

# A Comprehensive Approach to Fake News Detection using NLP

Neuromatch Academy | Deep Learning Course | Summer 2024 | Tranquil Kolwizia | Language Detectives

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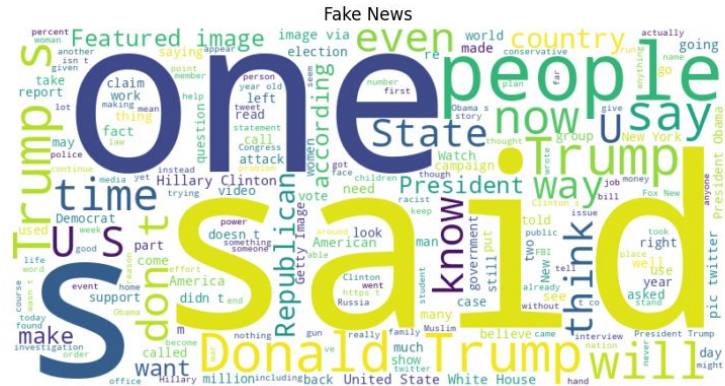
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Project TA: Joseph

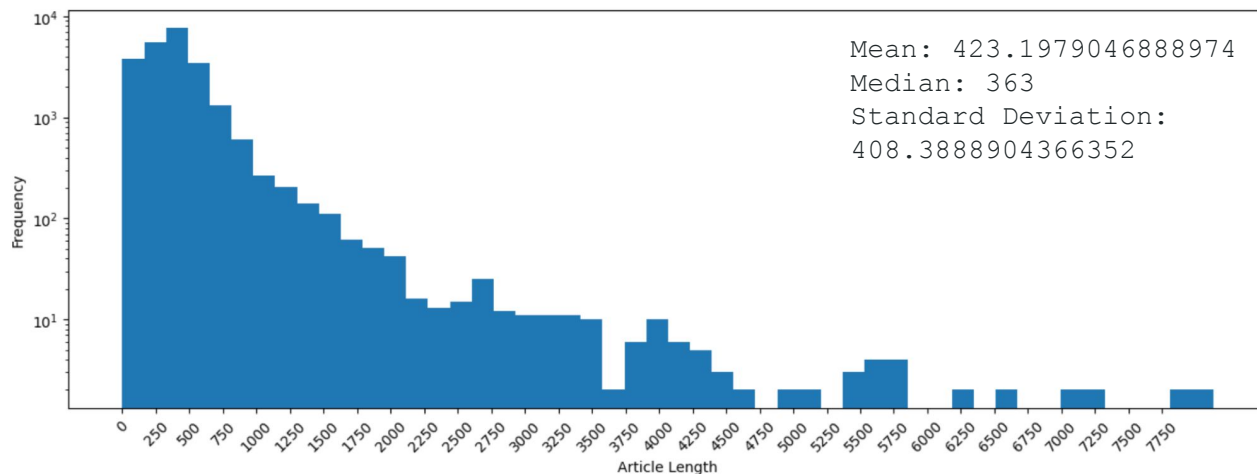
Pod TA: Mohammad

# DATASET

News	Size (Number of articles)	Subjects	
Real-News  Reuters	21417	Type	Articles size
		World-News	10145
		Politics-News	11272
Fake-News  unreliable websites that were flagged by Politifact and Wikipedia.	23481	Type	Articles size
		Government-News	1570
		Middle-east	778
		US News	783
		left-news	4459
		politics	6841
		News	9050



# DATASET



-Majority of the articles contain less than 400 words.

-This might be useful when padding the articles in later steps.

# PREPROCESSING

- ❑ Concatenate fake and true dataframes, label them either 0 or 1
- ❑ Join title and text columns
- ❑ Expand contractions  
e.g. replace '\$ ' with 'dollar'
- ❑ Remove HTML tags, URLs, usernames, emails
- ❑ Remove punctuation, digits
- ❑ Normalize unicode  
e.g. æ → a, ü → u
- ❑ Remove stopwords  
e.g. 'a', 'of', 'the', 'for', 'and'



# PREPROCESSING

## Before Preprocessing:

Donald Trump Sends Out Embarrassing New Yearâ€™s Eve Message; This is Disturbing Donald Trump just couldn't wish all Americans a Happy New Year and leave it at that. Instead, he had to give a shout out to his enemies, haters and the very dishonest fake news media. The former reality show star had just one job to do and he couldn't do it. As our Country rapidly grows stronger and smarter, I want to wish all of my friends, supporters, enemies, haters, and even the very dishonest Fake News Media, a Happy and Healthy New Year, President Angry Pants tweeted. 2018 will be a great year for America! As our Country rapidly grows stronger and smarter, I want to wish all of my friends, supporters, enemies, haters, and even the very dishonest Fake News Media, a Happy and Healthy New Year. 2018 will be a great year for America! Donald J. Trump (@realDonaldTrump)

