

Domestic Violence Detection

using social media posts

Presentation



WHY SHOULD WE CARE?

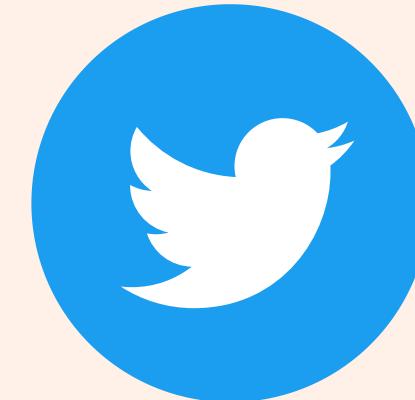
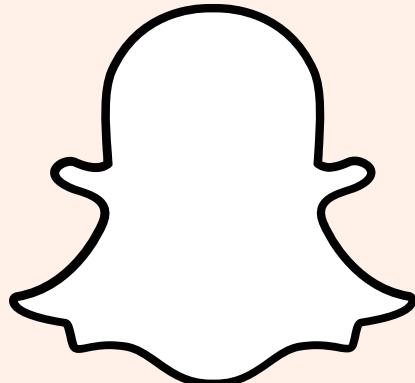


Do you know that **1 in 4** women and **1 in 7** men have been victims of severe physical violence by an intimate partner?



more than **1 in 3** women and **1 in 4** men have experienced either physical violence, rape, or stalking by an intimate partner in their lifetime?

WHY SOCIAL MEDIA?



- Selfhelp-hotline popup
- Domestic violence support recommendations

← ...

Top Latest People Photos Videos

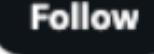
You are not alone

If you or someone you know is affected by domestic or gender-based violence and needs support, you are not alone. Our partner, the National Domestic Violence Hotline, can help.

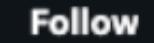
Reach out

@ndvh

People

National Domestic Violence Hotline 
@ndvh 
Resources & support for anyone in the U.S. affected by intimate partner violence 24/7/365. 1-800-799-7233. Chat at thehotline.org | Text "START" to 88788.

NNEDV 
@nnedv 
The National Network to End Domestic Violence (NNEDV) is creating a world where domestic violence no longer exists. Join us at NNEDV.org. 

NO MORE
@NOMOREorg 
NO MORE is a global public awareness & engagement organization focused on ending domestic violence and sexual assault.

← ...

Top Latest People Photos Videos

People

Jermaine (Juice) Hicks @HeDontHitLikeMe 
233lbs | 6'1 | OLB | MWSU 27'  

[View all](#)

ARO I MISS YOU DEAR    @meglyfer · Apr 10 ...
BRO, MY BEST FRIEND HIT ME WITH THE BALL ON PE WHILE PLAYING VOLLEYBALL AND HE HIT ME ON MY RIGHT EYE 

 ← ...

Top Latest People Photos Videos

Michelle Lesley @MichelleDLesley · 3h
--Told women not to bring their Bibles to a "Bible" study but, instead, to focus on "what the Spirit was saying to them"
--Along with her **husband**, spiritually **abused my husband & me** for standing on biblical truth

Sheesh. Vet the speakers at the conferences you attend, ladies. 2/end

2 3 36 796 

[Show this thread](#)

Kim Butler @Butl71606805Kim · Apr 9
Replying to @pulte
Happy Easter! Left my house last night with my son. **My husband** physically **abused me** for the first and last time. We have nothing. If you could help us get some food and a room today would be wonderful! I know you probably can't. \$kimbutler119

DATA COLLECTION

Data was pulled from Reddit using the **Pushshift API**

- DV posts: 10276
- Non-DV posts: 233426
- Total post: 243702

Group	Subreddit	Number of posts	Description
Domestic violence	Domestic violence	10279	Subreddit to discuss domestic violence
	Fitness	1541	A place for the pursuit of physical fitness goals
	Jokes	116221	jokes subreddit
Non-domestic violence (Control)	Meditation	10096	Community for sharing meditation experiences
	Studying	11843	A subreddit is for all things studying
	Relationships	93747	A place to discuss interpersonal relationship advice

Table 1. Summary of the collected data (after cleaning) from Reddit.

