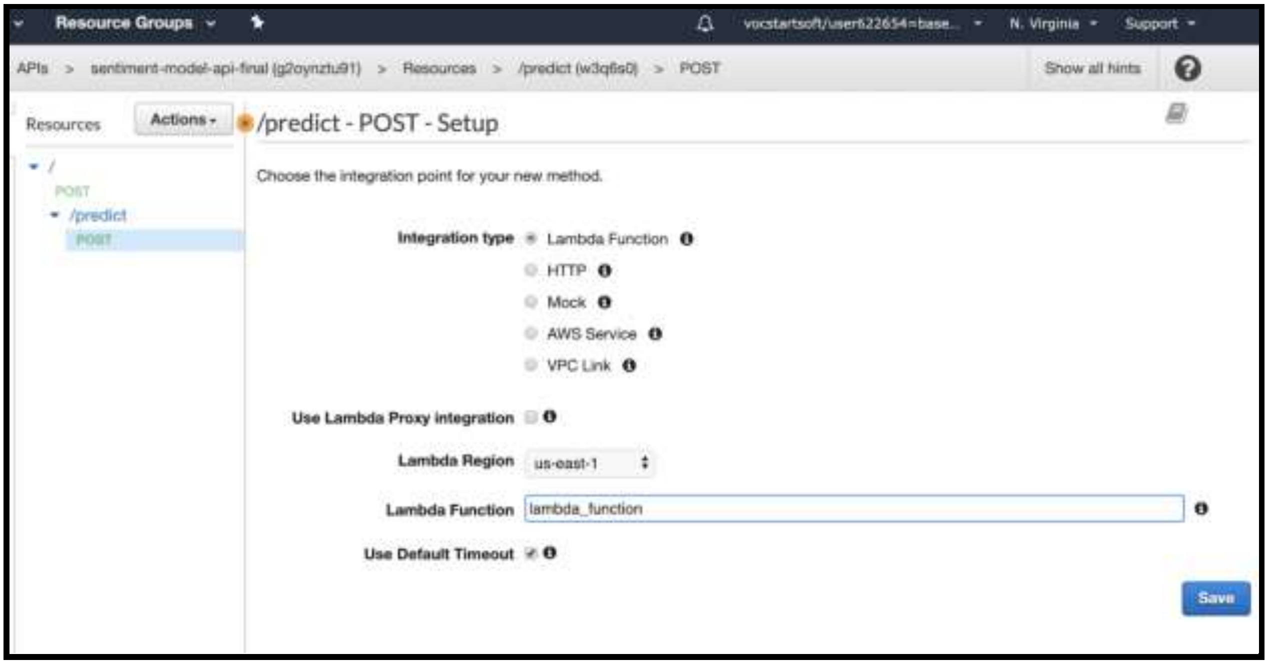


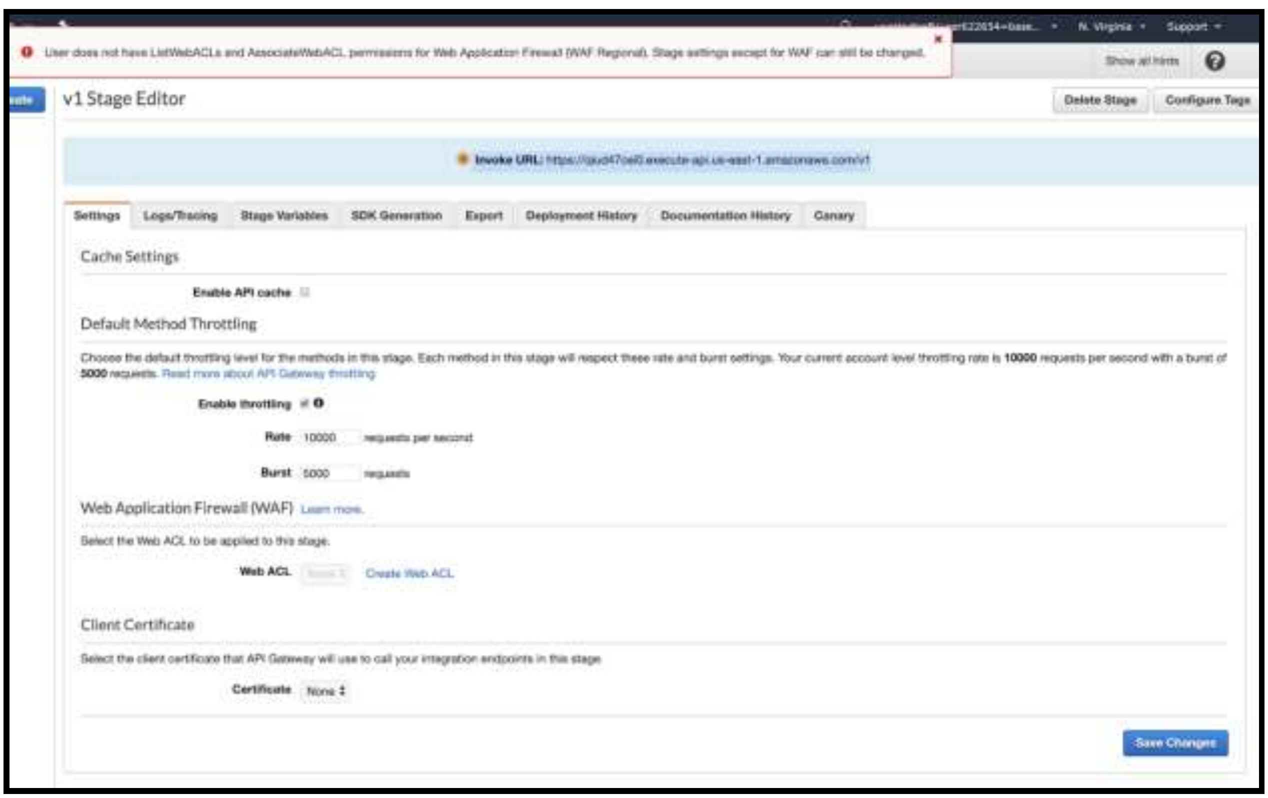
REST API

Here in this step we created an API Gateway to expose our lambda function.
The gateway implemented a "/predict" resource with a "POST" request method.
We then deployed it under a "v1" stage. The following set of images shows how we went about this process:

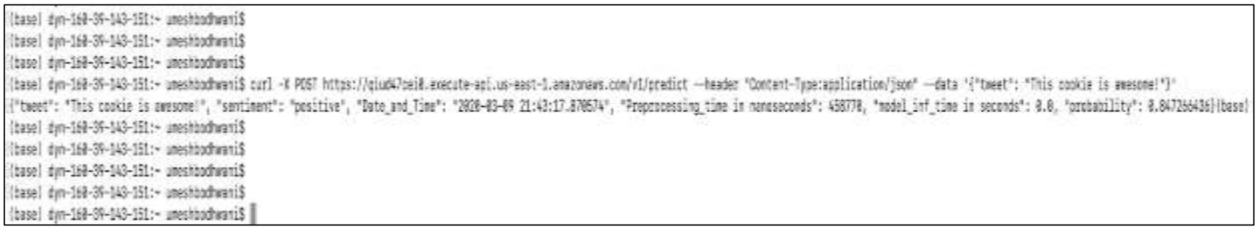

Services
Resource Groups
Amazon API Gateway
APIs > Create
Show all hints
Choose the protocol
Select whether you would like to create a REST API or a WebSocket API.
REST
WebSocket
Create new API
In Amazon API Gateway, a REST API refers to a collection of resources and methods that can be invoked through HTTPS endpoints.
New API
Import from Swagger or Open API 3
Example API
Settings
Choose a friendly name and description for your API.
API name*
sentiment-model-api-final
Description
Endpoint Type
Regional
* Required
Create API


