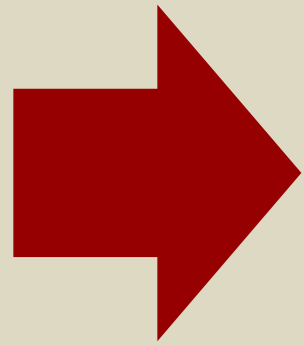




# Abuse Detection

— in Ao3 comments —



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*Problem Statement*

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*Data Collection & Cleaning*

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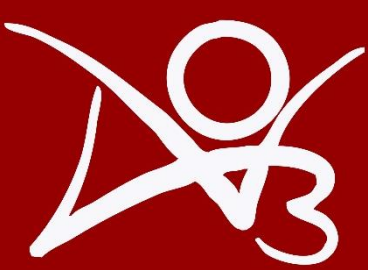
*Exploratory Data Analysis*

4

*Modelling & Model Evaluation*

5

*Conclusions & Recommendations*



# Problem statement

Search



## WHAT IS AO3?



Ao3 is a nonprofit, open-source archive for fanfiction

- 40 million+ daily visits
- 7 million+ works
- 4 million+ users

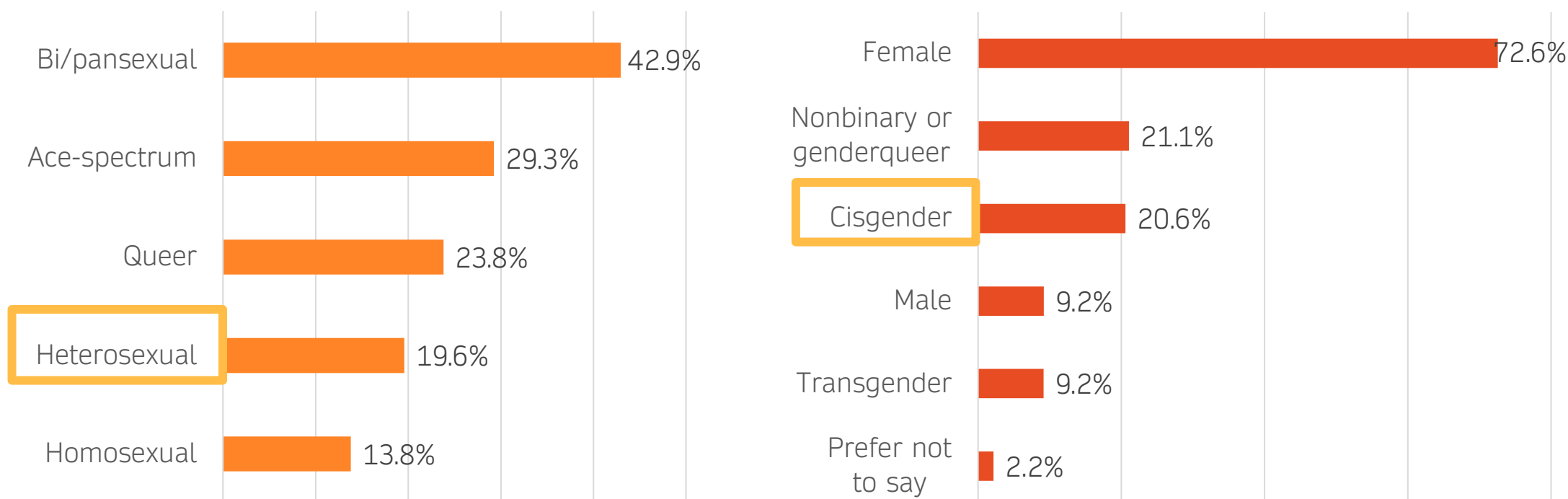


Fanfiction is fiction written in an amateur capacity by fans, based on existing works of fiction

## WHO CARES ABOUT FANFIC?



Fanfiction is primarily written and consumed by queer women and genderqueer folks



Only 5% of Ao3 works feature heterosexual couples

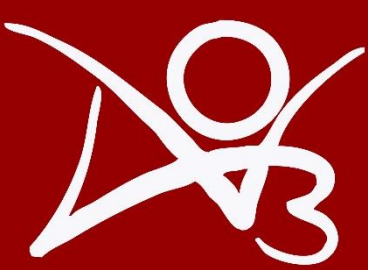
# Why Do Queer People Write Fan Fiction? To See Themselves in Mainstream Culture.

The history of queer representation is one long yellow brick road of insulting punchlines. Queer characters are traditionally relegated to secondary status and... if a queer person ever does get a shot at the spotlight, they often fall victim to a host of unfortunate tropes that are as insulting as they are tired and overdone.

For many queer viewers, favorite movies and TV shows offer a world in which complex, dynamic, actively queer people—people like them—do not exist.

Fanfiction is one of the few outlets that an increasingly frustrated queer audience has to engage with material that refuses to engage with them. It represents a challenge to the notion that being created in a straight world means one must live a straight life... It represents a refusal to be punchlines anymore, a refusal to express ourselves less because it's more convenient for everyone else.

In writing fanfiction, we do more than rewrite our favorite stories. We take those stories and make them strong enough to handle people like us.



# Problem statement

Search

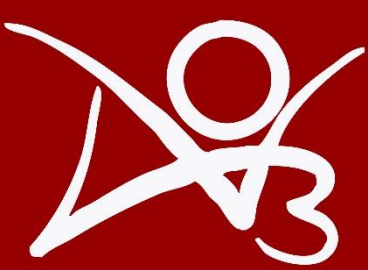


## WHAT IS AO3?

- ▶ Ao3 is a nonprofit, open-source archive for fanfiction
  - 40 million+ daily visits
  - 7 million+ works
  - 4 million+ users
- ▶ Fanfiction is fiction written in an amateur capacity by fans, based on existing works of fiction

## WHY CARE ABOUT FANFIC?

- ▶ Fanfiction is primarily written by queer women and genderqueer folks
- ▶ Fanfiction itself is a crucial form of self-expression and representation for many queer folks
- ▶ Online communities based around fanfiction are safe havens for queer people to meet, mingle, and bond over queer content



# Problem statement

Search



## CHALLENGES



### Censorship by webhosts

- Livejournal Strikethrough
- Fanfiction.net's R ban
- Tumblr's porn ban



### Legal threats

The Anne Rice crackdown  
on fanfic authors in 2000

## BIRTH OF AO3



Started by queer  
women specially for  
hosting fanfiction



Anti-censorship



Legal advocacy

## CRITICISMS



### Abuse & harassment

Lack of features to block  
harassment

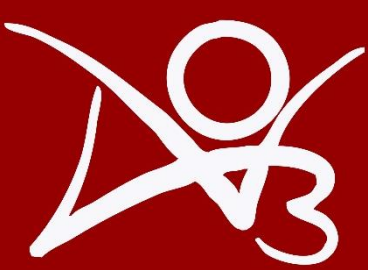
- Turn off anon comments
- Comment moderation



### Racism

Racist trolling

Racist harassment of Ao3  
authors of colour



# Problem statement

Search



My goal is to build a text classification model that can flag abusive comments. If successful, this model could serve as proof of concept for an “automated comment moderation” function, which could be used to:

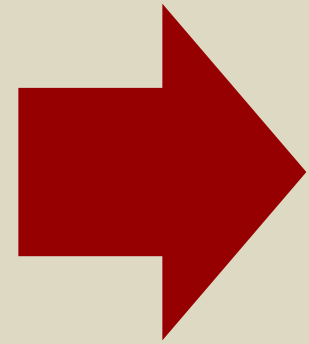
- (1) automatically filter abusive comments into a separate inbox
- (2) flag trolls and hateful accounts to the Abuse Team

Hateful speech and online abuse is a serious issue

30% of polled users have been harassed by commenters on Ao3

Who is going to do the moderation? Ao3 is run by volunteers.





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*Problem Statement*

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*Data Collection & Cleaning*

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*Exploratory Data Analysis*

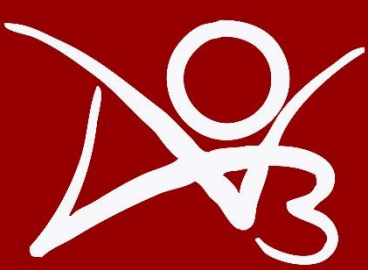
4

*Modelling & Model Evaluation*

5

*Conclusions & Recommendations*





# Data collection

Search



## KEY CHALLENGE

Lack of a large and diverse enough dataset of hateful and abusive Ao3 comments

## TRAINING DATASET

- 100,000 Wikipedia discussion comments rated for toxicity (1–5), aggression (1-7), and whether the comment contained a personal attack
- I sampled 15,000 comments, 50% of which were flagged as attacks

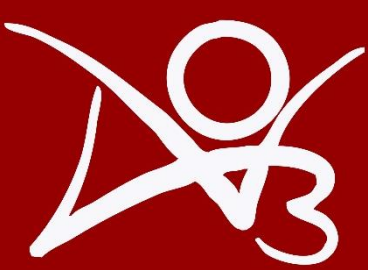
## FINAL TEST DATASET

- 320 Ao3 comments, 50% of which were flagged as abusive
- I searched the names of four known trolls from a specific fandom / subcommunity
  - Two datasets of abusive comments
  - Several documents containing pictures of comments from known trolls
  - Pictures of comments posted directly to Twitter



- Feature engineering
  - attack: 1 if majority scored 1, else 0
  - toxicity (1-5): mean score given
  - aggression (1-7): mean score given
- Removal of outliers (mean  $\pm$  3SD)
  - Comments that were abnormally long

[illegible][illegible]