## After preprocessing !!!

donald trump sends out embarrassing new years eve message this is disturbing donald trump just couldn't wish all americans a happy new year and leave it at that instead he had to give a shout out to his enemies haters and the very dishonest fake news media the former reality show star had just one job to do and he couldn't do it as our country rapidly grows stronger and smarter i want to wish all of my friends supporters enemies haters and even the very dishonest fake news media a happy and healthy new year president angry pants tweeted will be a great year for america as our country rapidly grows stronger and smarter i want to wish all of my friends supporters enemies haters and even the very dishonest fake news media a happy and healthy new year will be a great year for america

# GLOVE

(Global Vectors for Word  
Representation)

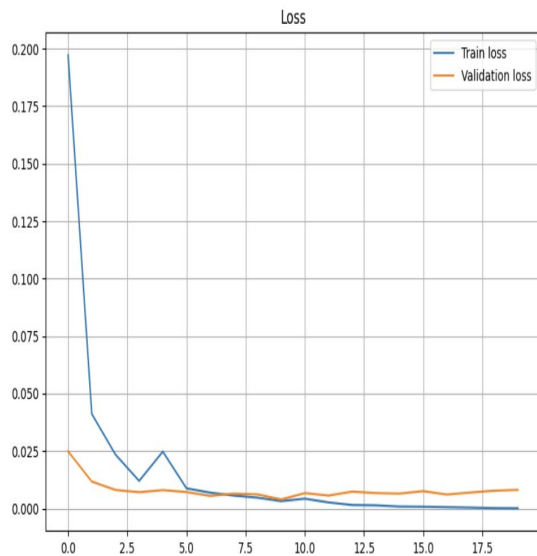
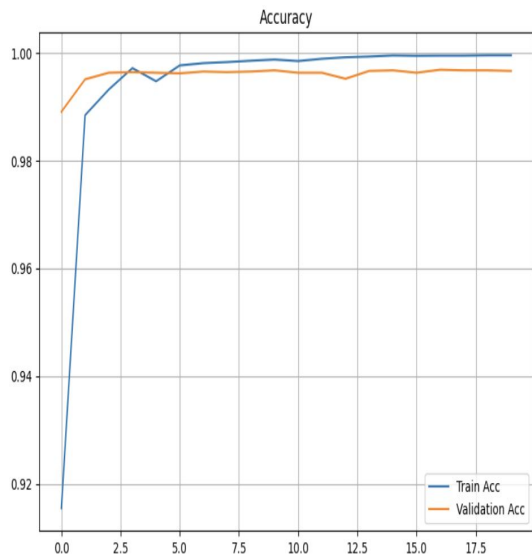
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# LSTM

(Long Short-Term Memory)

Embedding dim	100
Epoch	20
Batch size	64
Max article length	200
Learning rate	0.01
Loss function	nn.BceLoss()
optimizer	torch.optim.Adam()
Dropout probability	0.1

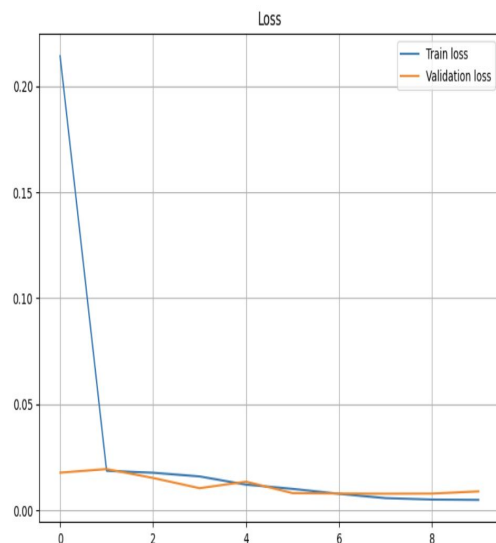
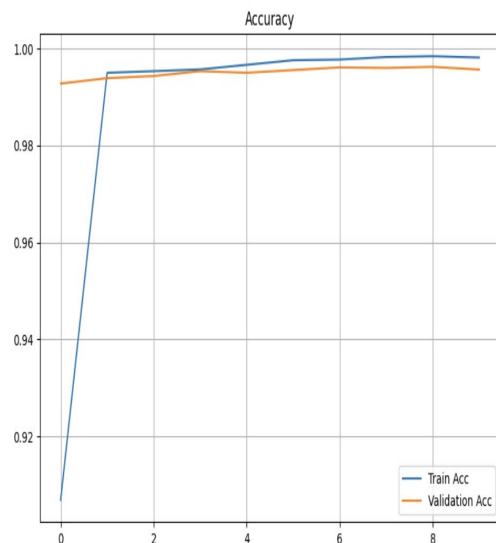
# Glove + uni\_LSTM



