

# Variation in Political News

## An NLP Approach

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# Background

*"If you can't measure it, you can't improve it."*

— Peter Drucker

- The 2016 United States Presidential Election raised doubts for many about the quality of their news.
- Allcott and Gentzkow [2017] estimate that the average US adult read and remembered about one, and possibly up to several, fake news articles during the election period.
- It is now not uncommon for the president of the United States to tweet that certain news sources are "Fake News".

# Literature Review: Computer Science

- The LSTM architecture was introduced in Hochreiter and Schmidhuber [1997].
- More recently, Gers and Schmidhuber [2000], Chung et al. [2014], and Yao et al. [2015] introduce variations.
- Greff et al. [2016] show them all to be roughly equivalent.
- Schuster and Paliwal [1997] introduced the first bidirectional RNN.
- Together, bidirectional LSTM architectures prove to be among the most accurate models for language tasks, consistent with Wang et al. [2015].

# Literature Review: Economics

- Gentzkow and Shapiro [2010] find that readers prefer to consume “like-minded” news and this can account for around 20% of the variation in political slant or bias.
- Gentzkow and Shapiro [2006] also show that a Bayesian consumer will reinforce their beliefs of a given news source quality when they read something that confirms their priors.
- Together, these works suggest that political news bias may tactical, and that this polarization we see may be self-reinforcing.
- Gentzkow and Shapiro [2008] suggest that competition in information markets may actually be counterproductive.

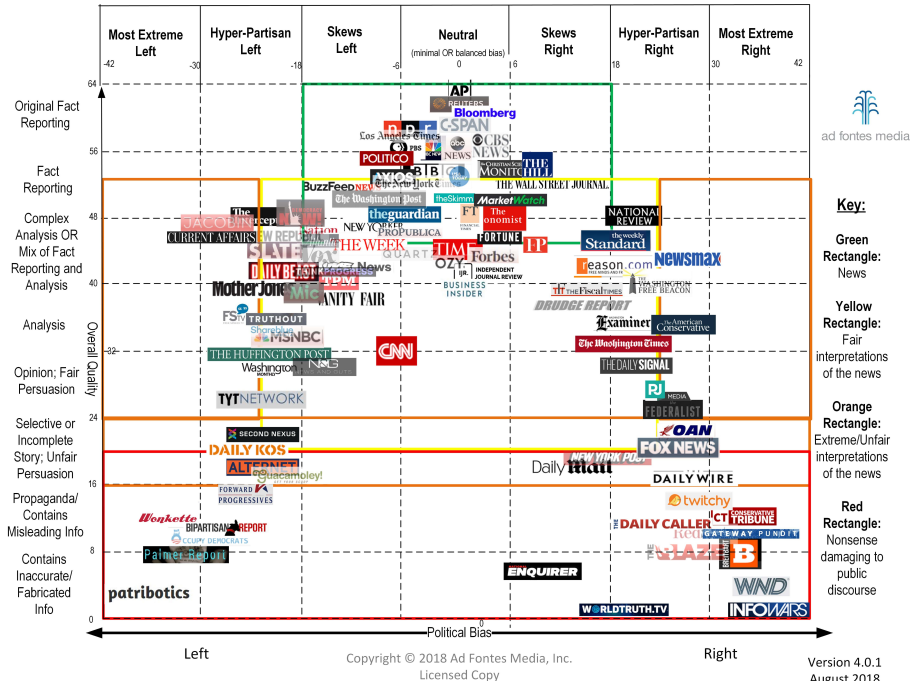
# Summary

- With a goal of classifying articles by their news source, I scraped several thousand news articles from Fox, Vox, and PBS News.
- I find that a relatively simple, bidirectional, LSTM recurrent neural network can correctly predict the source of an article with very high accuracy.
- I then use the result of this trained network to build a web app that can allow for a copy-and-paste interface to interact with this classification model.
- To my knowledge, this work provides the first thorough NLP approach to understanding semantic differences across news sources.

- I mined political news articles from the websites of Fox News, Vox News, and PBS News.
- Intuitively, the motivation is to focus only on sentiment or semantics, rather than subject matter differences.
- By some estimations,<sup>1</sup> these three news sites represent distinct categories of news:
  - ▶ Fox as a conservative right opinion.
  - ▶ PBS as the center primary source news position.
  - ▶ Vox as a liberal left opinion.

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<sup>1</sup>Source: <https://www.adfontesmedia.com>.





# Descriptive Statistics

Table: Summary statistics by news source.

<i>Source</i>	<i>Num Docs</i>	<i>Average word count</i>	<i>Pct adj</i>	<i>Pct adv</i>	<i>Average words / sentence</i>
Fox	661	686.2	6.6 %	3.4 %	20.1
PBS	1739	654.3	6.6 %	3.2 %	18.0
Vox	1027	1332.8	7.3 %	4.6 %	21.3

# N-gram Frequencies

Table: Word Frequencies

Num	Vox	PBS	Fox
1	trump	trump	trump
2	tax	said	said
3	will	president	president
4	people	house	house
5	health	will	new
6	bill	new	will
7	republicans	white	democratic
8	one	senate	democrats
9	new	democrats	told
10	care	campaign	border

# N-gram Frequencies

Table: Top frequencies of two word phrases.