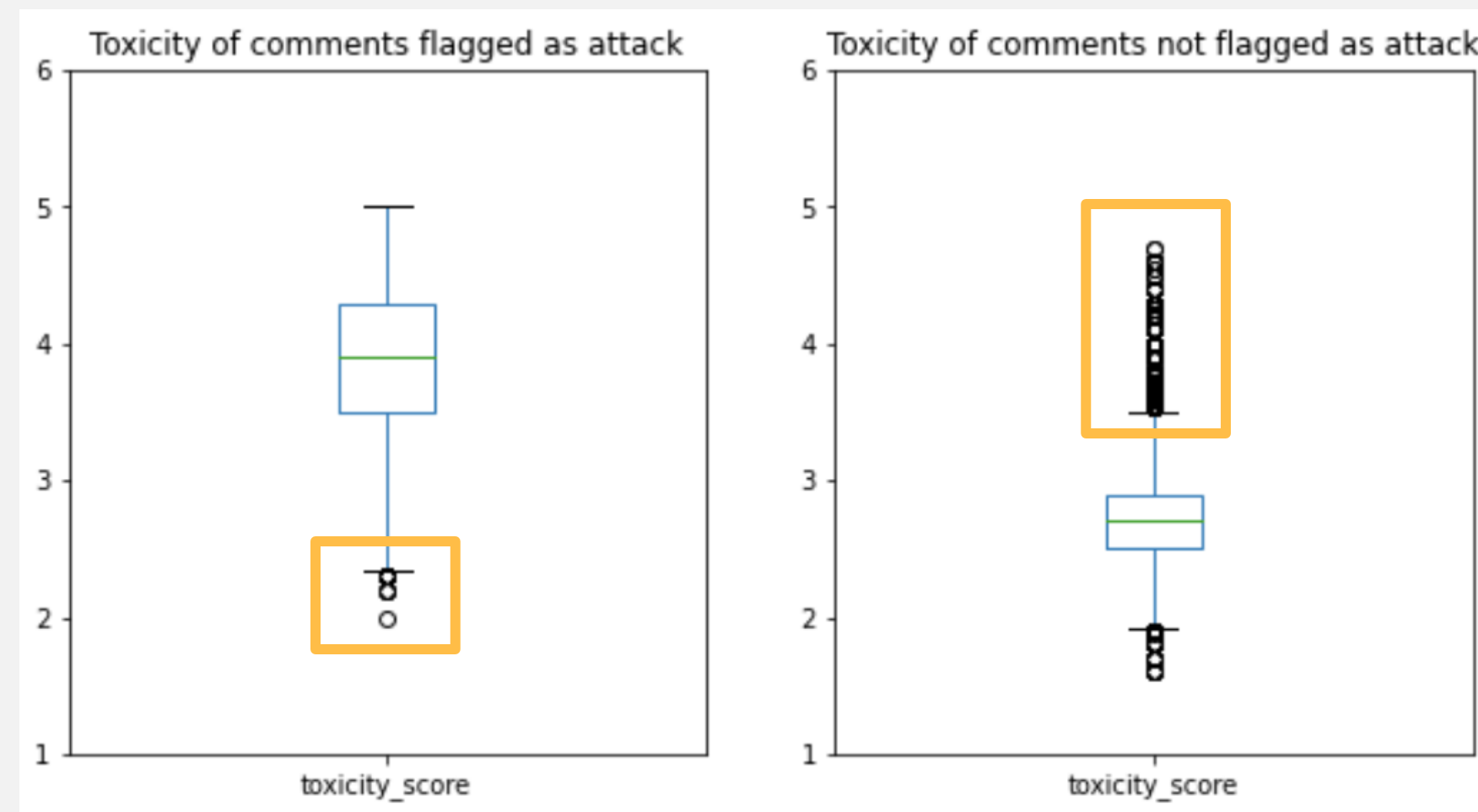
# Data cleaning

Search



## WIKIPEDIA SET (TRAINING)

- Feature engineering
  - attack: 1 if majority scored 1, else 0
  - toxicity (1-5): mean score given
  - aggression (1-7): mean score given
- Removal of outliers (mean  $\pm$  3SD)
  - Comments that were abnormally long
  - Comments flagged “attack” but with low toxicity or aggression
  - Comments flagged “not attack” but with high toxicity or aggression

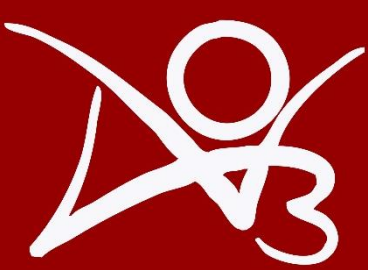


HOPE YOUR HEAD GETS CUT OFF AND SOMEONE WIPES...

== you are dumb == Mexican Punk is the god of...

::Haha, I fucking pissed myself reading this ...

you people are cunts, bombing every ones mail ...



# Data cleaning

Search



## WIKIPEDIA SET (TRAINING)

- Feature engineering
  - attack: 1 if majority scored 1, else 0
  - toxicity (1-5): mean score given
  - aggression (1-7): mean score given
- Removal of outliers (mean  $\pm$  3SD)
  - Comments that were abnormally long
  - Comments flagged “attack” but with low toxicity or aggression
  - Comments flagged “not attack” but with high toxicity or aggression
- Undersampling of majority class





# Data cleaning

Search



WIKIPEDIA SET (TRAINING)

A03 SET (FINAL TEST)

Remove punctuation

Tokenize

Remove stopwords

Lemmatize



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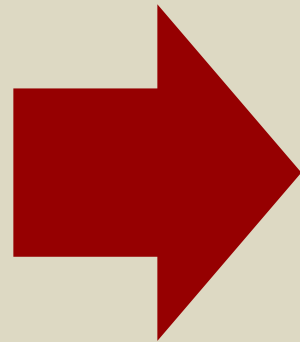
*Exploratory Data Analysis*

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WIKIPEDIA

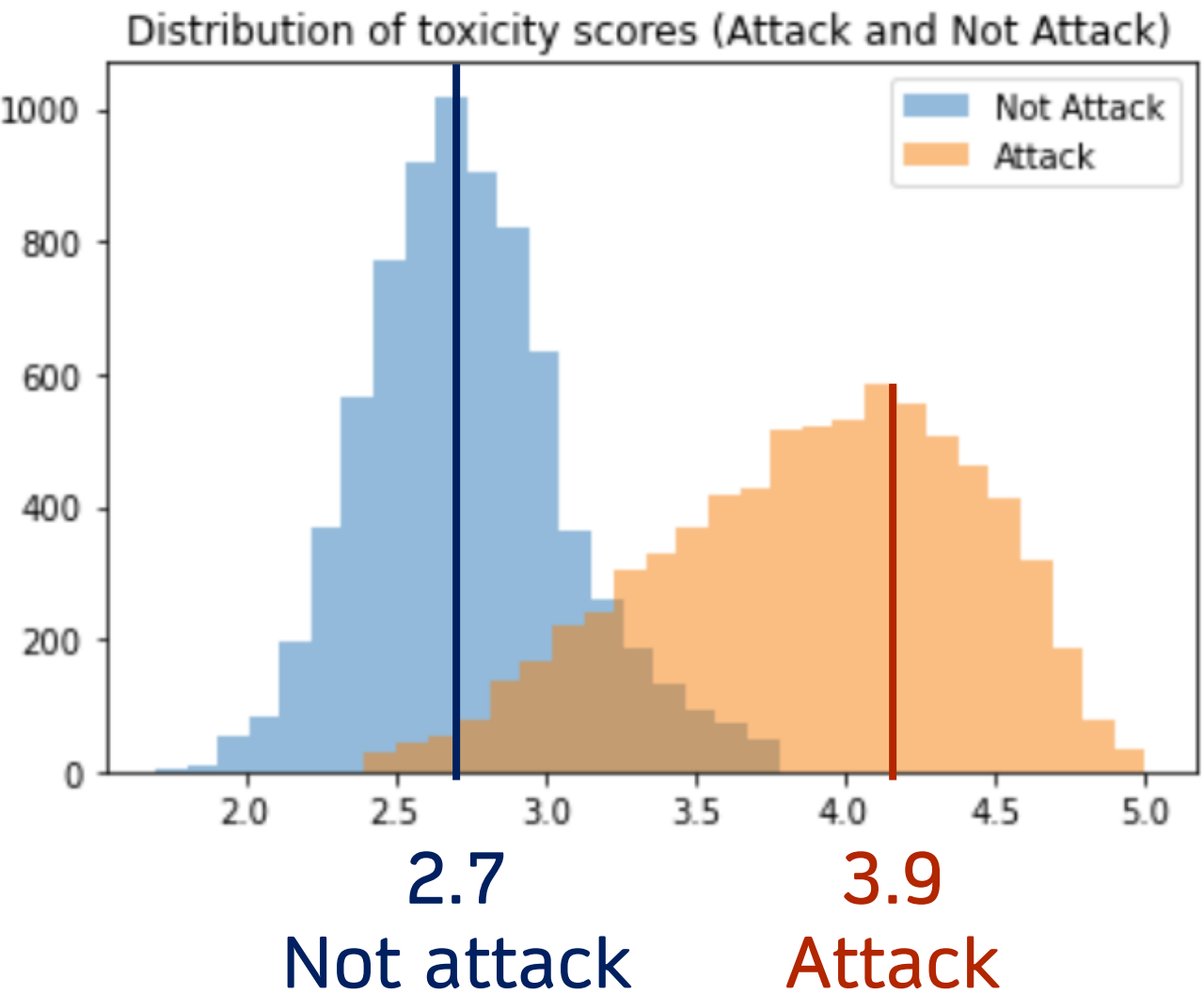
# Data Visualization (Wikipedia)

