



SPEECH SENTIMENT ANALYSIS
USING RECURSIVE NEURAL NETWORKS
(LSTM)





Objective

- To achieve accuracy in predicting the sentiment of the speech
- Attempt to extend text-based sentiment analysis to speech
- Incorporated word sequencing on training data, and LSTM model for fitting the same

TRAINING DATASET

-[Sentiment140 Dataset]-

*Courtesy of Stanford

1.6 Million
RECORDS

Real Extracted Tweets

6
VARIABLES

Sentiment, Tweet ID, Date, Query,
Username, Text of the tweet

2
SENTIMENTS

Positive, negative

* Citation: Go, A., Bhayani, R. and Huang, L., 2009. Twitter sentiment classification using distant supervision. *CS224N Project Report, Stanford, 1(2009)*, p.12.

Procedure



Import data



Pre-Process



Feature Engineer



Define Model



Fit and Evaluate Model



**Input Speech from microphone
and extract text**



Predict sentiment



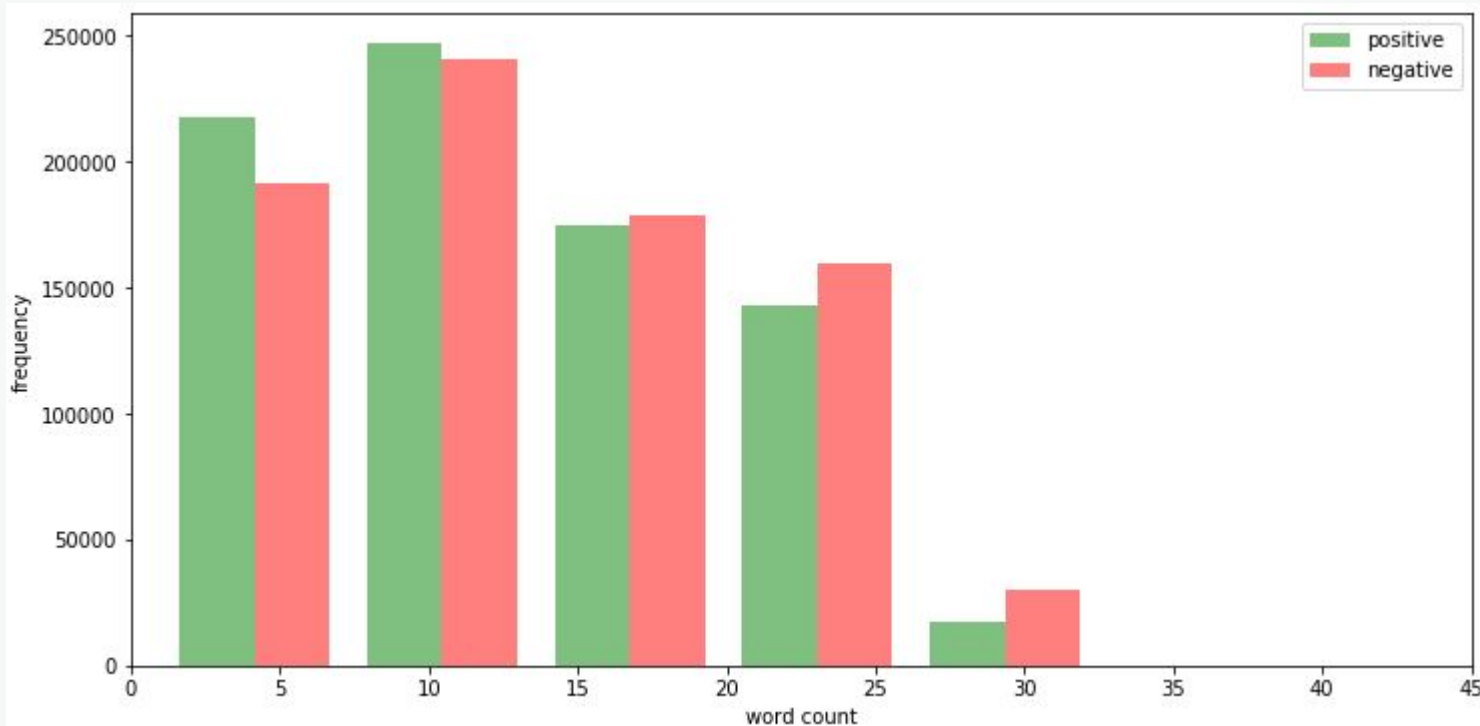
Imported Data

	sentiment	id	date	flag	user	text
0	0	1467810369	Mon Apr 06 22:19:45 PDT 2009	NO_QUERY	_TheSpecialOne_	@switchfoot http://twitpic.com/2y1zl - Awww, t...
1	0	1467810672	Mon Apr 06 22:19:49 PDT 2009	NO_QUERY	scotthamilton	is upset that he can't update his Facebook by ...
2	0	1467810917	Mon Apr 06 22:19:53 PDT 2009	NO_QUERY	mattycus	@Kenichan I dived many times for the ball. Man...
3	0	1467811184	Mon Apr 06 22:19:57 PDT 2009	NO_QUERY	ElleCTF	my whole body feels itchy and like its on fire
4	0	1467811193	Mon Apr 06 22:19:57 PDT 2009	NO_QUERY	Karoli	@nationwideclass no, it's not behaving at all....
...
1599995	4	2193601966	Tue Jun 16 08:40:49 PDT 2009	NO_QUERY	AmandaMarie1028	Just woke up. Having no school is the best fee...