Num	Vox	PBS	Fox
1	health care	white house	white house
2	white house	president donald	new york
3	trump administration	donald trump	president trump
4	donald trump	special counsel	green new
5	tax cuts	supreme court	health care
6	health insurance	attorney general	new deal
7	new york	new york	united states
8	affordable care	justice department	border security
9	tax bill	counsel robert	donald trump
10	federal government	trump said	state union

# Challenges

- ① Difference in corpus size from each source.
  - ▶ Bootstrap the data.
- ② Variability of online formatting.
  - ▶ I removed any mention of their own organization.
  - ▶ Other common and unique affiliations.
  - ▶ Any other noticeable identifying characteristics.
- ③ Difference in the average article length.
  - ▶ I limited the article length to the first 500 words.

# Statistical Analysis

- Based on Taddy [2013], I perform a statistical analysis of the data to see what words are most related to the various sources.
- Intuitively, consider speech as making draws from a multinomial distribution, based on your underlying “sentiment”.
- Using the multinomial inverse regression, we can compare to see what phrases are most associated with which news source.

# Vox and PBS

**Table:** Phrases that are indicitave of either Vox or PBS News.

VOX			PBS	
1	email explain biggest	-6.90	chairman paul manafort	6.84
2	explain biggest news	-6.90	campaign chairman paul	6.84
3	biggest news health	-6.90	russia trump campaign	6.84
4	news health care	-6.90	mari clare jalonick	6.83
5	newslett check newslett	-6.90	trump campaign chairman	6.82
6	check newslett page	-6.90	mueller russia investig	6.82
7	mark email explain	-6.89	giant timelin everyth	6.81
8	health care edit	-6.89	timelin everyth russia	6.81
9	care edit sarah	-6.89	everyth russia trump	6.81
10	edit sarah kliff	-6.89	russia trump investig	6.81

# PBS and Fox

**Table:** Phrases that are indicitave of either PBS or Fox News.

<i>PBS</i>			<i>FOX</i>	
1	washington presid donald	-6.52	alexandria ocasiocortez dni	7.36
2	spoke condit anonym	-6.48	ongo partial feder	7.35
3	mari clare jalonick	-6.45	york democrat rep	7.35
4	timelin everyth russia	-6.44	alex pappa report	7.35
5	everyth russia trump	-6.44	chad pergram report	7.34
6	russia trump investig	-6.44	presid trump former	7.34
7	giant timelin everyth	-6.44	john robert report	7.34
8	read giant timelin	-6.44	adam shaw report	7.33
9	investig russian elect	-6.44	ap photoj scott	7.33
10	author speak publicli	-6.44	photoj scott applewhit	7.33

# Vox and Fox

**Table:** Phrases that are indicative of either Vox or Fox News.

VOX			FOX	
1	email explain biggest	-6.45	nanci pelosi dcalif	7.43
2	explain biggest news	-6.45	partial feder govern	7.43
3	biggest news health	-6.45	kamala harri dcalif	7.43
4	news health care	-6.45	elizabeth warren dmass	7.42
5	newslett check newslett	-6.45	ongo partial feder	7.42
6	check newslett page	-6.45	york democrat rep	7.41
7	mark email explain	-6.44	greenhous ga emiss	7.41
8	health care edit	-6.44	major leader steni	7.40
9	care edit sarah	-6.44	leader steni hoyer	7.40
10	edit sarah kliff	-6.44	alex pappa report	7.40