Search



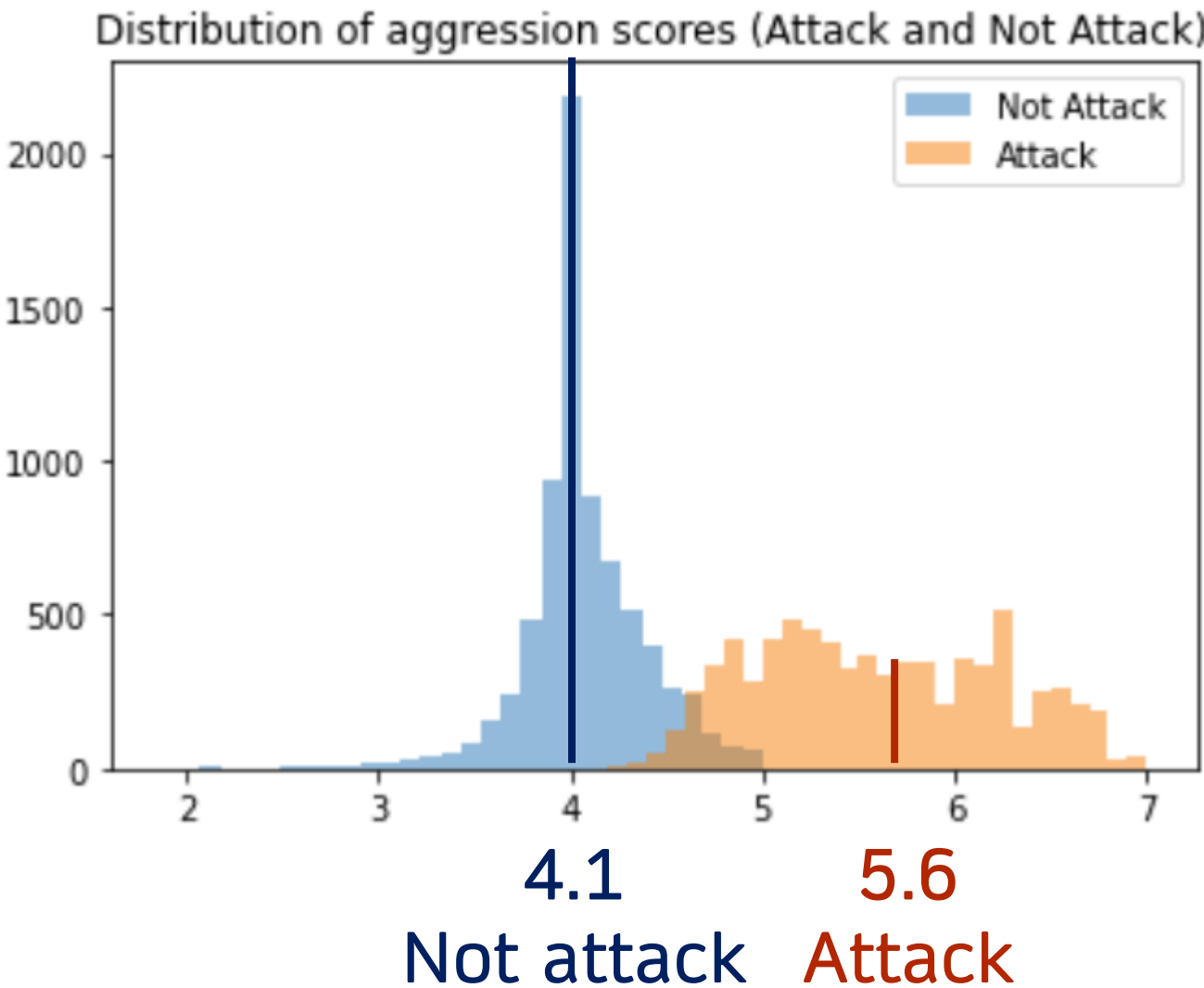
## TOXICITY SCORE

Average score of 3.3 with 3 representing  
“Neither toxic nor healthy”

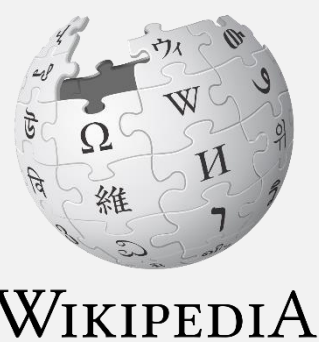


## AGGRESSION SCORE

Average score of 4.8 with 4 representing  
“Neither aggressive nor friendly”







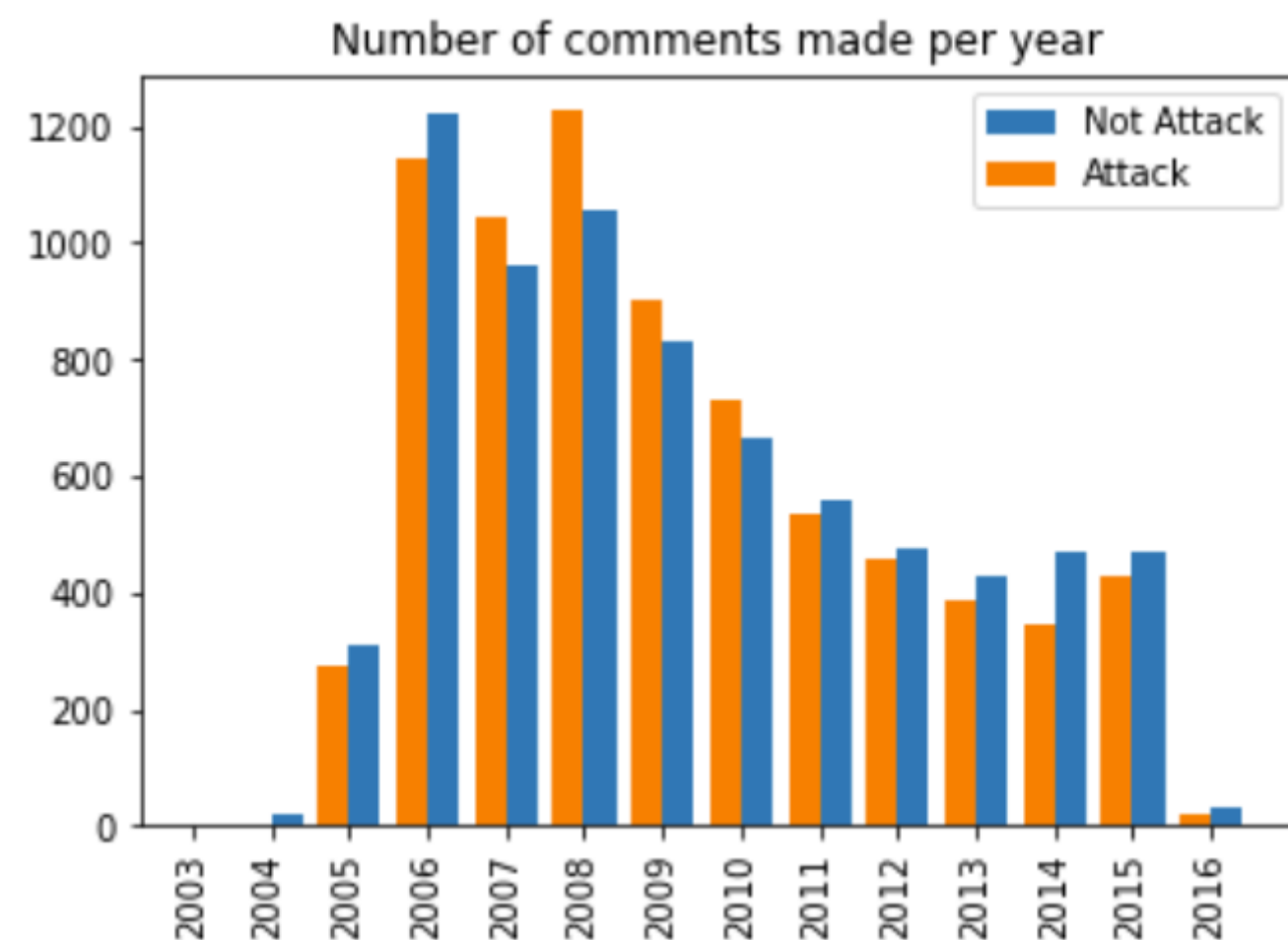
# Data Visualization (Wikipedia)

Search



## YEAR OF COMMENT

- Posted between 2003 to 2016
- No difference between attack and not



## LOGIN STATUS

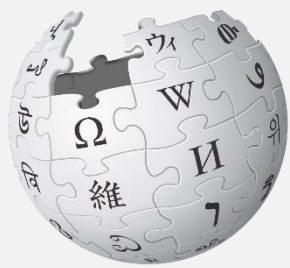
- Majority of abusive comments were made by anonymous commenters

	Logged In	Attack	Not Attack	Total
0	Yes	46.3%	71.1%	58.7%
1	No	53.7%	28.9%	41.3%

- However, it's notable that there was still a significant number of logged-in users (46.3%) making abusive comments







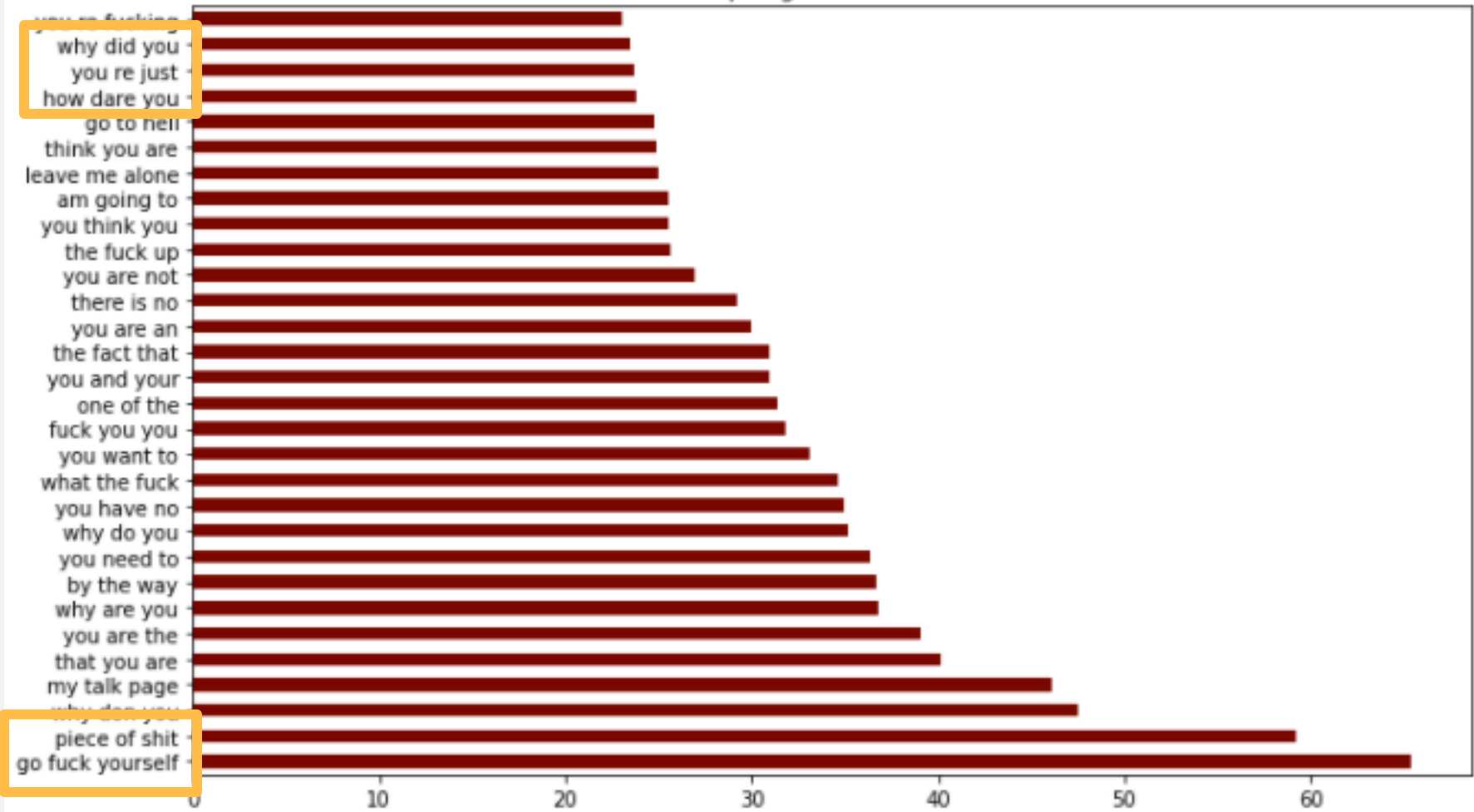
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Search