accuracy	99.87%
precision	99.87%
recall	99.87%
f1-score	99.87%

Actual Classes	Predicted Classes	
	True	False
True	4264	9
False	3	4684

# Glove + bi\_LSTM



Actual Classes	True	False
	4267	7
True	16	4670

accuracy	99.74%
precision	99.74%
recall	99.75%
f1-score	99.74%



# TF-IDF VECTORIZER

Max df	0.75
Max features	2000

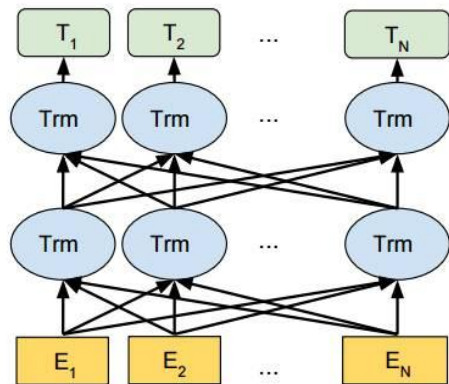
# LOGISTIC REGRESSION

Penalty	L2
Solver	newton-cg
multi_class	multinomial

Actual Classes	True	False
Predicted Classes	4259	25
False	34	4662

accuracy	99.34%
precision	99.34%
recall	99.35%
f1-score	99.34%

# BERT

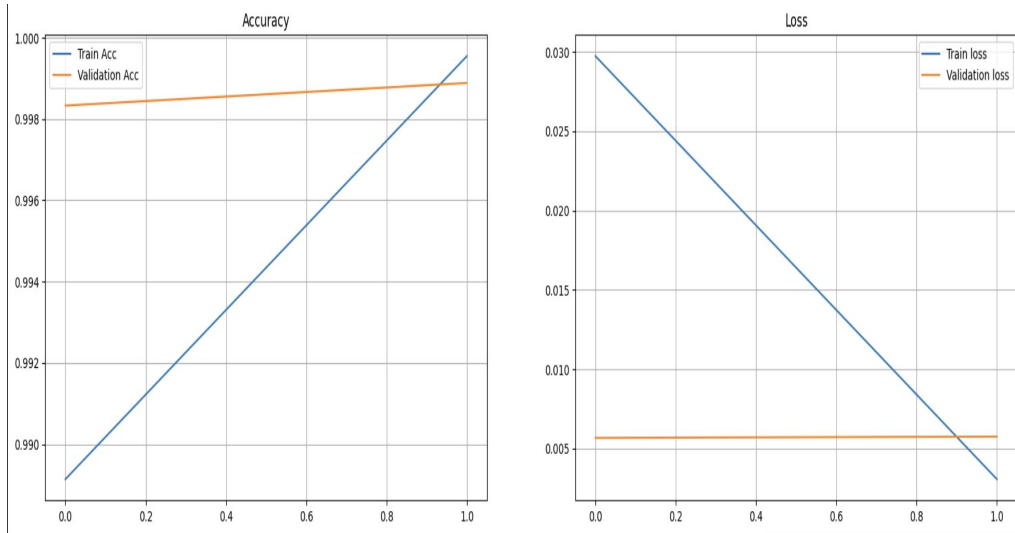


Don't touch  
me



Hidden size	768
Epoch	2
Batch size	64
Max article length	100
Learning rate	1e-5
Loss function	BceLoss()
optimizer	Adam
Dropout rate	0.2

# BERT MODEL CURVES



accuracy	99.91%
precision	99.91%
recall	99.91%
f1-score	99.91%

Actual Classes	True	4278	6
	False	2	4694
		True	False
		Predicted Classes	

# SUSPICIOUSLY ACCURURATE MODELS

	title	text	subject	date
21412	'Fully committed' NATO backs new U.S. approach...	BRUSSELS (Reuters) - NATO allies on Tuesday we...	worldnews	August 22, 2017
21413	LexisNexis withdrew two products from Chinese ...	LONDON (Reuters) - LexisNexis, a provider of l...	worldnews	August 22, 2017
21414	Minsk cultural hub becomes haven from authorities	MINSK (Reuters) - In the shadow of disused Sov...	worldnews	August 22, 2017
21415	Vatican upbeat on possibility of Pope Francis ...	MOSCOW (Reuters) - Vatican Secretary of State ...	worldnews	August 22, 2017
21416	Indonesia to buy \$1.14 billion worth of Russia...	JAKARTA (Reuters) - Indonesia will buy 11 Sukh...	worldnews	August 22, 2017



Notice the 'Reuters' tag on real news articles. Indeed it's present in a considerable number of articles.