1599996	4	2193601969	Tue Jun 16 08:40:49 PDT 2009	NO_QUERY	TheWDBboards	TheWDB.com - Very cool to hear old Walt interv...
1599997	4	2193601991	Tue Jun 16 08:40:49 PDT 2009	NO_QUERY	bpbabe	Are you ready for your MoJo Makeover? Ask me f...
1599998	4	2193602064	Tue Jun 16 08:40:49 PDT 2009	NO_QUERY	tinydiamondz	Happy 38th Birthday to my boo of all time!!! ...
1599999	4	2193602129	Tue Jun 16 08:40:50 PDT 2009	NO_QUERY	RyanTrevMorris	happy #charitytuesday @theNSPCC @SparksCharity...

160000 rows x 6 columns



- [Wordcount v Freq by Sentiment] -





Pre-Processing



Clean tweets by removing link, user and special characters



Remove stopwords



Obtain tokenized versions of tweets and use stemming



Feature Engineering



Tweets' text converted to corpus



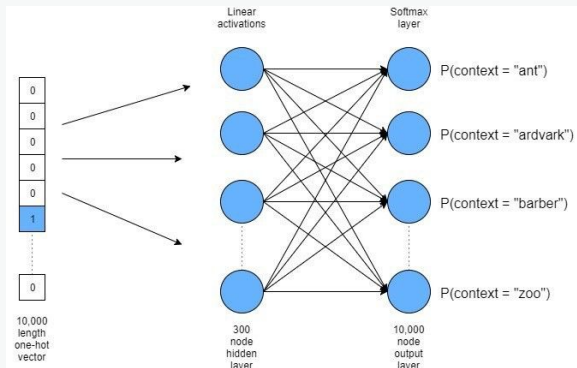
Corpus (text) converted to feature vector (numeric) using word2vec



Word feature vectors help ready input for the neural network



- Two layer neural net that processes text input
- Inputs text corpus and gives word feature vector as output
- Groups contextually similar words in the vector space, mathematically, using cosine distance



```
w2v_model.most_similar("silly")
```

```
[('dumb', 0.4478142559528351),  
 ('stupid', 0.4135172963142395),  
 ('funny', 0.40255165100097656),  
 ('retarded', 0.3919326066970825),  
 ('weird', 0.38109514117240906),  
 ('wierd', 0.35878676176071167),  
 ('childish', 0.35817572474479675),  
 ('rude', 0.33793044090270996),  
 ('mean', 0.3277094066143036),  
 ('insensitive', 0.3249208927154541)]
```