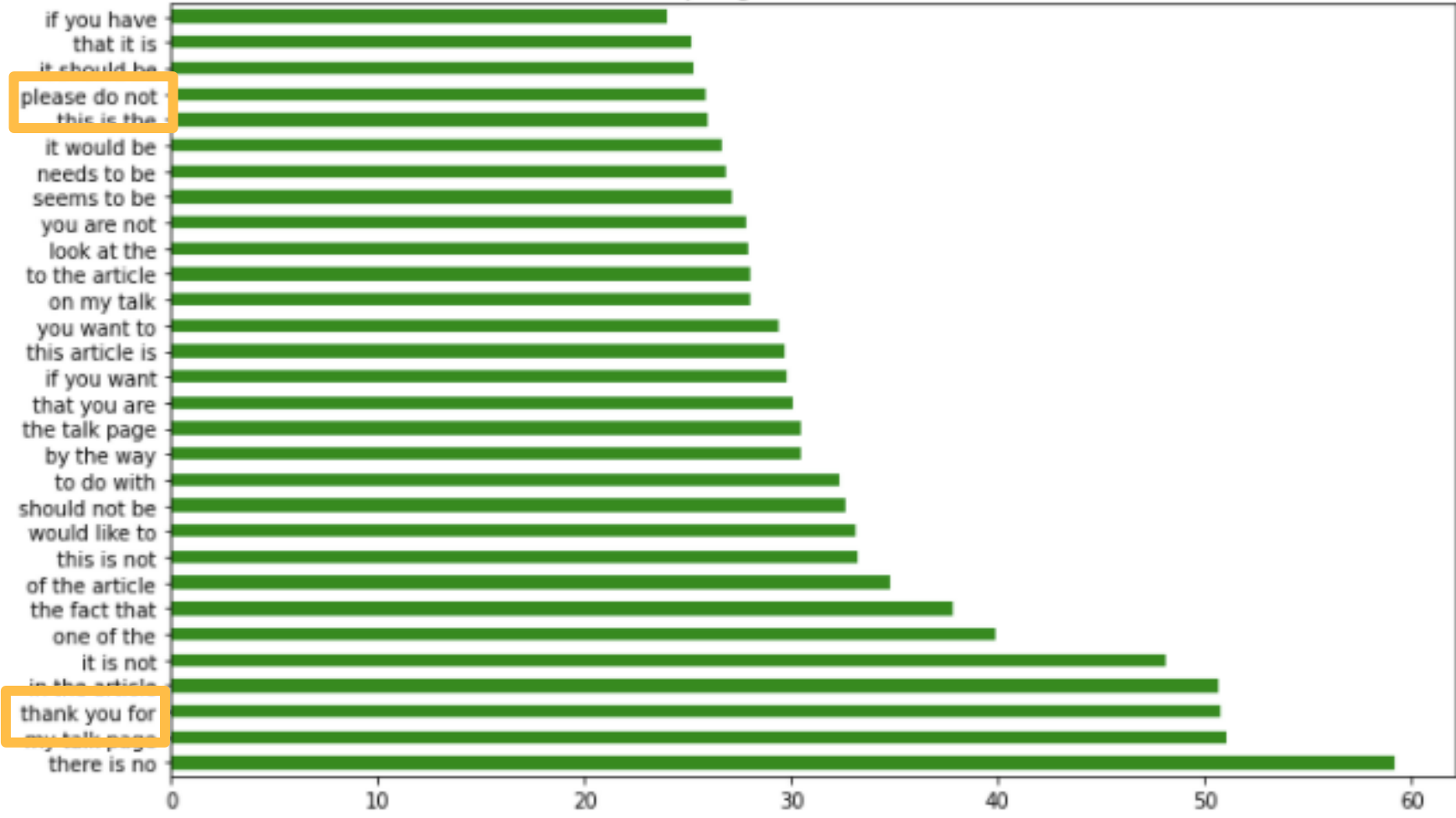
High in profanity

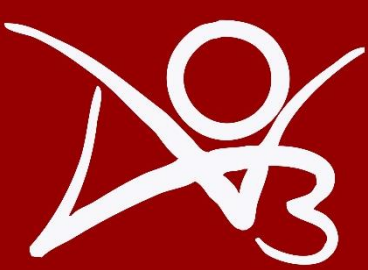
Top Trigrams (Attack)



Polite and objective

Top Trigrams (Not Attack)





# Data Visualization (Ao3)

Search



## AGGRESSORS (TROLLS)

	Comments	Logged in	Type of comments
Troll 1	45	69% of the time	Attacks on writing. Low to medium toxicity.
Troll 2	30	Always anon	Violent language . High toxicity.
Troll 3	32	62% of the time	Insults and hate speech. High toxicity.
Troll 4	42	Always anon	Attacks on writing. Medium toxicity. Sarcasm.
Unknown	11	18% of the time	Mixed

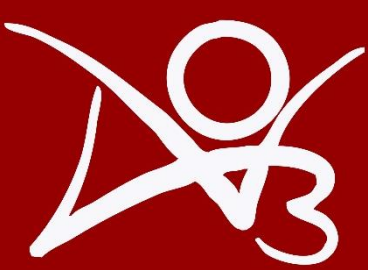


kill urself please

dear author, i hope  
someone precious to you  
dies- maybe ur parents?

still i just think you werent  
bullied enough for being  
half horse half rat freak bc  
you still seem to have the  
nerve to exist. how odd.

kinda amazing that anyone  
would want to display  
theyre a hideous middle  
aged tranny to everyone,  
but alas



# Data Visualization (Ao3)

Search



## AGGRESSORS (TROLLS)

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Troll 4	42	Always anon	Attacks on writing. Medium toxicity. Sarcasm.
Unknown	11	18% of the time	Mixed

Felt rushed. But other than that, a pretty okay story :)  
Genuinely disgusted EW what the FUCK SHSMS

lol wow love how you completely gutted their personalities to write this au!  
great job! :D :D :D

Fantastic self-insert where you could shove all your favorite pairings together no matter how illogical and change the plot to suit your own fantasies :D





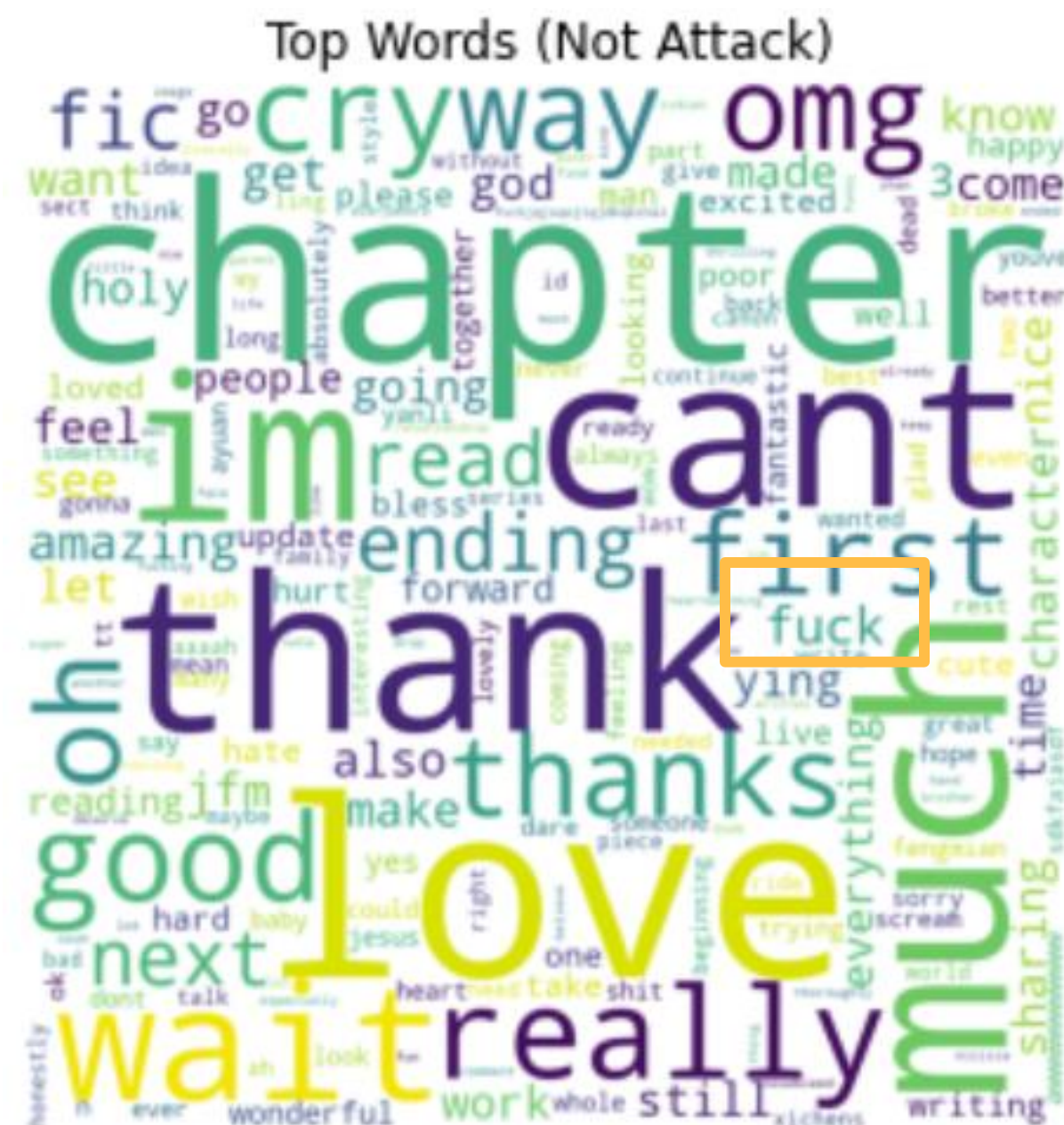
# Search

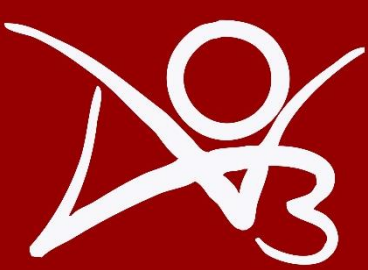


# Fanfiction-specific vocab



# Excited and grateful





# Data Visualization (Ao3)



## AGGRESSORS (TROLLS)

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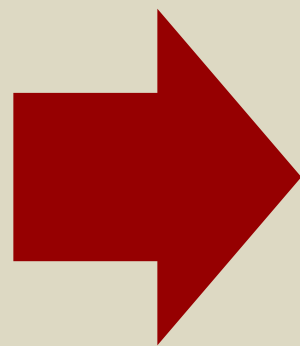
*Exploratory Data Analysis*