We should remove them to prevent our models from cheating and to make them actually learn the semantic relationship between words.

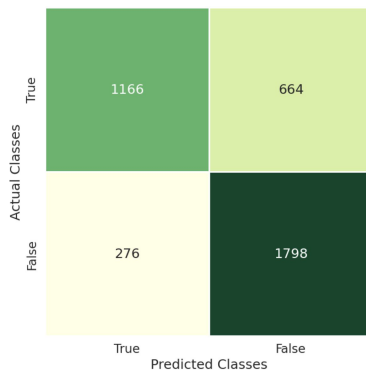


# COMPARING ALL 3 MODELS

		Glove + Uni_LSTM	TFIDF + Log_Reg	BERT
With Reuters }	accuracy	99.87%	99.34%	99.91%
	f1-score	99.87%	99.34%	99.91%
Without Reuters }	accuracy	98.97%	98.78%	99.48%
	f1-score	98.97%	98.77%	99.47%

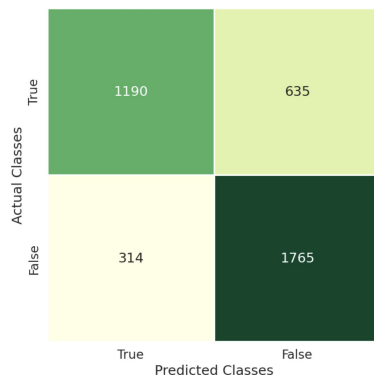
# ANOTHER DATASET

Glove + uni\_LSTM



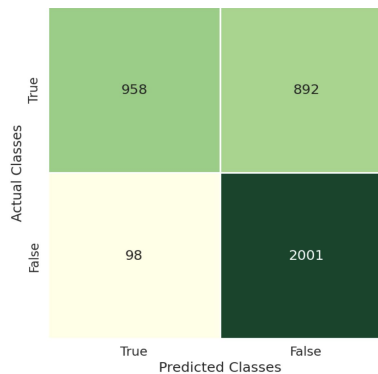
accuracy	75.92%
precision	75.27%

Glove + bi\_LSTM



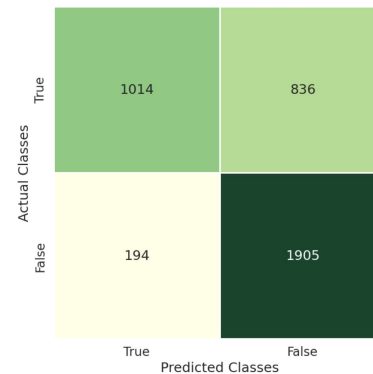
accuracy	75.69%
precision	75.15%

TFIDF + Log\_Reg



accuracy	74.93%
precision	73.05%

BERT



accuracy	73.92%
precision	72.52%

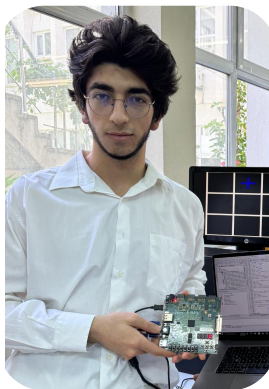
# CONCLUSION AND FUTURE DIRECTIONS

- All the models were able to extract features from news articles and classify them very accurately
- Order of the words don't really matter !!! (for fake news detection)
- Don't increase complexity unless needed
- Models should be trained on larger scale datasets consisting of news articles from various sources
- Other modalities (like images) can be explored



# THANK YOU - ANY QUESTIONS ?

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## References

- [https://github.com/nihar-max/nlp\\_news\\_classification/blob/main/News%20Classification%20using%20NLP%20part%201.ipynb](https://github.com/nihar-max/nlp_news_classification/blob/main/News%20Classification%20using%20NLP%20part%201.ipynb)
- [https://www.learndataasci.com/glossary/tf-idf-term-frequency-inverse-document-frequency/#:~:text=cost%20to%20you.,What%20is%20TF%20IDF%3F,%2C%20relative%20to%20a%20corpus\).](https://www.learndataasci.com/glossary/tf-idf-term-frequency-inverse-document-frequency/#:~:text=cost%20to%20you.,What%20is%20TF%20IDF%3F,%2C%20relative%20to%20a%20corpus).)
- <https://www.kaggle.com/code/sadikaljarif/fake-news-detection-using-bert>
- <https://huggingface.co/learn/nlp-course/en/chapter6/6>
- <https://www.kaggle.com/code/satyamsss/fake-news-prediction-lstm-97-accurate>