DATA WRANGLING

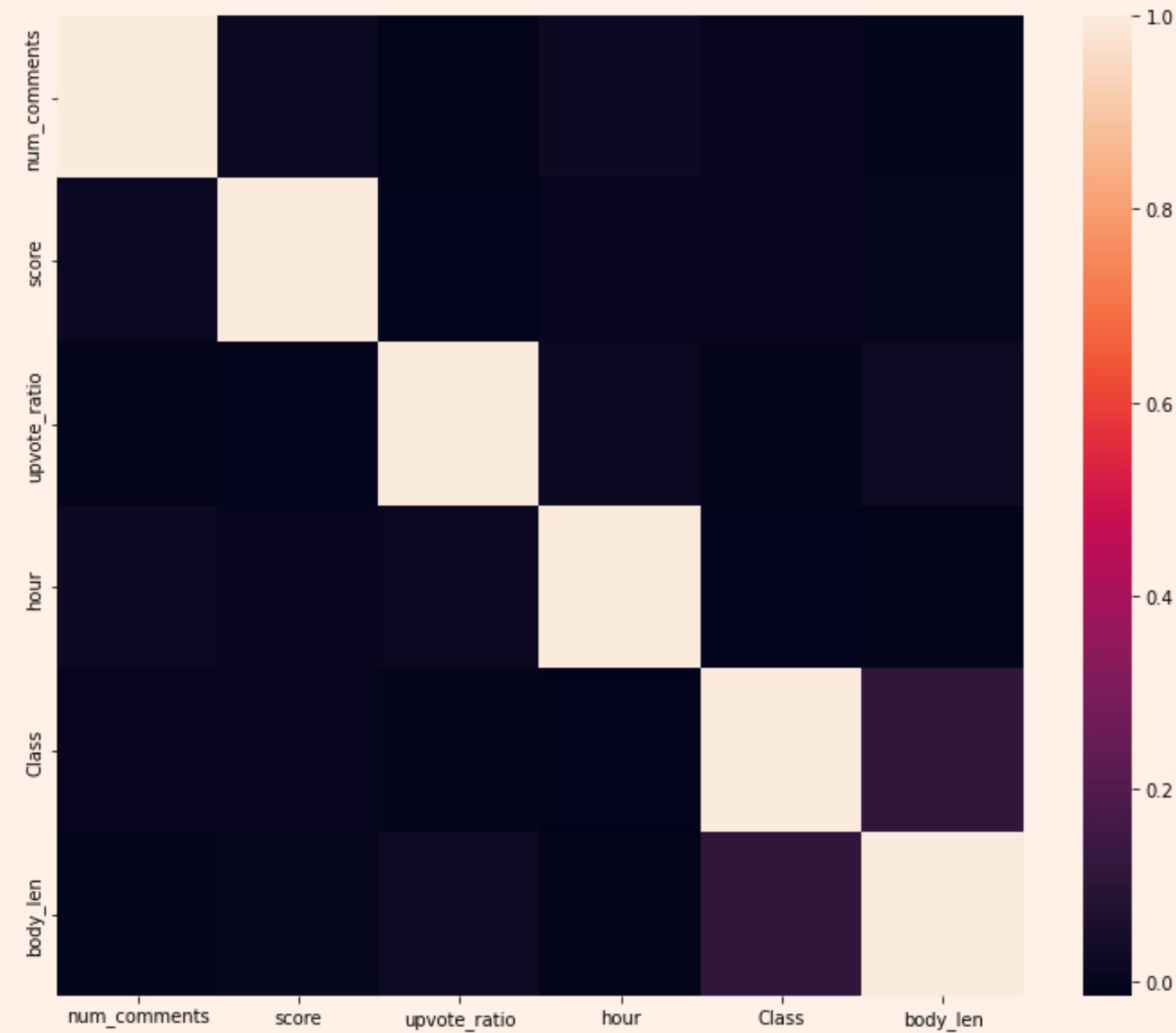
Before

	created_utc	id	num_comments	score	selftext	subreddit	title	upvote_ratio	created
0	1662007007	x2ycxd	0	1.0	[removed]	domesticviolence	Women with abusive fathers, How do i get past ...	1.0	1.662032e+09
1	1662002574	x2wyl4	1	1.0	I haven't ordered/eaten our favorite food sinc...	domesticviolence	I can't even eat chocolate without thinking ab...	1.0	1.662028e+09
2	1661996523	x2uv4c	1	1.0	I think this time he's really changing this ti...	domesticviolence	How do I know he's really changing?	1.0	1.662022e+09
3	1661985458	x2qure	0	1.0	[removed]	domesticviolence	Representation or no?	1.0	1.662011e+09
4	1661982397	x2pn4w	1	1.0	This is more of a rant than anything because I...	domesticviolence	Just got my 5th NFA 😭	1.0	1.662008e+09

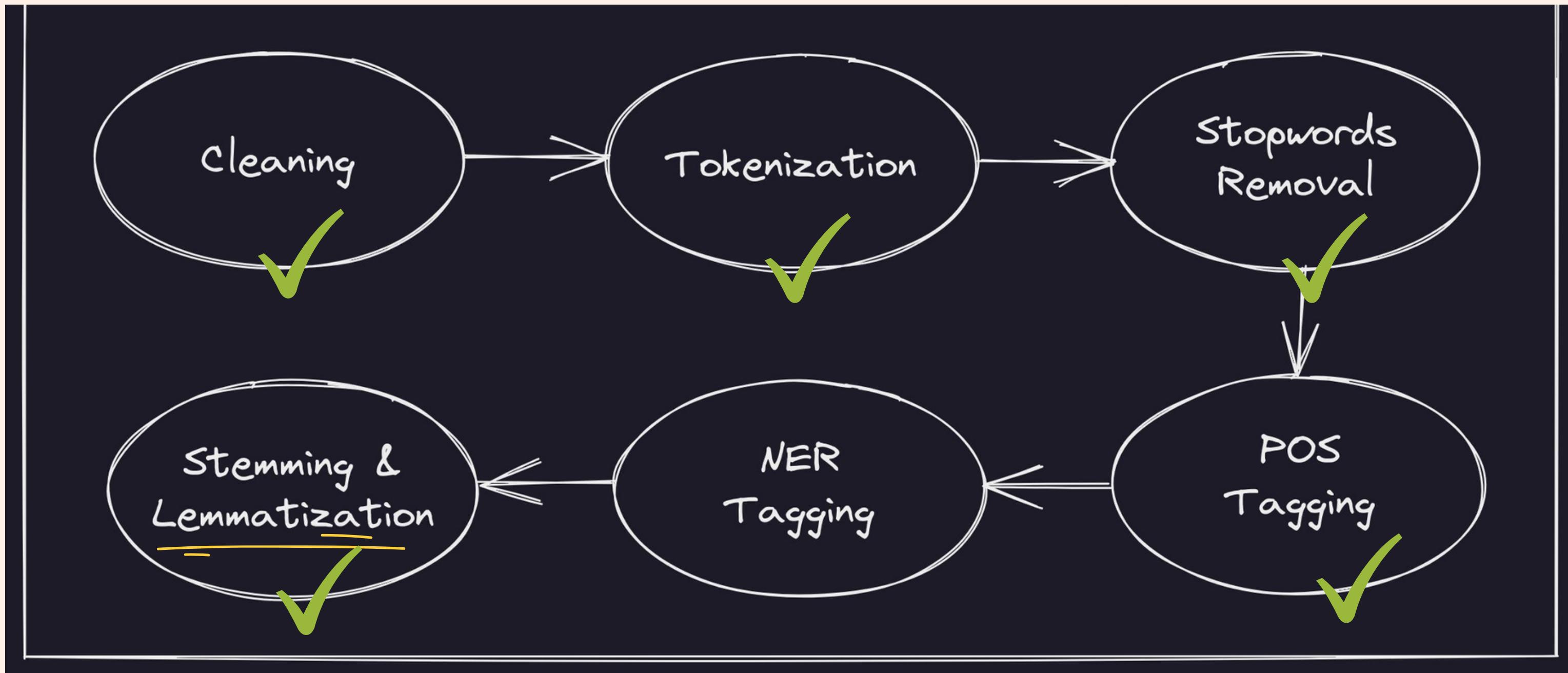
After

	id	num_comments	score	upvote_ratio	all_text	hour	Class	body_len
0	x2wyl4		1.0	1.0	1.0 I can't even eat chocolate without thinking ab...	10	1	356
1	x2uv4c		1.0	1.0	1.0 How do I know he's really changing? I think th...	8	1	380
2	x2pn4w		1.0	1.0	1.0 Just got my 5th NFA 😭 This is more of a rant t...	4	1	732
3	x2p5sn		1.0	1.0	1.0 Can't find the energy to leave Hi, I have been...	4	1	631
4	x2jeo4		1.0	1.0	1.0 Am I really at a point where I should avoid do...	0	1	2356

DATA WRANGLING



NLP PREPROCESSING



- removed non-English text
- converted emojis to text

'I love Python ❤️, it is brilliant 👍'

'I love Python :red_heart:, it is brilliant :thumbs_up:'