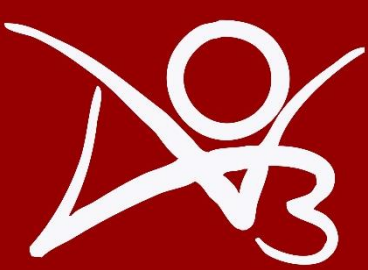
4

*Modelling & Model Evaluation*

5

*Conclusions & Recommendations*





# Summary of modelling

Search



## VECTORIZERS

### BAG OF WORDS

- Tf-idf Vectorizer

### WORD EMBEDDINGS

- GloVE (100 dimensions)
- GloVE (300 dimensions)

BERT

## LEARNING

### PYCARET

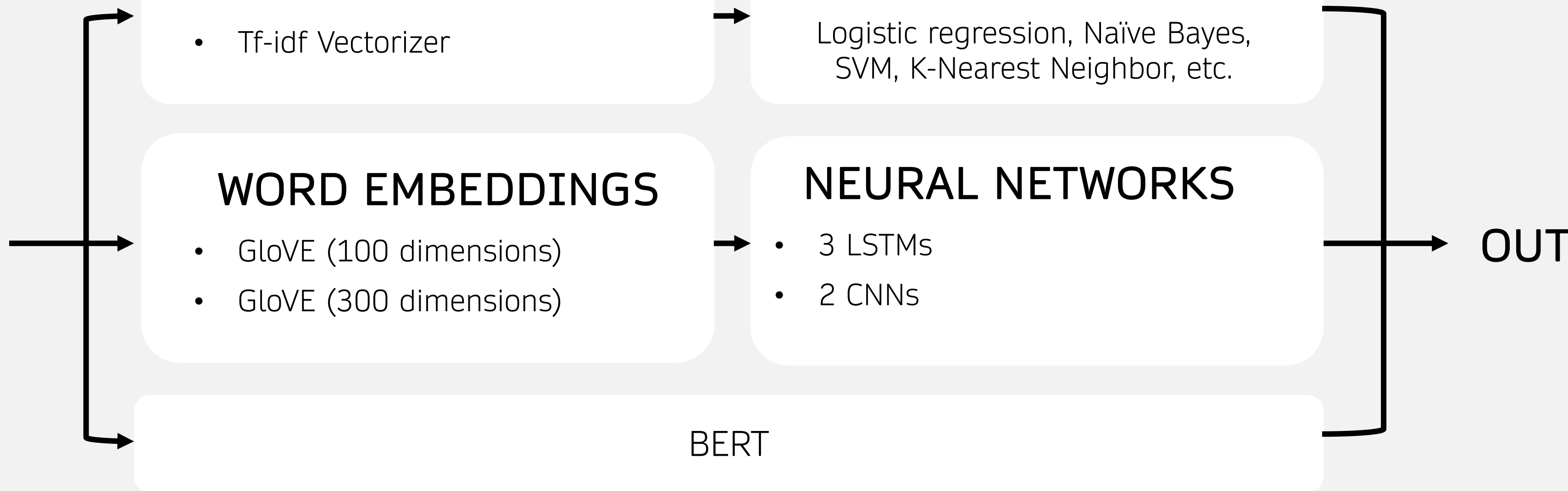
Logistic regression, Naïve Bayes, SVM, K-Nearest Neighbor, etc.

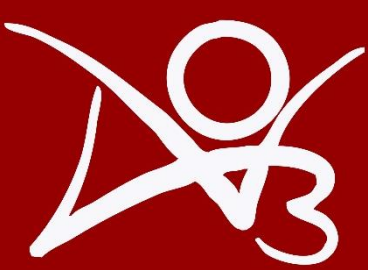
### NEURAL NETWORKS

- 3 LSTMs
- 2 CNNs

IN

OUT





# Summary of modelling

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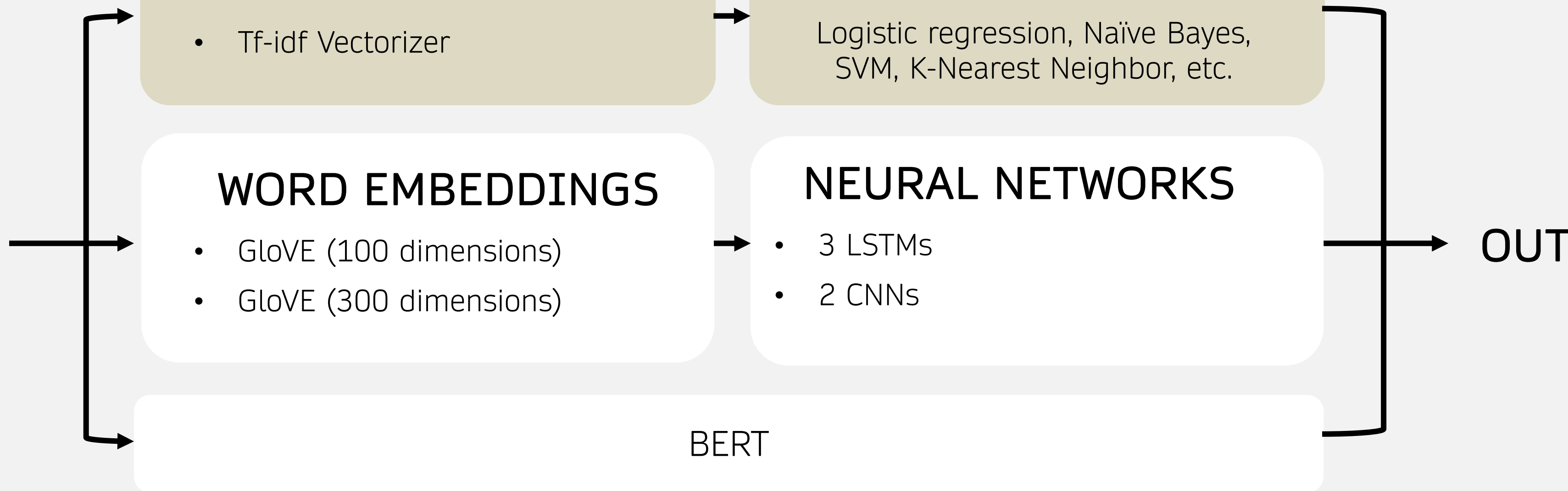
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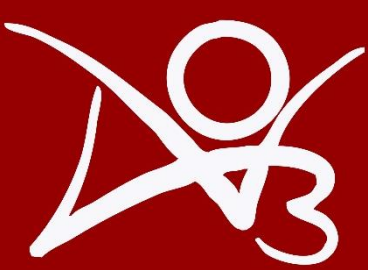
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IN

OUT





# Model Evaluation (Bag-of-Words)

Search



## INITIAL MODEL RESULTS

	Model	Accuracy	AUC	Recall	Prec.	F1	Kappa	MCC	TT (Sec)
svm	SVM - Linear Kernel	0.8392	0.0000	0.7778	0.8872	0.8286	0.6785	0.6840	1.0400
lr	Logistic Regression	0.8387	0.9141	0.7864	0.8786	0.8297	0.6773	0.6814	2.5200
et	Extra Trees Classifier	0.8362	0.9111	0.7829	0.8766	0.8269	0.6724	0.6764	16.3910
rf	Random Forest Classifier	0.8257	0.9032	0.7607	0.8747	0.8135	0.6514	0.6572	8.9020
ridge	Ridge Classifier	0.8125	0.0000	0.7690	0.8426	0.8039	0.6249	0.6276	1.6290
ada	Ada Boost Classifier	0.7918	0.8521	0.6946	0.8627	0.7693	0.5836	0.5953	6.6680
gbc	Gradient Boosting Classifier	0.7916	0.8660	0.6417	0.9168	0.7547	0.5833	0.6116	24.8980
dt	Decision Tree Classifier	0.7808	0.7855	0.7894	0.7763	0.7827	0.5617	0.5619	14.6340
lda	Linear Discriminant Analysis	0.7421	0.8084	0.7428	0.7419	0.7421	0.4841	0.4844	45.5230
nb	Naive Bayes	0.7305	0.7330	0.8107	0.6989	0.7506	0.4609	0.4670	0.4740
qda	Quadratic Discriminant Analysis	0.5998	0.6000	0.2207	0.9135	0.3547	0.1998	0.3062	70.7290
knn	K Neighbors Classifier	0.5511	0.7281	0.9448	0.5402	0.6805	0.1019	0.1454	41.6640
dummy	Dummy Classifier	0.5002	0.5000	1.0000	0.5002	0.6669	0.0000	0.0000	0.1010

## MODEL TUNING

- Alpha = 0.0002
- L1 ratio = 0.08
- Penalty = ElasticNet

	Train	Test	Ao3
Precision	88.4%	89.4%	59.3%
Recall	78.3%	80.5%	55.6%
Accuracy	84.0%	85.5%	58.8%





# Search

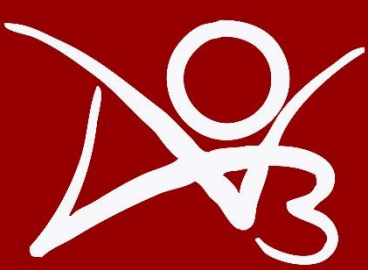


Misclassifies abusive comments that isn't profane but has criticisms that are specific to fanfiction



Misclassifies positive comments that have profanity, or that includes negative comments on an antagonist





# Model Evaluation (Bag-of-Words)

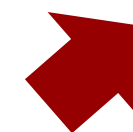
Search



“fuck, imma gonna crie”

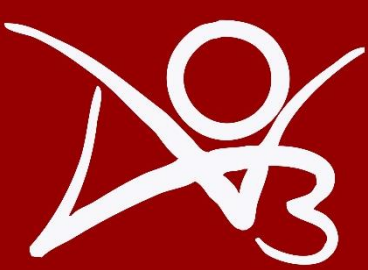
“oh fuck oh fuck it’s going down and im not ready. we’re about to be massacred with feels”

“CAN SOMEONE FUCKING DECK HIS DAD IN THE FACE OMG HIS DAD IS SUCH A PIECE OF SHIT!!!!”