Neural Network Model Definition



Neural RNN-LSTM Network defined

Model: "sequential_1"

Layer (type)	Output Shape	Param #
embedding_1 (Embedding)	(None, 300, 300)	100652400
dropout_1 (Dropout)	(None, 300, 300)	0
lstm_1 (LSTM)	(None, 100)	160400
dense_1 (Dense)	(None, 1)	101

Total params: 100,812,901

Trainable params: 160,501

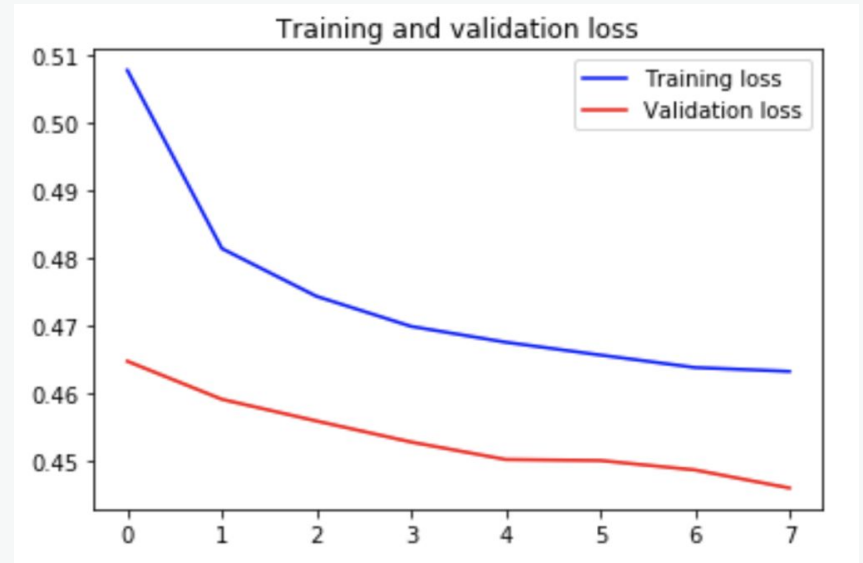
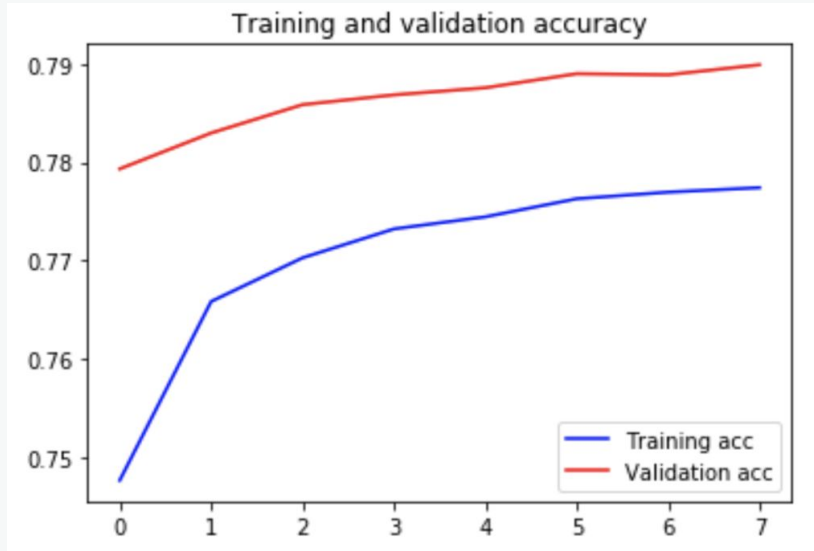
Non-trainable params: 100,652,400