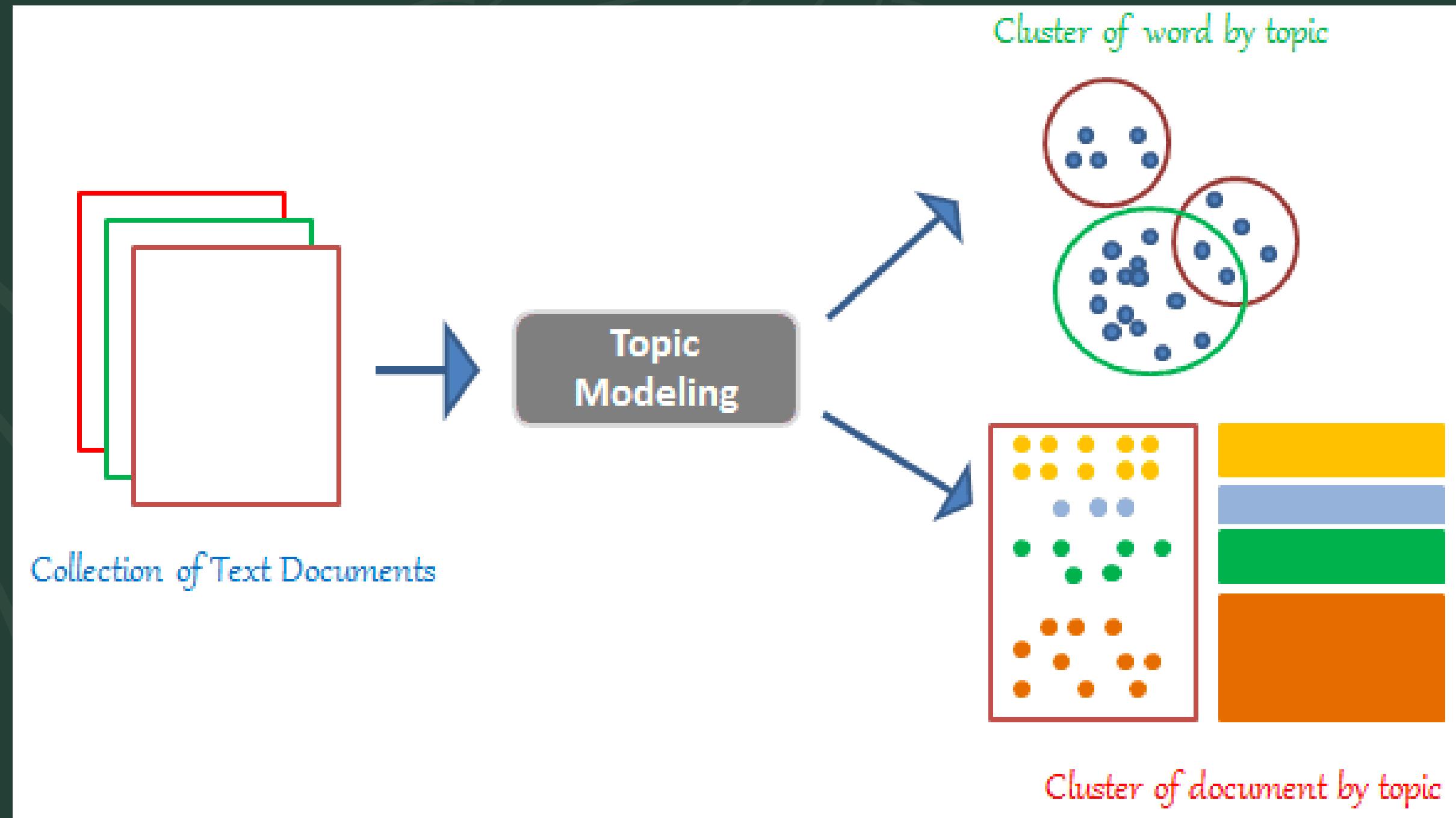
TOPIC MODELING



figure. Wordcloud shows abuse related words appeared in domestic violence posts, e.g ‘help’, ‘leave’, ‘abuse’, ‘police’

LDA

(Latent Dirichlet Allocation)



A statistical model for discovering the abstract topics aka topic modeling.

LDA

(Latent Dirichlet Allocation)



- every document is a distribution of topics
- every topic is a distribution of words

Topics & top words

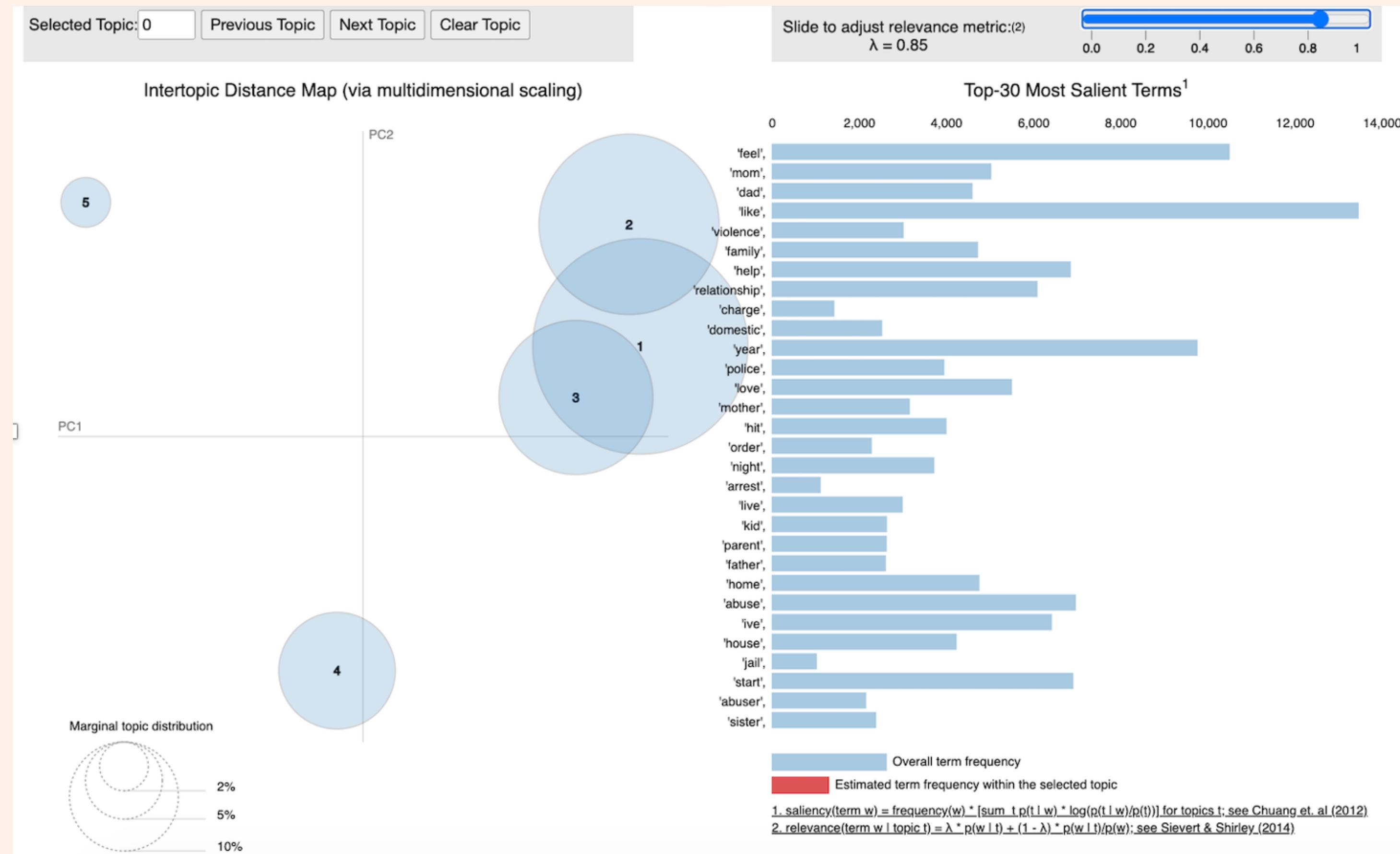
Domestice Violence	
Topics	Words
family	mom, help, dad, family, year, work, mother, home, house, house
time	start, come, time, hit, try, night, say, ask, day, face
violence & abuse	violence, domestic, police, order, abuser, abuse, victim, woman, amp
crime	charge, arrest, jail, assault, neck, press, injury, court, Officer, prison
feel/Relationship	like, feel, want, Time, thing, relationship, I've, year, think, love

table. topics and the top 10 words associated with each topic extracted from domestic violence subreddits.