Misclassifies abusive comments that isn’t profane but has criticisms that are specific to fanfiction

Misclassifies positive comments that have profanity, or that includes negative comments on an antagonist



# Data Visualization (Ao3)

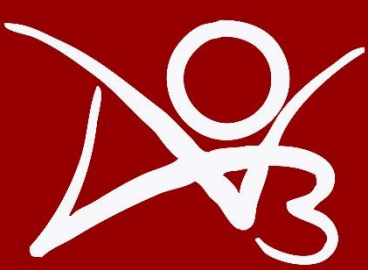


## AGGRESSORS (TROLLS)

	Comments	Flagged	Percent	Type of comments
Troll 1	45	16	35.6%	Attacks on writing. Low to medium toxicity.
Troll 2	30	21	70.0%	Violent language . High toxicity.
Troll 3	32	26	81.2%	Insults and hate speech. High toxicity.
Troll 4	42	21	50.0%	Attacks on writing. Medium toxicity. Sarcasm.
Unknown	11	5	45.5%	Mixed







# Summary of modelling

Search



## VECTORIZERS

### BAG OF WORDS

- Tf-idf Vectorizer

### WORD EMBEDDINGS

- GloVE (100 dimensions)
- GloVE (300 dimensions)

BERT

## LEARNING

### PYCARET

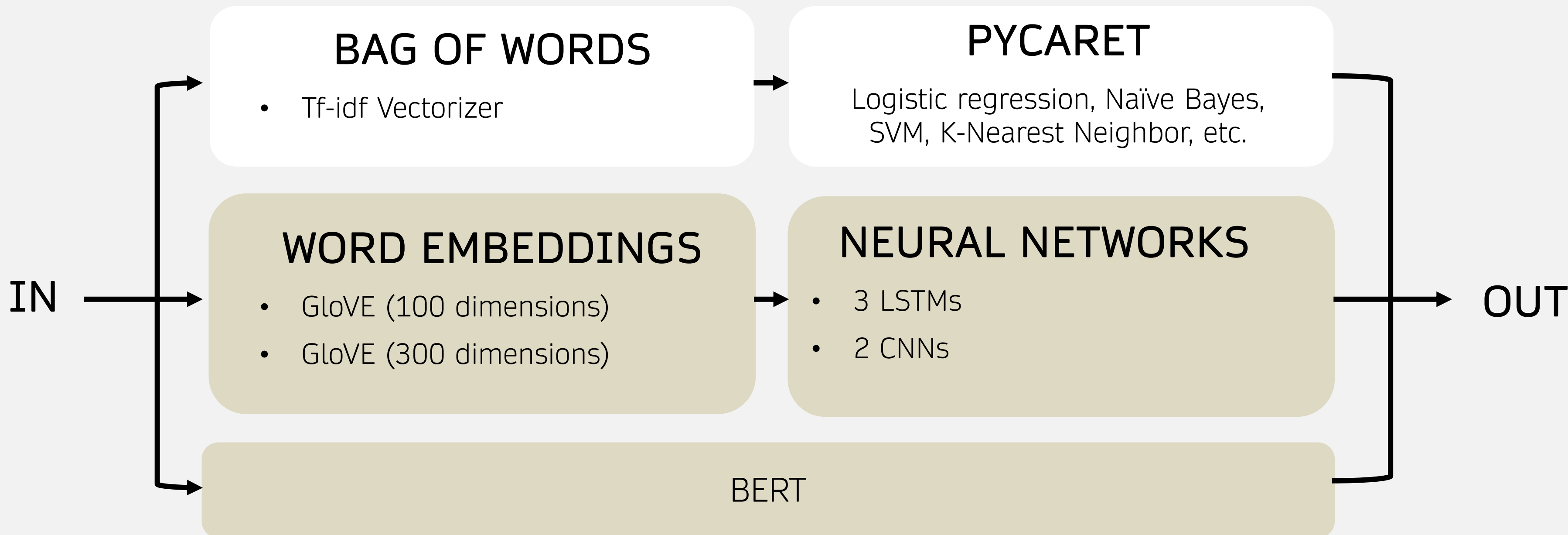
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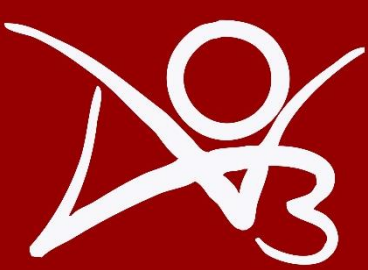
### NEURAL NETWORKS

- 3 LSTMs
- 2 CNNs

IN

OUT





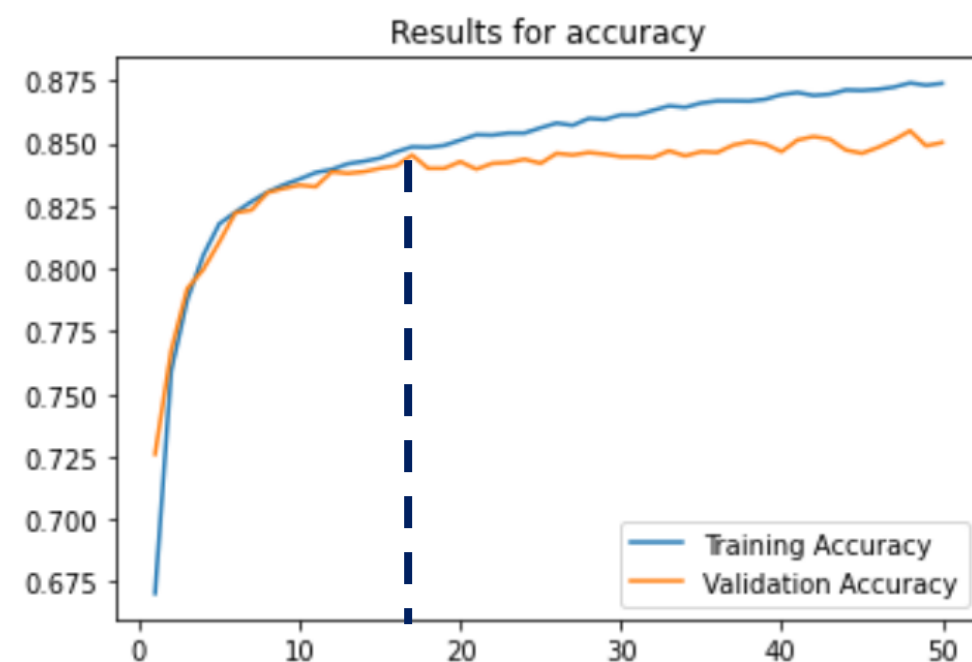
# Model Evaluation (LSTMs)

Search



## LSTM with GloVE 100d

- 100-dimensional GloVE
- LSTM layer with 10 nodes
- Trained to 17<sup>th</sup> epoch





# Model Evaluation (LSTMs)

Search



## LSTM with GloVE 100d

- 100-dimensional GloVE
- LSTM layer with 10 nodes
- Trained to 17<sup>th</sup> epoch

	Train	Test	Ao3
Precision	86.3%	87.1%	65.1%
Recall	83.8%	80.5%	60.6%
Accuracy	85.2%	84.3%	64.1%
Baseline accuracy	84.0%	85.5%	58.8%



# Model Evaluation (LSTMs)

Search



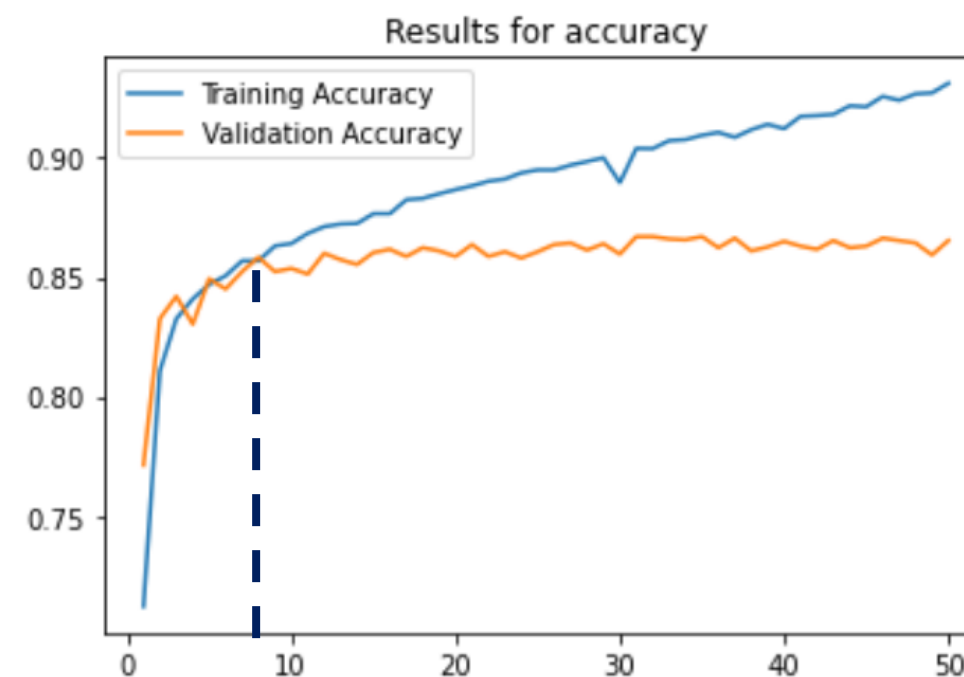
## LSTM with GloVE 100d

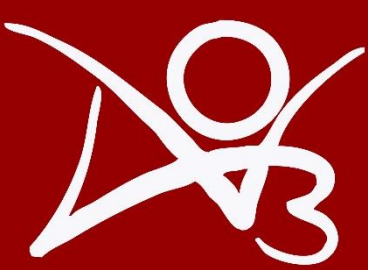
- 100-dimensional GloVE
- LSTM layer with 10 nodes
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	Train	Test	Ao3
Precision	86.3%	87.1%	65.1%
Recall	83.8%	80.5%	60.6%
Accuracy	85.2%	84.3%	64.1%
Baseline accuracy	84.0%	85.5%	58.8%

## LSTM with GloVE 300d

- 300-dimensional GloVE
- LSTM layer with 24 nodes
- Trained to 8<sup>th</sup> epoch





# Model Evaluation (LSTMs)

Search



## LSTM with GloVE 100d

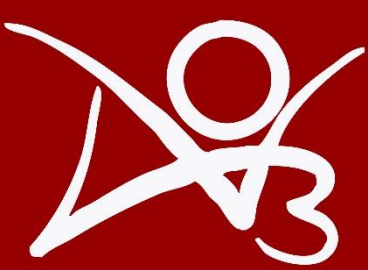
- 100-dimensional GloVE
- LSTM layer with 10 nodes
- Trained to 17<sup>th</sup> epoch