Fitting and Evaluation



Test and Validation Results





Fitting and Evaluation



Results on Test Set

- **Accuracy:** 0.8384401202201843
- **Loss:** 0.3755808174610138

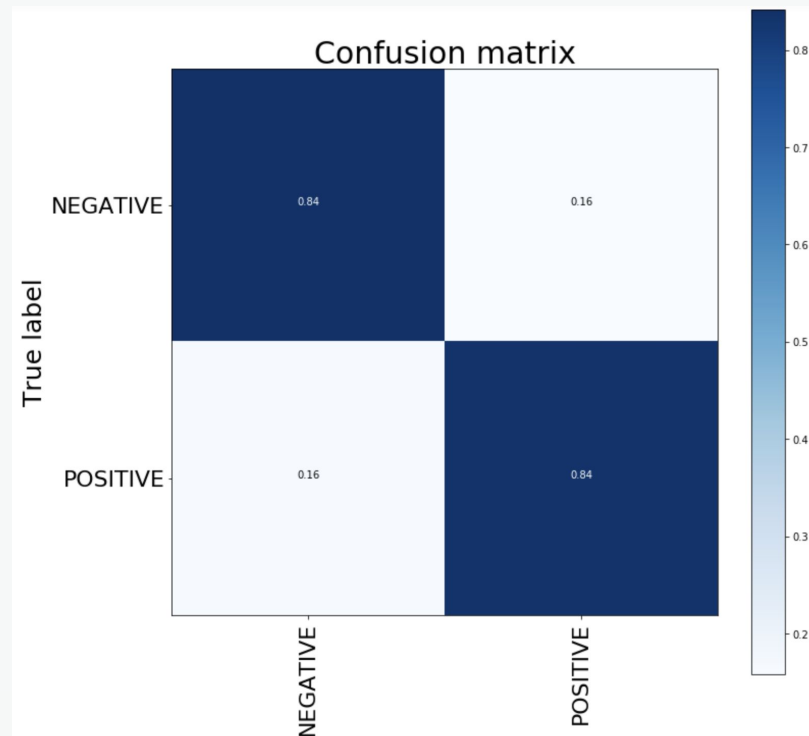


Fitting and Evaluation



Results on Test Set

	precision	recall
NEGATIVE	0.83	0.84
POSITIVE	0.84	0.84





Speech Sentiment Prediction



Inputting Speech from Microphone

- Speech recognition capabilities incorporated using the SpeechRecognition Python module
- Recognized speech is then converted to text for analysis



Speech Sentiment Prediction



Prediction

- Classified sentiment label, as well as the sentiment score is returned

Go ahead and say something using the device microphone!

it's a beautiful day outside

```
predict(text)
```

```
{'label': 'POSITIVE', 'score': 0.9126543998718262}
```

Challenges



Detection of sarcasm, double-negation



Contextual-sentiment detection problem alleviated but still present



Computational time



Complexities in integrating tone and emotion detection



Difficulties with dialects and pace of speech



Business Applications

- Monitoring call center and customer support performance
- Gauging Consumer Responses
- Opinion Analysis via interviews
- Developing branding and marketing strategies
- Detection of hate speech in online videos and podcasts





-[References]-

- Sentiment140 dataset: Go, A., Bhayani, R. and Huang, L., 2009. Twitter sentiment classification using distant supervision. CS224N Project Report, Stanford, 1(2009), p.12.
- word2vec: Distributed Representations of Words and Phrases and their Compositionality, Tomas Mikolov, Ilya Sutskever, Kai Chen, Greg Corrado, Jeffrey Dean, Google Inc., (2013)
- SpeechRecognition: Zhang, Anthony. 2017. Speech Recognition (version 3.8).
- LSTM Neural Networks: Sepp Hochreite, Jürgen Schmidhuber, Neural Computation, Volume 9 Issue 8, November 15, 1997