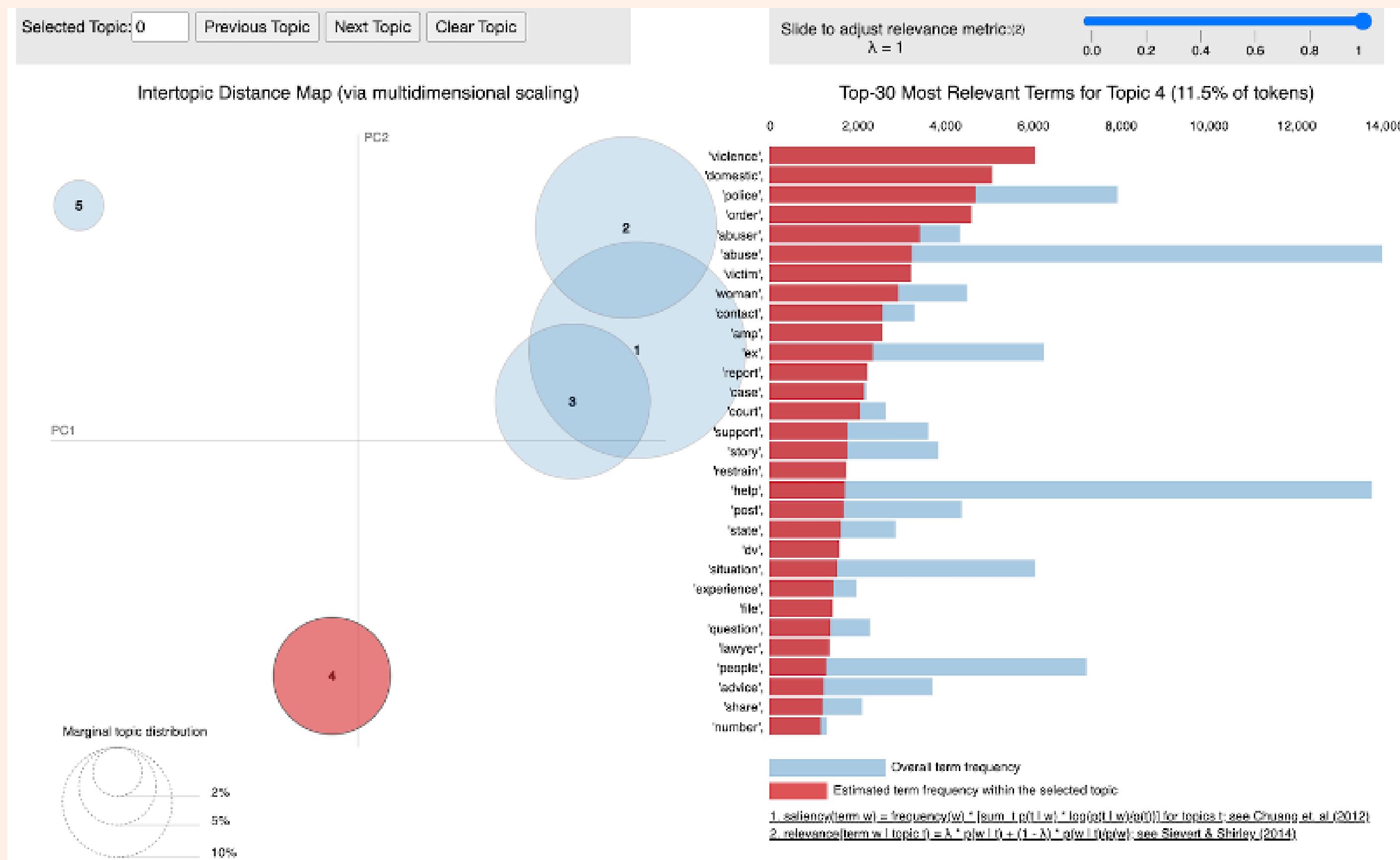
Non Domestice Violence	
Topics	Words
study/school	study, learn, write, people, focus, subject, life, online, university, best
study	use, school, student, list, complete, test, study, task, grade, course
meditation	breath, breathing, pen, platform, store, khan, drug, clearly, participate, brother
feel	Feel: like, time, help, thing, want, day, exam, feel, need, start
fitness	thread, accountability, post, video, accountable, well-educated, versatile, topictask, expertise, daily

table. topics and the top 10 words associated with each topic extracted from non-domestic violence subreddits.

pyLDAvis visualization of the topics



pyLDAvis visualization of the topics



CountVectorizer vs TfidfVectorizer

Data = ['The', 'quick', 'brown', 'fox', 'jumps', 'over', 'the', 'lazy', 'dog']