	Train	Test	Ao3
Precision	86.3%	87.1%	65.1%
Recall	83.8%	80.5%	60.6%
Accuracy	85.2%	84.3%	64.1%
Baseline accuracy	84.0%	85.5%	58.8%

## LSTM with GloVE 300d

- 300-dimensional GloVE
- LSTM layer with 24 nodes
- Trained to 8<sup>th</sup> epoch

	Train	Test	Ao3
Precision	89.7%	87.1%	63.3%
Recall	84.3%	80.7%	50.6%
Accuracy	87.3%	85.1%	60.6%
Baseline accuracy	84.0%	85.5%	58.8%



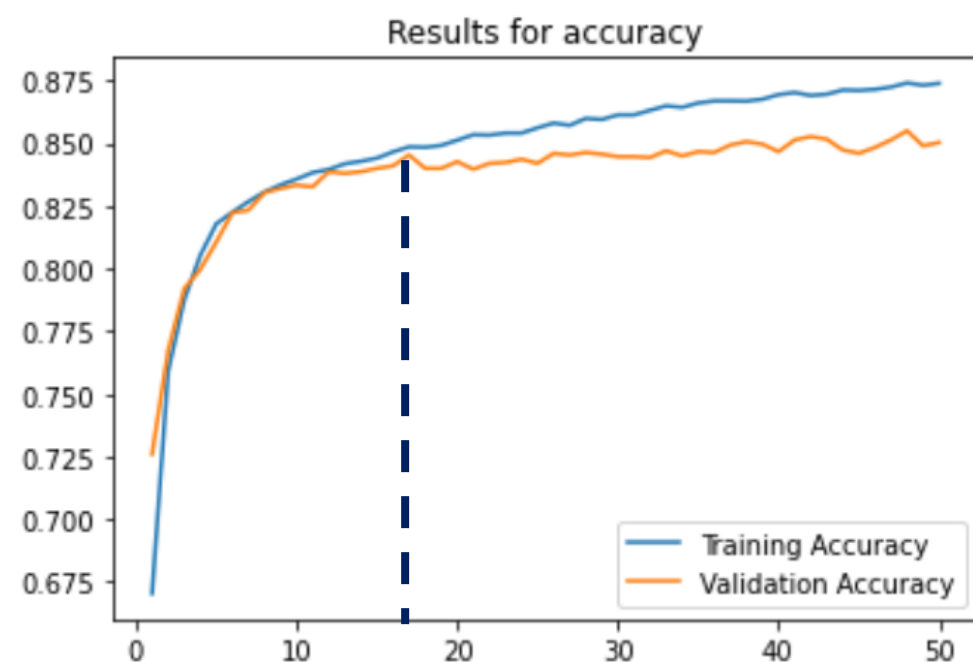
# Model Evaluation (LSTMs)

Search



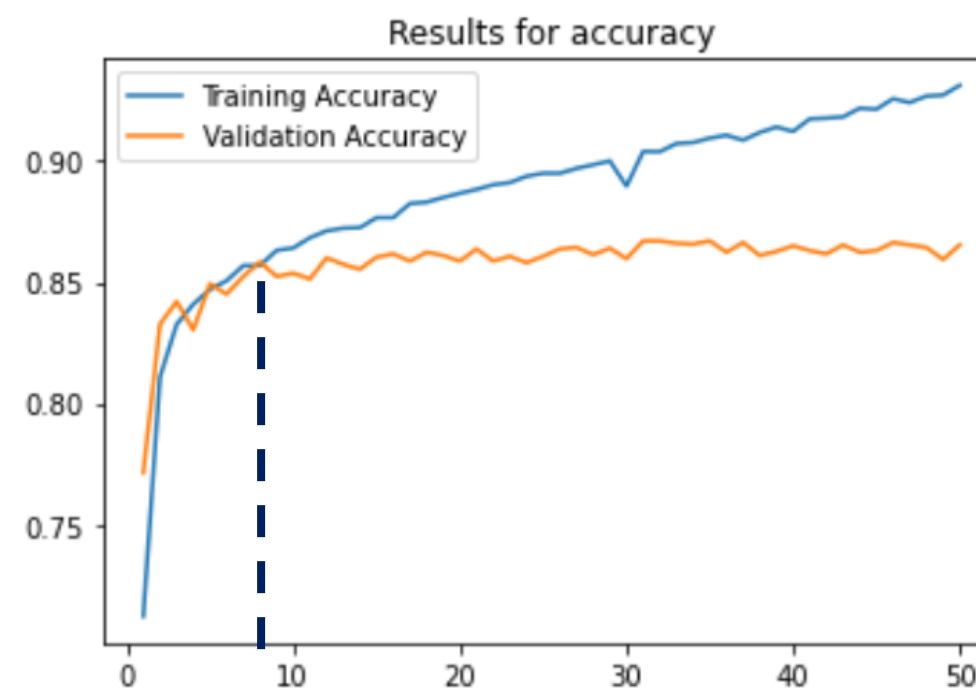
## LSTM with GloVE 100d

- 100-dimensional GloVE
- LSTM layer with 10 nodes
- Trained to 17<sup>th</sup> epoch



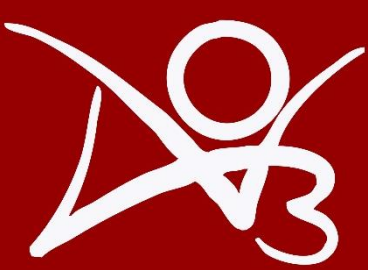
## LSTM with GloVE 300d

- 300-dimensional GloVE
- LSTM layer with 24 nodes
- Trained to 8<sup>th</sup> epoch



## Bi-LSTM with GloVE 100d

- 100-dimensional GloVE
- Bi-LSTM layer with 10 nodes
- L2 weights regularization



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	Train	Test	Ao3
Precision	86.3%	87.1%	65.1%
Recall	83.8%	80.5%	60.6%
Accuracy	85.2%	84.3%	64.1%
Baseline accuracy	84.0%	85.5%	58.8%

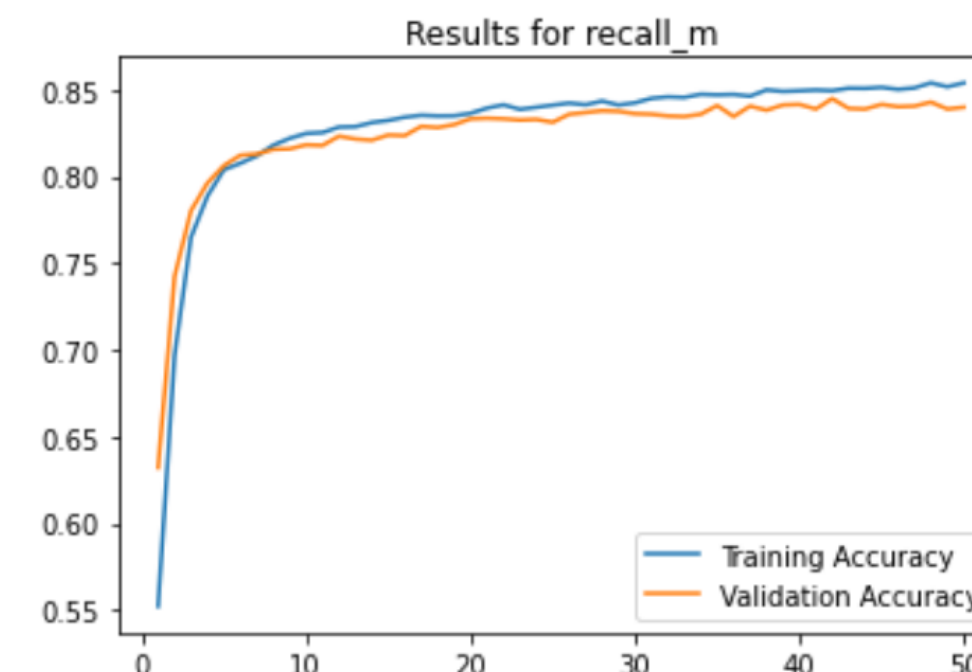
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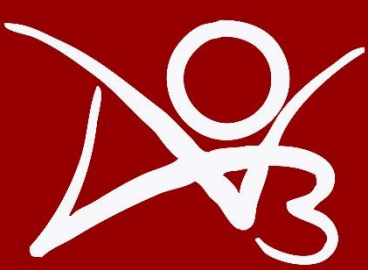
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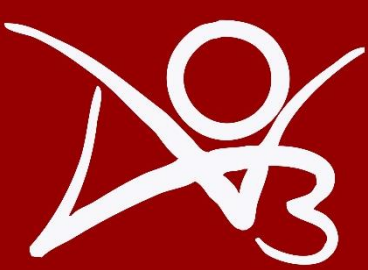
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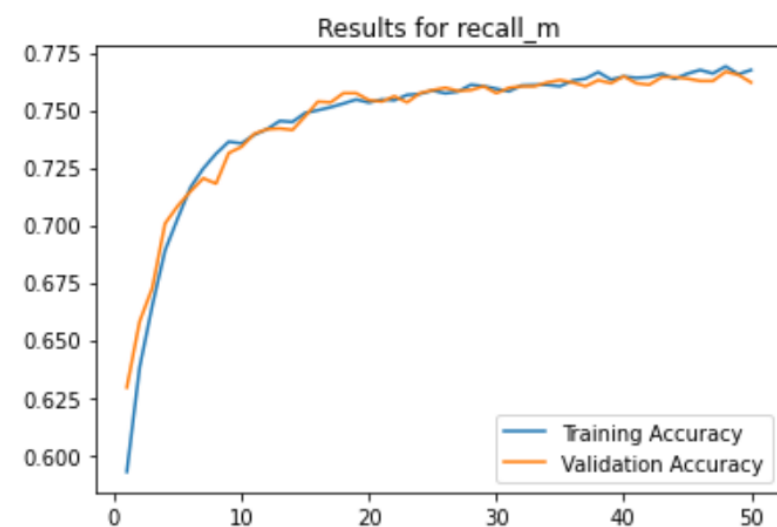