Services
Resource Groups
Amazon API Gateway
APIs > sentiment-model-api-final (g2oynztu91) > Resources > / (lhvkxk7g0) > Create
Show all hints
APIs
Custom Domain Names
API: sentiment-mode...
Resources
Stages
Authorizers
Gateway Responses
Models
Resource Policy
Documentation
Settings
Usage Plans
Resources
Actions
New Child Resource
Use this page to create a new child resource for your resource.
Configure as proxy resource
Resource Name*
predict
Resource Path*
predict
Enable API Gateway CORS
* Required
Cancel
Create Resource



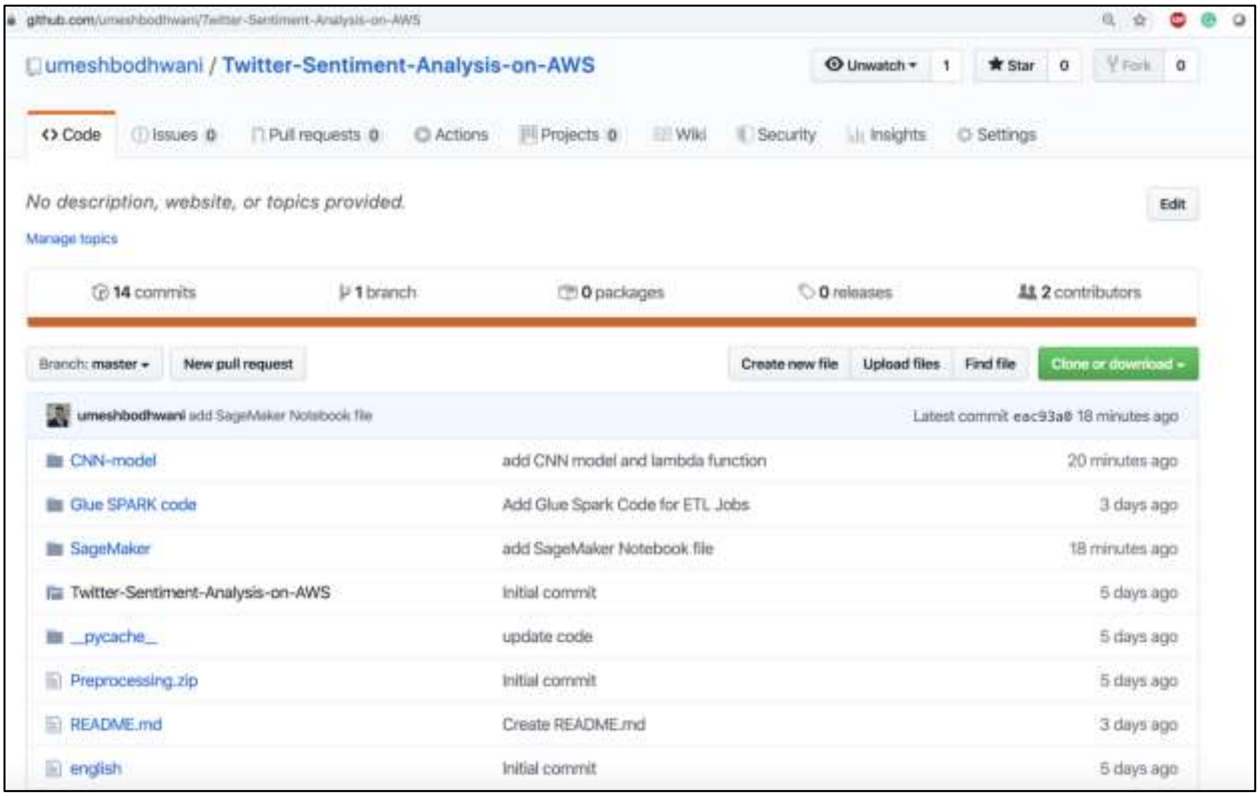


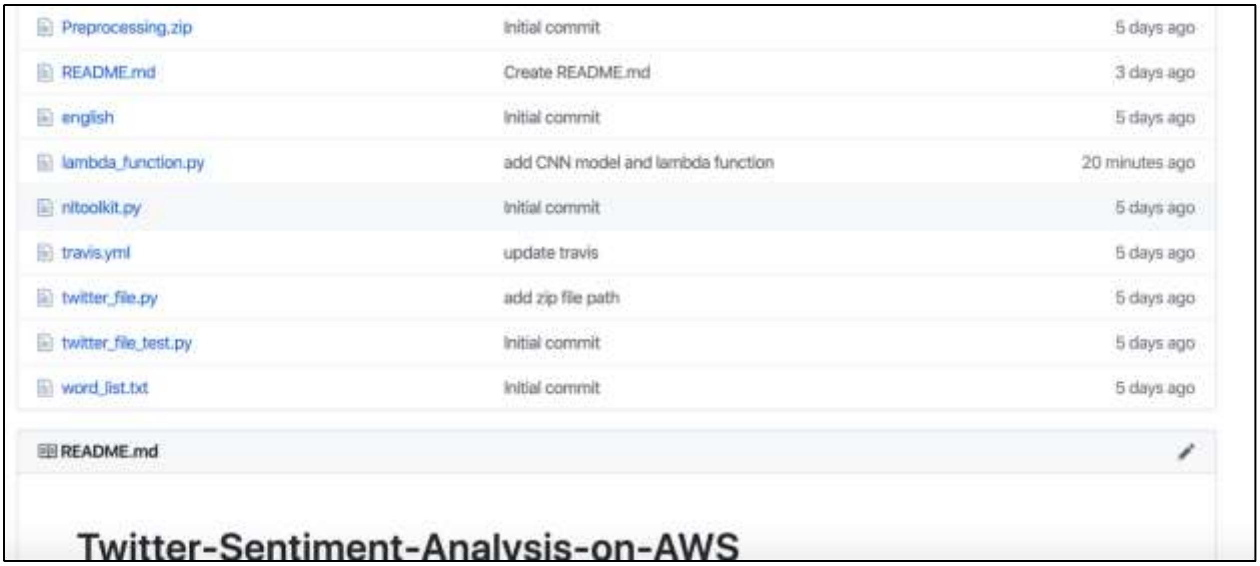
Invoke URL: https://qiud47cei0.execute-api.us-east-1.amazonaws.com/v1



```
(base) dyn-160-39-143-151:~ umeshbodhwani$
(base) dyn-160-39-143-151:~ umeshbodhwani$
(base) dyn-160-39-143-151:~ umeshbodhwani$
(base) dyn-160-39-143-151:~ umeshbodhwani$ curl -X POST https://qiud47cei0.execute-api.us-east-1.amazonaws.com/v1/predict --header "Content-Type:application/json" --data '{"tweet": "This cookie is awesome!"}'
{"tweet": "This cookie is awesome!", "sentiment": "positive", "Date_and_Time": "2020-03-09 21:43:17.870574", "Preprocessing_time in nanoseconds": 458770, "model_inf_time in seconds": 0.0, "probability": 0.8472566436}(base)