↓

Data	The	quick	brown	fox	jumps	over	lazy	dog
	2	1	1	1	1	1	1	1

$$w_{x,y} = tf_{x,y} \times \log \left(\frac{N}{df_x} \right)$$

TF-IDF

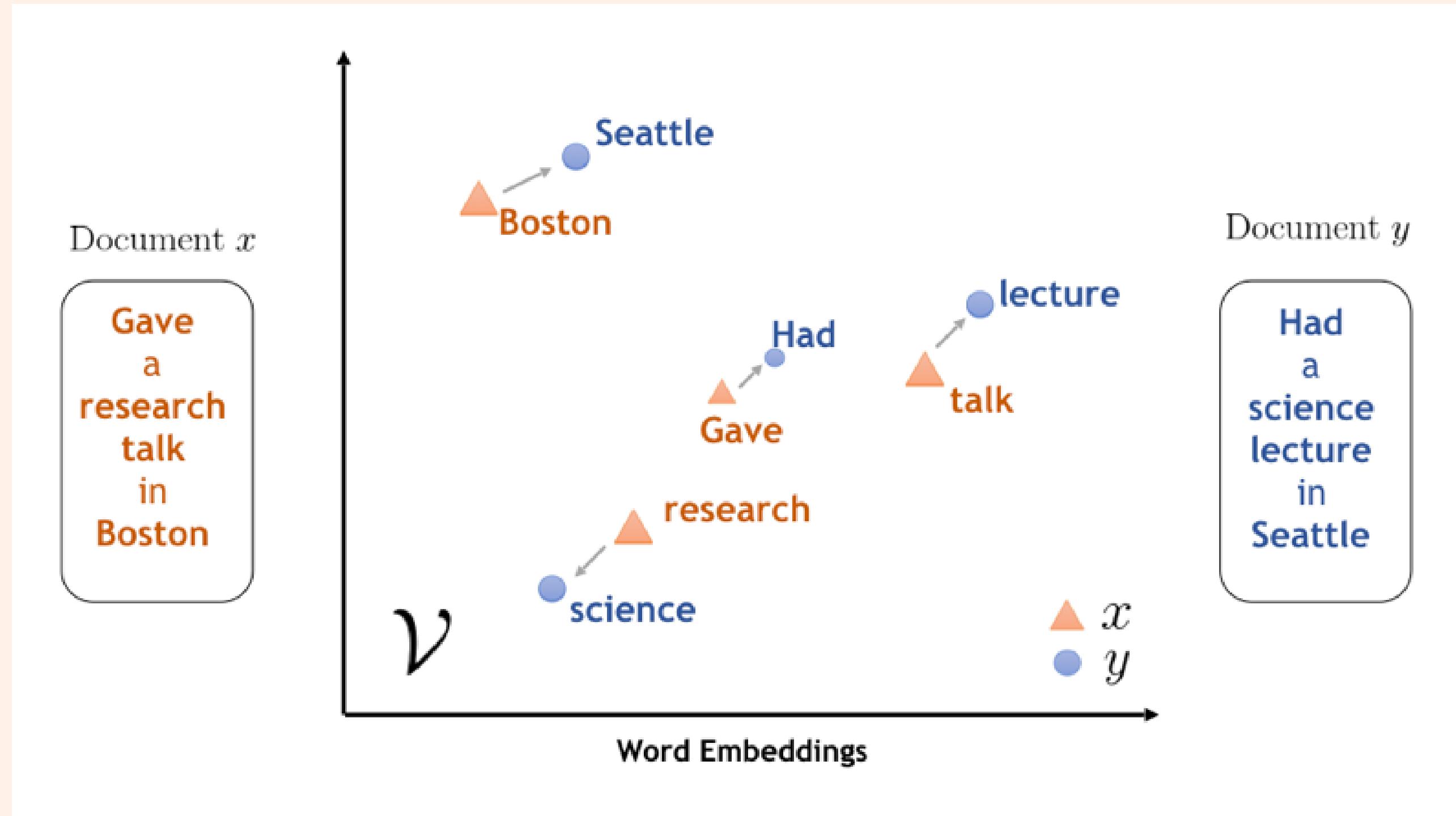
Term x within document y

$tf_{x,y}$ = frequency of x in y

df_x = number of documents containing x

N = total number of documents

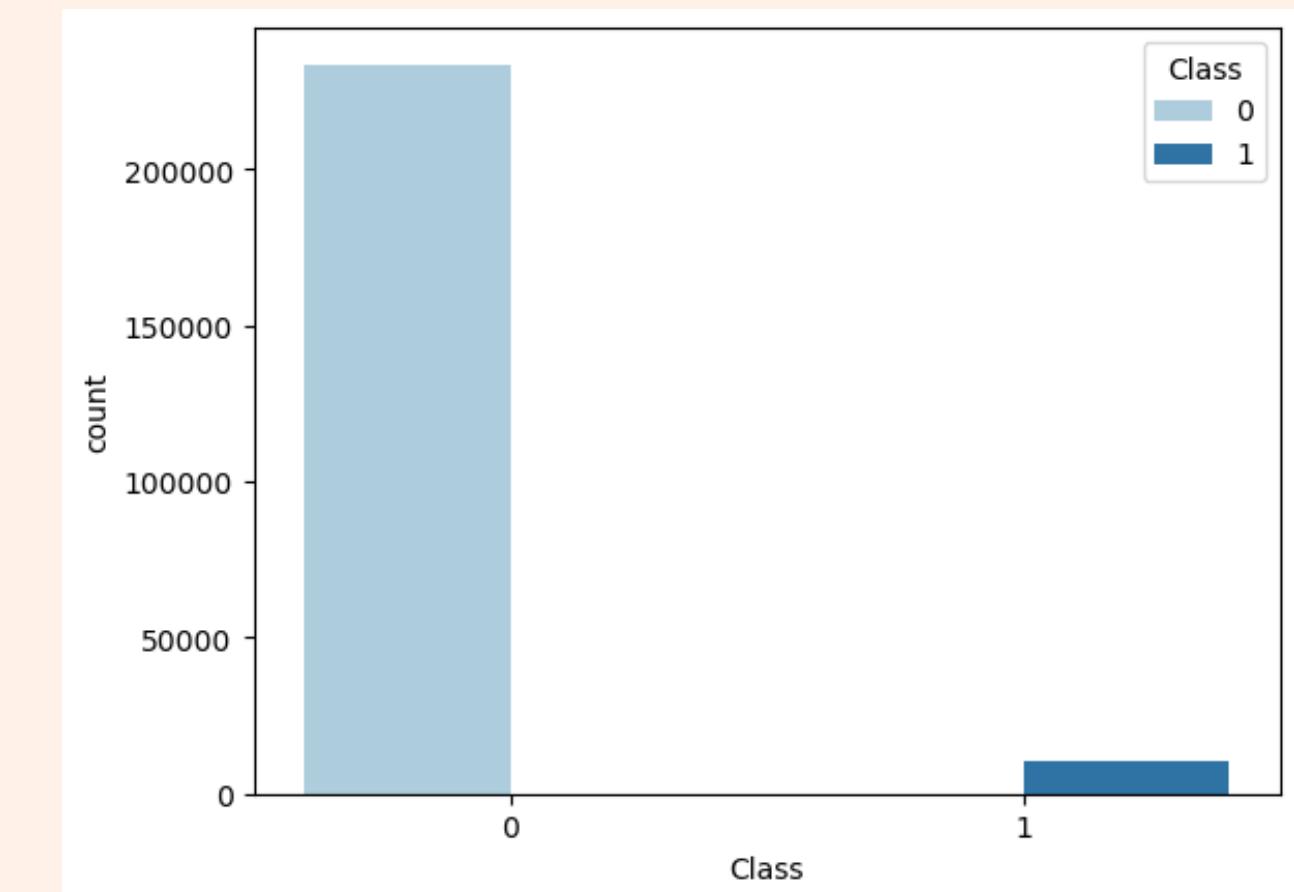
word embedding



Word embeddings are numerical vector representations of words, created in such a way that similar words (in terms of meaning or context) have similar vectors, thus capturing semantic relationships between words.

Dealing with Imbalanced dataset

- Choose appropriate evaluation metrics
- Update loss function
 - class_weight
- Select appropriate algorithms
- Resampling methods
 - oversampling
 - Generate synthetic examples/ data augmentation
 - undersampling
 - example weights
- Combine multiple techniques



Evaluation Metrics

Accuracy vs F1 score

		Positive	Negative
		True Positive (TP)	False Positive (FP)
Predicted Label	Positive		
	Negative	False Negative (FN)	True Negative (TN)
True Label			