# Model Evaluation (CNNs)

Search

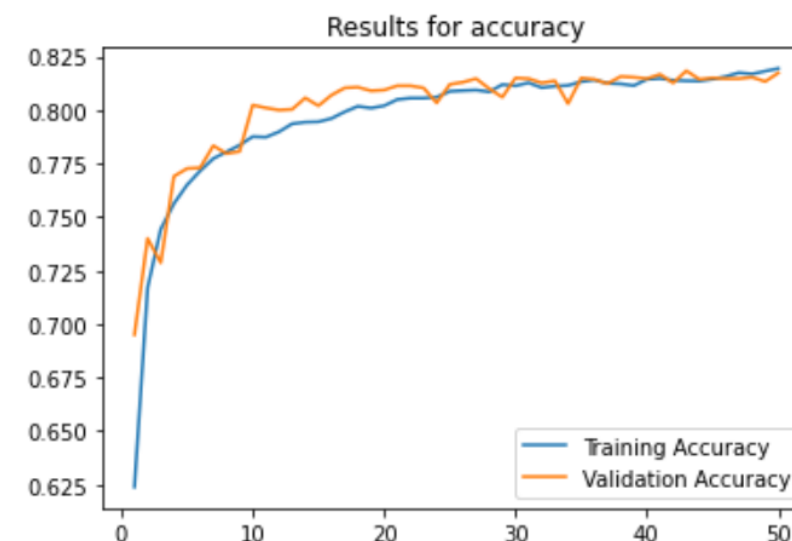


## 1D CNN with GloVE 100d

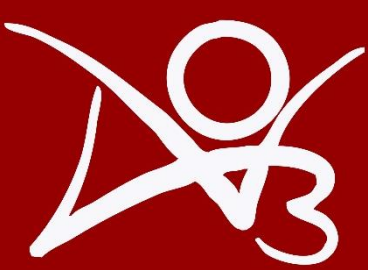


	Train	Test	Ao3
Precision	79.2%	79.7%	51.9%
Recall	72.7%	70.3%	52.5%
Accuracy	76.8%	76.2%	51.9%
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## 1D CNN with GloVE 300d



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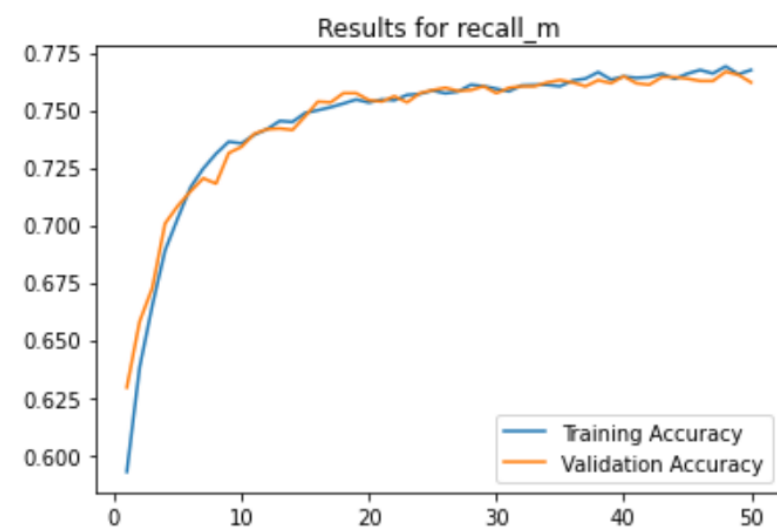


# Model Evaluation (CNNs & BERT)

Search

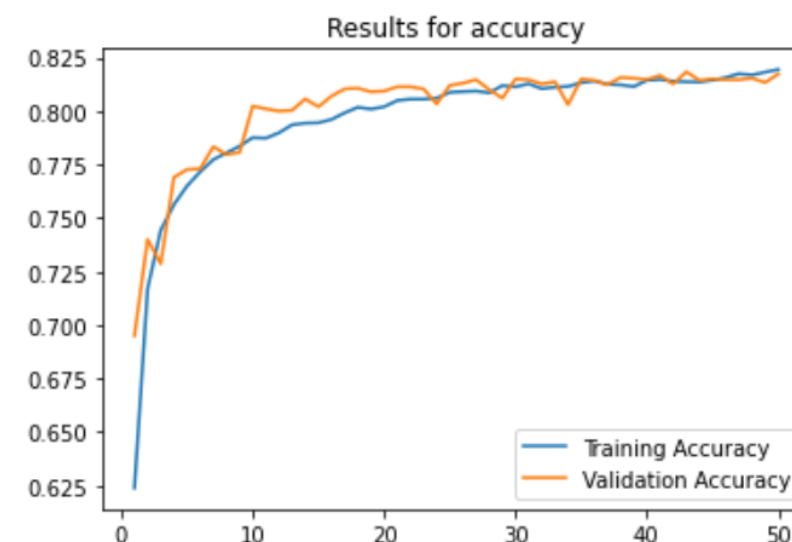


## 1D CNN with GloVE 100d



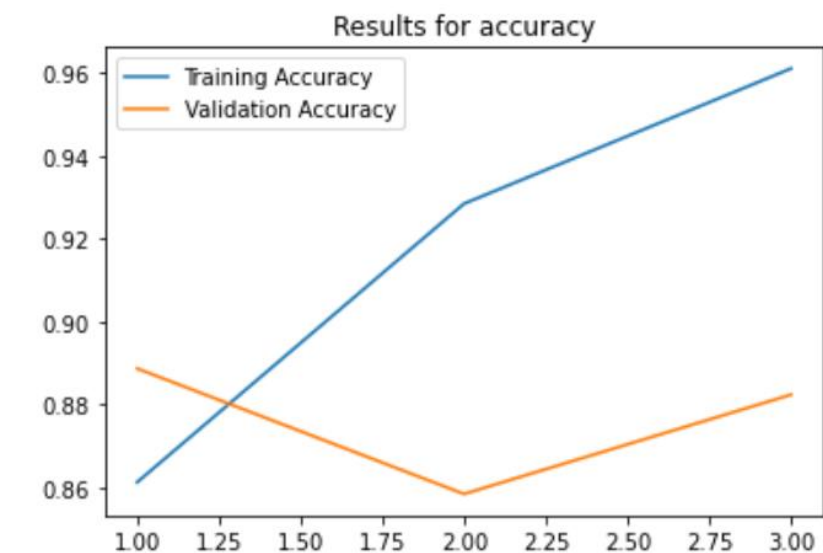
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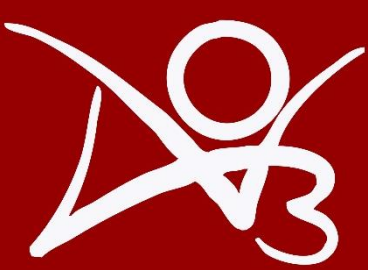


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## BERT



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# Model Evaluation (NNs)

Search



## LSTM with GloVE 100d

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## Bi-LSTM with GloVE 100d

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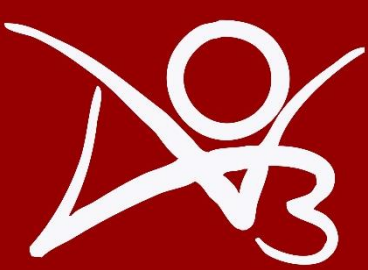




# Search



## Still misclassifies positive comments that contain profanities



# Model Evaluation (LSTM)

Search

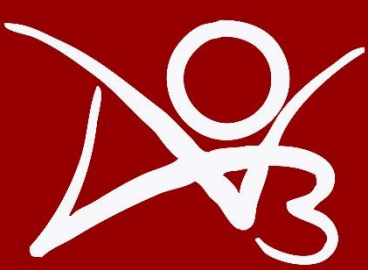


## AGGRESSORS (TROLLS)

	Comments	Base	LSTM	Type of comments
Troll 1	45	35.6%	35.6%	Attacks on writing. Low to medium toxicity.
Troll 2	30	70.0%	70.0%	Violent language . High toxicity.
Troll 3	32	81.2%	81.2%	Insults and hate speech. High toxicity.
Troll 4	42	50.0%	64.4%	Attacks on writing. Medium toxicity. Sarcasm.
Unknown	11	45.5%	72.7%	Mixed







# Model Evaluation (LSTM)

Search



- ▶ Model doesn't do well on positive comments that contain profanity  
“that was fucking amazing! thank you!” – 0.8757
- ▶ Model does decently on sarcastic comments  
“amazingly illogical and senseless! good job!” – 0.8310
- ▶ But model is sensitive to typos - prediction changed quite drastically  
“amazingly illogical and senseless! good job!” – 0.6574
- ▶ Model doesn't do well with vocabulary that it wasn't trained on  
“amazingly ooc! good job!” – 0.1783

1

*Problem Statement*

2

*Data Collection & Cleaning*

3

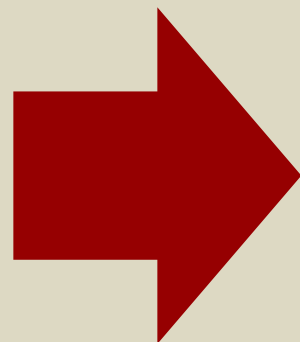
*Exploratory Data Analysis*

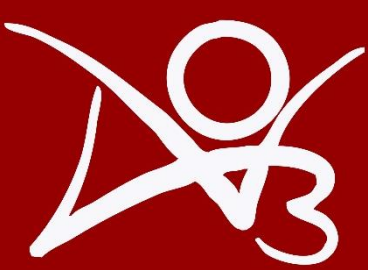
4

*Modelling & Model Evaluation*

5

*Conclusions & Recommendations*



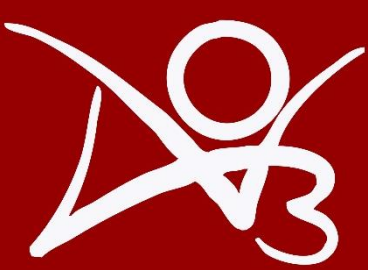


# Conclusions & Recommendations

Search



- ▶ Achieved baseline accuracy of 58.8% with SVM and tf-idf vectorization
- ▶ LSTM model outperformed baseline model with accuracy of 64.1%
  - Model doesn't do well on positive comments that contain profanity
  - Model doesn't do well with vocabulary that it wasn't trained on
  - Model is sensitive to typos - prediction changed quite drastically
  - Can be helped by using character-level rather than word-level embeddings.
  - Can't be helped. Requires more tailored training content.
    - Choose better dataset to train on
    - Label Ao3 data



# Conclusions & Recommendations

Search



1

## More advanced models

- Deep learning models implemented are relatively shallow models
- Try deeper layers, hybrid models, better architecture
- Try tailored pre-trained models like HateBERT

2

## Choose better train data

- Style of conversation and typing is more formal on Wikipedia than on Ao3
- Try to find train data that better matches the writing style and vocabulary used on Ao3
- This is potentially difficult

3

## Collect and label Ao3 data

- Best way is to integrate a data collection system into the platform and let users flag content for you – but this requires action from the platform managers
- If manually done, it will be manpower intensive, but will probably lead to the best performance