(base) dyn-160-39-143-151:~ umeshbodhwani$
(base) dyn-160-39-143-151:~ umeshbodhwani$
(base) dyn-160-39-143-151:~ umeshbodhwani$
(base) dyn-160-39-143-151:~ umeshbodhwani$
(base) dyn-160-39-143-151:~ umeshbodhwani$
```

curl -X POST https://qiud47cei0.execute-api.us-east-1.amazonaws.com/v1/predict --header "Content-Type:application/json" --data '{"tweet": "This cookie is awesome!"}'





Links:

Embedding dict: https://twittera6.s3.amazonaws.com/parent_folder/embedding_list/glove.txt

Train: https://twittera6.s3.amazonaws.com/parent_folder/train/train.json

Dev: https://twittera6.s3.amazonaws.com/parent_folder/dev/dev.json

Eval: https://twittera6.s3.amazonaws.com/parent_folder/eval/eval.json

Model: https://twittera6.s3.amazonaws.com/parent_folder/model127.tar.gz

Github URL: https://github.com/umeshbodhwani/Twitter-Sentiment-Analysis-on-AWS

REST API Deployment link:

curl -X POST https://qiud47cei0.execute-api.us-east-1.amazonaws.com/v1/predict --header "Content-Type:application/json" --data '{"tweet": "This cookie is awesome!"}'