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

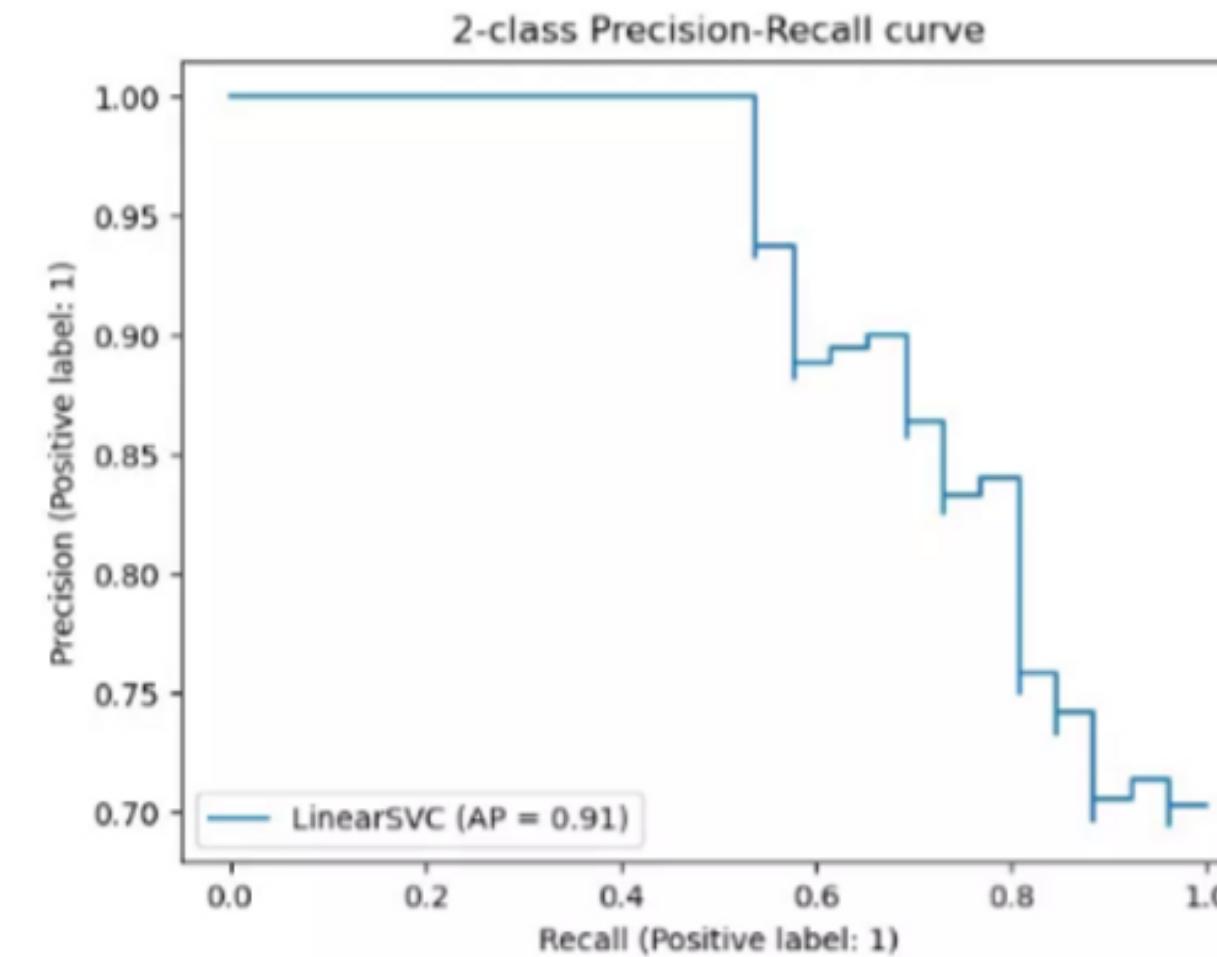
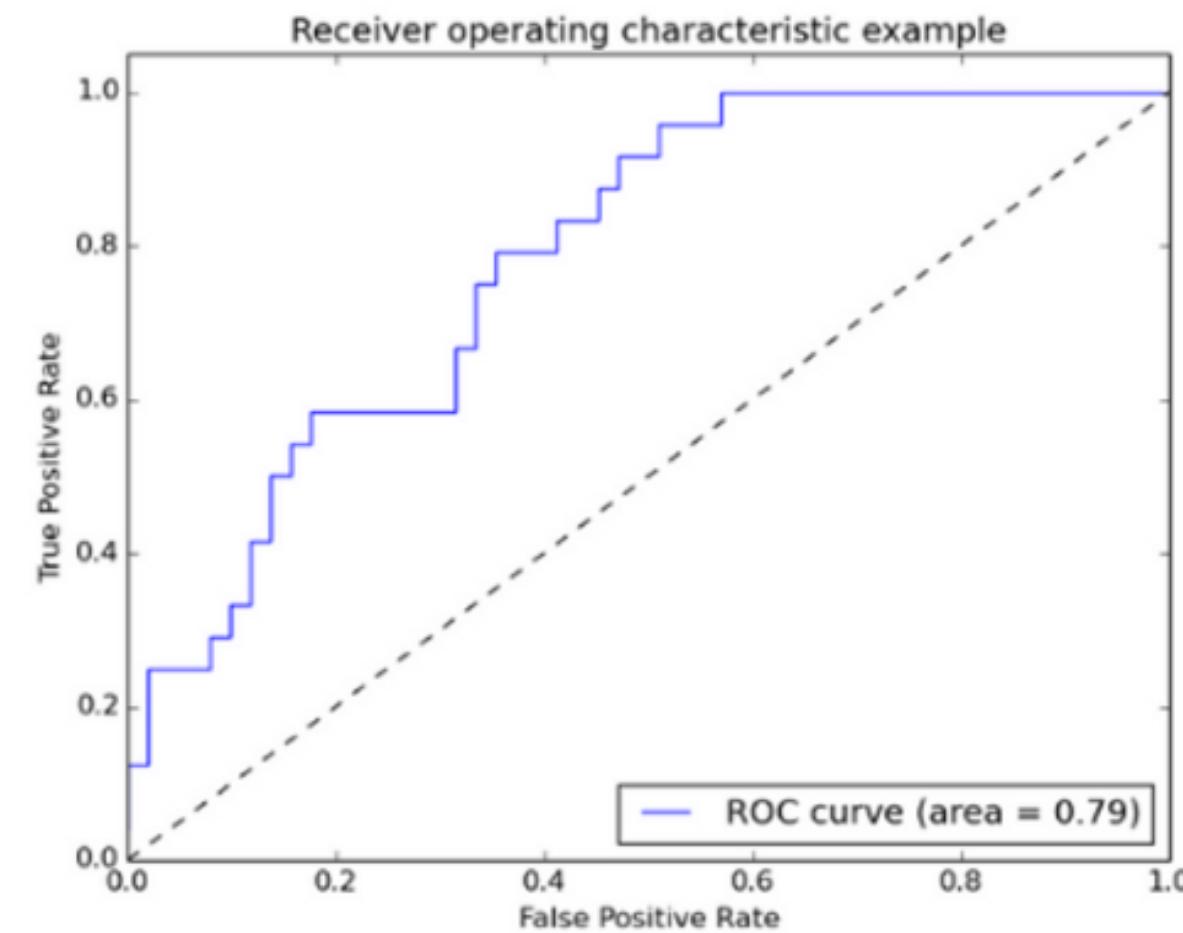
$$\text{Precision} = \frac{TP}{TP + FP}$$

$$\text{Recall} = \frac{TP}{TP + FN}$$

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

Evaluation Metrics

ROC VS PRC(Precision-Recall curve)



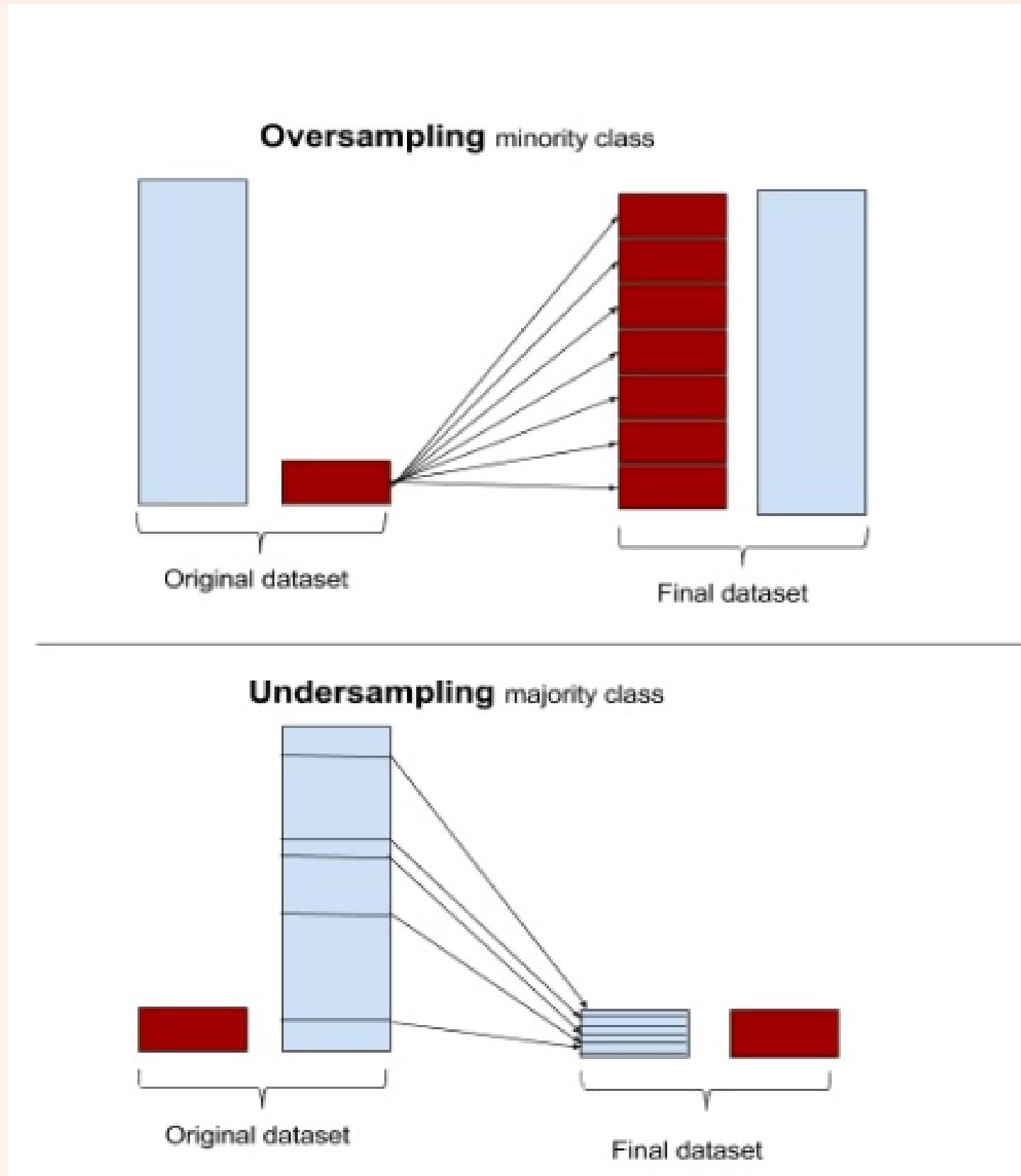
Both Precision-Recall Curve and ROC-AUC curve are used:

- To explain model goodness of fit
- To identify the correct threshold to map probabilities value to the actual classes 0/1

When to use which one:

- Precision Recall curve is used when there is imbalance class distribution.
- ROC-AUC curve is used when there is balanced class distribution in data.

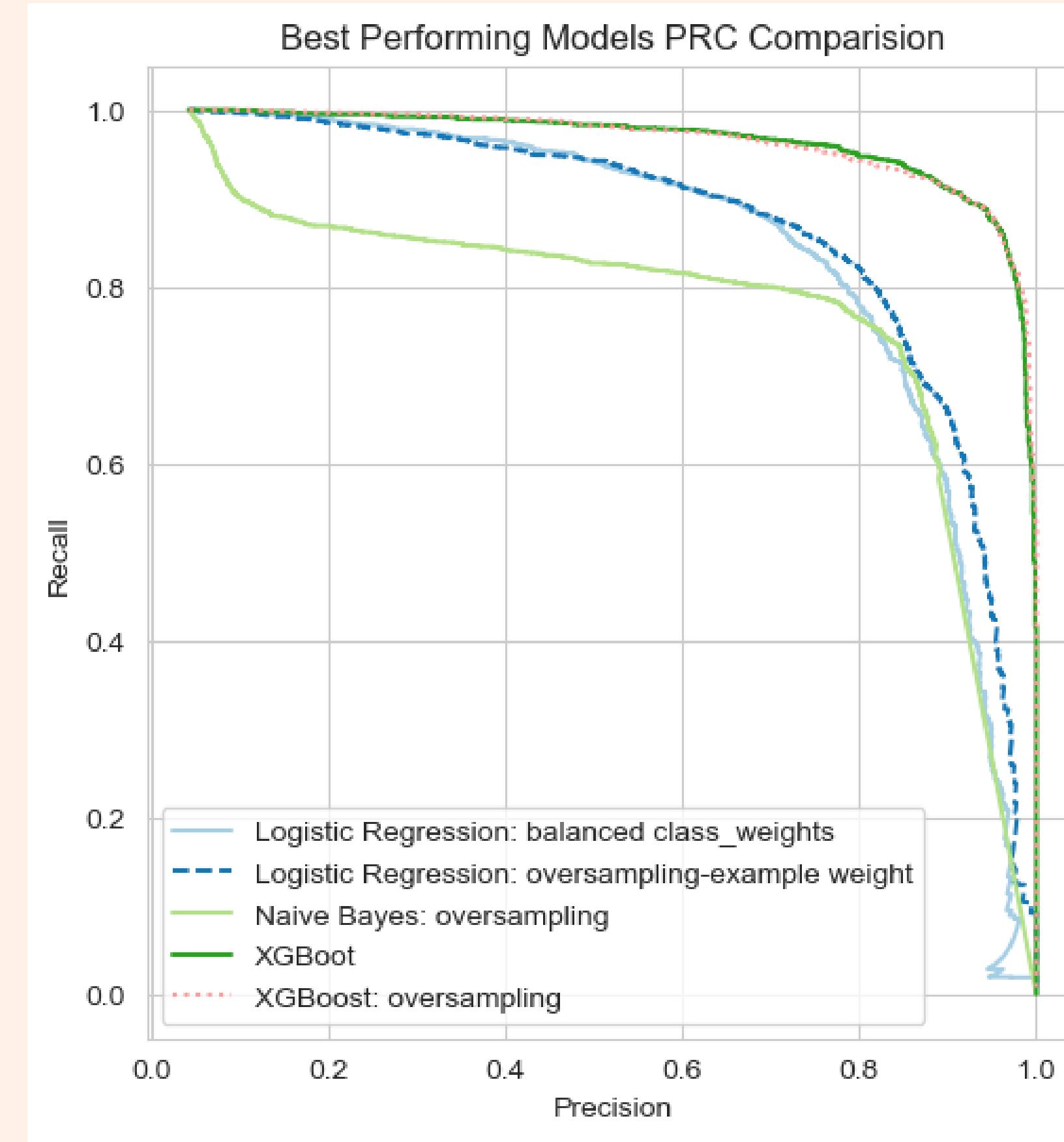
Resampling



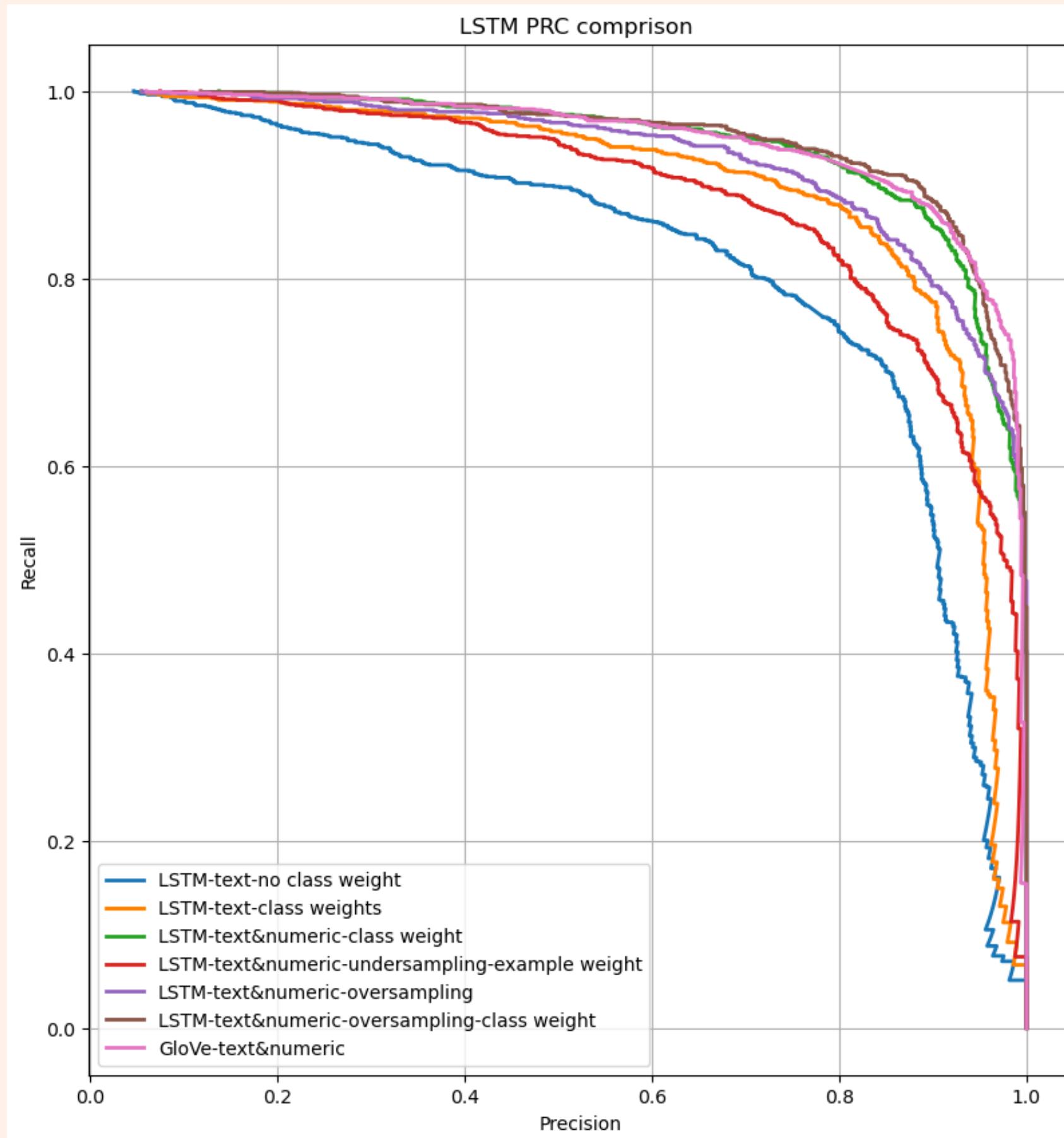
example weight:
reduce weigh to the oversampled
examples