# LSTM Model

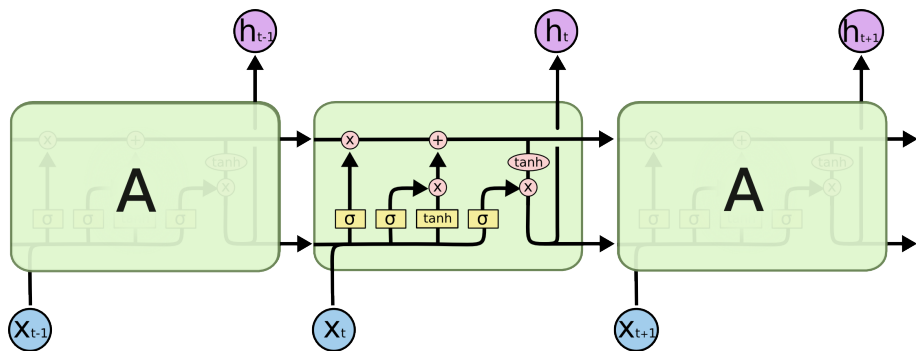


Figure: A graphical depiction of a single LSTM cell.<sup>2</sup>

<sup>2</sup>Source: <https://colah.github.io/posts/2015-08-Understanding-LSTMs>

# Bidirectional Training

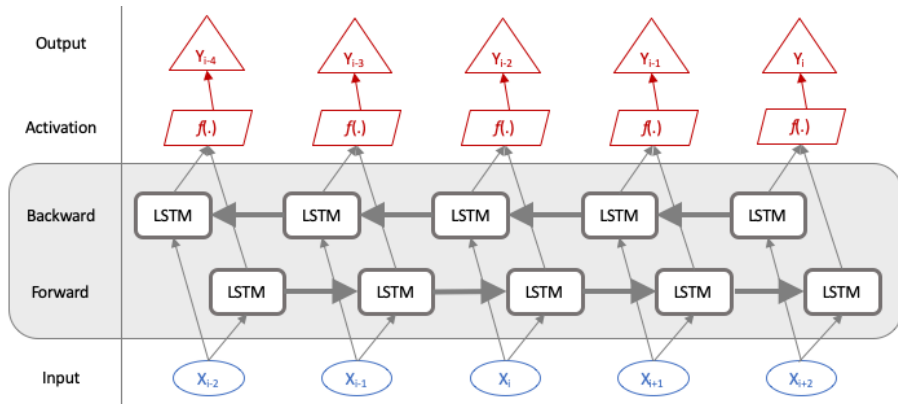


Figure: A visual representation of a bidirectional LSTM training.

# Word Embedding

- I use the common crawl 840B Global Word Vector (i.e. GloVe).
- Introduced in Pennington et al. [2014] and uses 840 billion tokens and a case-sensitive vocabulary of 2.2 million words to map words into a corresponding  $300 \times 1$  dimensional vector.
- Accordingly, I do minimal preprocessing to the text besides the basic cleaning mentioned previously.

# Methodology

- I split the data into training (90%) and testing (10%).
- Using the training data, I fit a bidirectional LSTM using a range of parameterizations, and then calculate F1 scores using the unseen testing dataset.
- Similarly, I compare the bidirectional model to a forward only model using the same approach.

Note,

$$F_1 = 2 \frac{\textit{Precision} \cdot \textit{Recall}}{\textit{Precision} + \textit{Recall}}$$

Where,

$$\textit{Precision} = \frac{\textit{TruePositives}}{\textit{TruePositives} + \textit{FalsePositives}}$$

$$\textit{Recall} = \frac{\textit{TruePositives}}{\textit{TruePositives} + \textit{FalseNegatives}}$$

# Results: Bidirectional LSTM

**Table:** Training results from the bidirectional LSTM, sorted by F1 score.

<b>Article Length</b>	<b>Batch Size</b>	<b>Dropout</b>	<b>Recurrent Dropout</b>	<b>Steps Per Epoch</b>	<b>F1</b>
250	64	0.1	0.2	1000	0.946
500	64	0.2	0.2	1000	0.944
500	64	0.2	0.1	1000	0.939
250	64	0.1	0.1	1000	0.937
500	64	0.1	0.1	1000	0.937
500	64	0.1	0.2	1000	0.933
250	64	0.2	0.1	1000	0.921
250	32	0.2	0.1	1000	0.910
250	32	0.1	0.1	1000	0.906
...	...	...	...	...	...
500	32	0.1	0.1	500	0.828

# Results: Forward LSTM

**Table:** Training results from the unidirectional LSTM, sorted by F1 score.

<b>Article Length</b>	<b>Batch Size</b>	<b>Dropout</b>	<b>Recurrent Dropout</b>	<b>Steps Per Epoch</b>	<b>F1</b>
250	64	0.2	0.1	1000	0.824
250	64	0.1	0.2	1000	0.797
250	32	0.1	0.2	1000	0.766
500	64	0.1	0.1	1000	0.724
250	64	0.2	0.2	1000	0.716
250	32	0.2	0.1	1000	0.703
500	64	0.2	0.2	1000	0.703
250	32	0.2	0.2	1000	0.695
250	64	0.1	0.2	500	0.686
...	...	...	...	...	...
500	64	0.2	0.1	500	0.556

# Demo

# xyzNews

*Locate Yourself*

Paste the text from a news article here.

Submit

Figure: The web app's home page.

# Conclusion and Discussion

- I've shown that NLP techniques can accurately classify news articles based on language differences in the underlying news sources.
- Given Gentzkow and Shapiro [2008] and Gentzkow and Shapiro [2006], it seems unlikely that biased news (or even fake news) will disappear anytime soon.
- A web application based on these ideas could serve as a starting point to measure news consumption. Analogous to:
  - ▶ Calendars can help to measure our time use.
  - ▶ Nutrition apps measure our macronutrients.
  - ▶ GPS measures our geographical position.
  - ▶ Can we have an app to measure our news consumption?



End

Thank you for your time.  
Questions?

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