example weight:
add weigh to the downsampled examples

Performance Comparison



LSTM Performance Comparison



Data augmentation

- Original text:

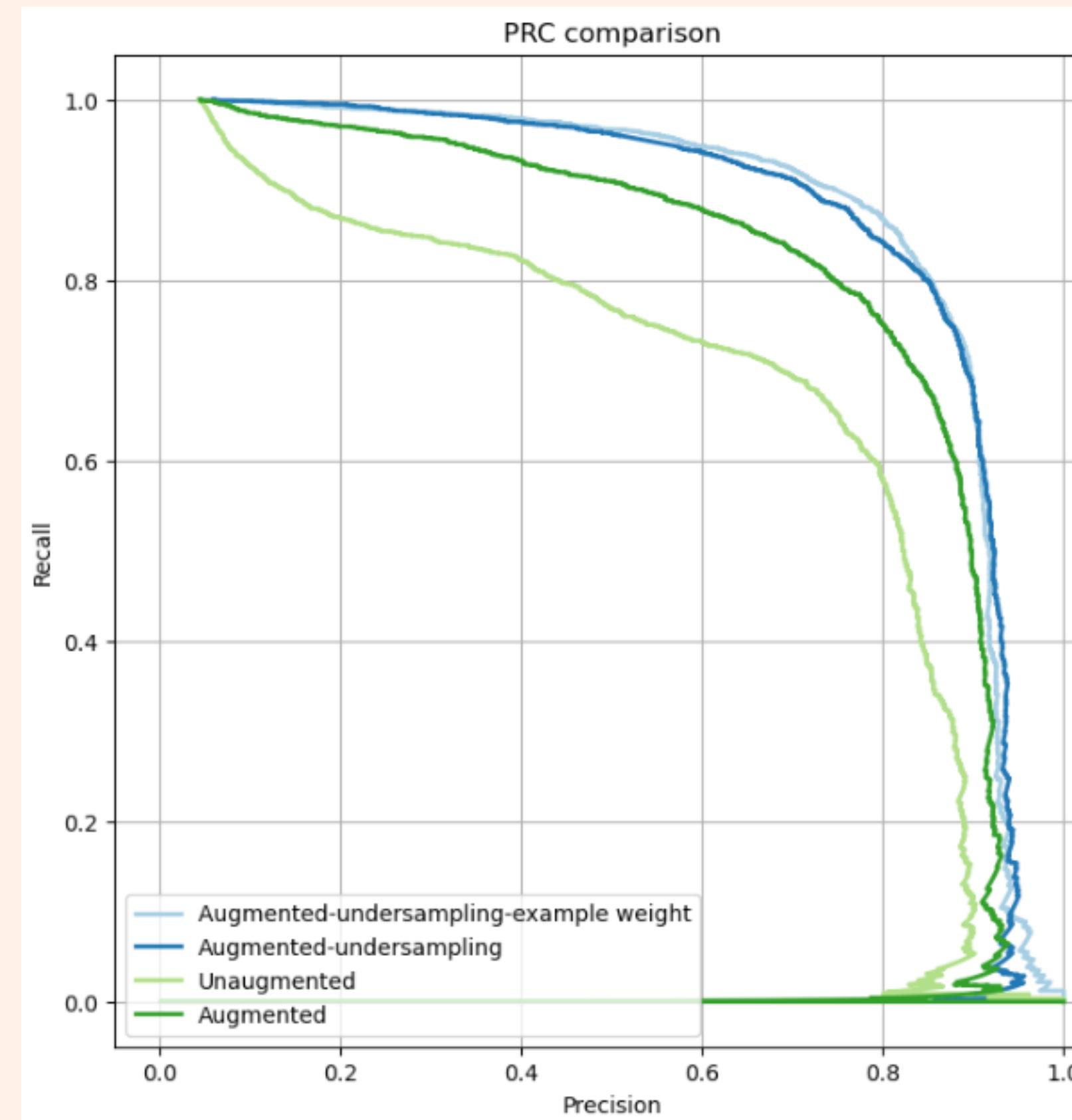
"ladies please take warning and stay aware from him
[https://www.tiktok.com/t/ZTRPL4whN/\n\nI'm trying to spread awareness to all so u don't go through the physical and emotional abuse that he put me through.... ais there any advice to help recover?"](https://www.tiktok.com/t/ZTRPL4whN/\n\nI'm trying to spread awareness to all so u don't go through the physical and emotional abuse that he put me through.... ais there any advice to help recover?)

```
augmenter = aug.ContextualWordEmbsAug(model_path='bert-base-uncased', action="insert")
```

- Augmented text:

"ladies please take warning and stay aware only from him https : / / www. tiktok. at com / [UNK] t / the ztrpl4whn / [UNK] i'm trying to spread awareness to all so **hope** u don't just go through the physical and emotional abuse **spells** that he put his me through.... ais there any advice **here** to help recover?"

Augmented vs Unaugmented LSTM Comparison



Results

Best F1-score:

	precision	recall	f1-score	support
0	0.99	1.00	1.00	42055
1	0.93	0.87	0.90	1812
accuracy			0.99	43867
macro avg	0.96	0.93	0.95	43867
weighted avg	0.99	0.99	0.99	43867

➤ nearly perfect scores for negative class

Best precision:

	precision	recall	f1-score	support
0	0.98	1.00	0.99	42055
1	0.96	0.63	0.77	1812
accuracy			0.98	43867
macro avg	0.97	0.82	0.88	43867
weighted avg	0.98	0.98	0.98	43867

➤ tradeoff between precision and recall for positive class

Best Best recall:

	precision	recall	f1-score	support
0	1.00	0.99	0.99	42055
1	0.77	0.95	0.85	1812
accuracy			0.99	43867
macro avg	0.88	0.97	0.92	43867
weighted avg	0.99	0.99	0.99	43867

What's next

- Build a web app with Flask using the best performing model to detect domestic violence posts
- Try to improve the model performance further:
 - Try other word augmenter form nlpaug, eg. random word augmenter
 - Try other augmenter form nlpaug, eg. sentence augmenter and character augmenter
 - Try other augmentation methods, eg. SMOTE (synthetic minority oversampling technique)
 - Try to improve the scores for positive class further and decrease the scores for negative class less than 1

