

# Information Extraction from Social Media: Tasks, Data, and Open-Source Tools

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**\*Some of the work presented here was done during my PhD at UIUC  
Work done at twitter will be marked with  Twitter logo.**

Content and views expressed in this tutorial are solely the responsibility of the presenters.

<https://socialmediaie.github.io/tutorials/LREC2022/>

QnA Page: <https://slido.com> with #3287167

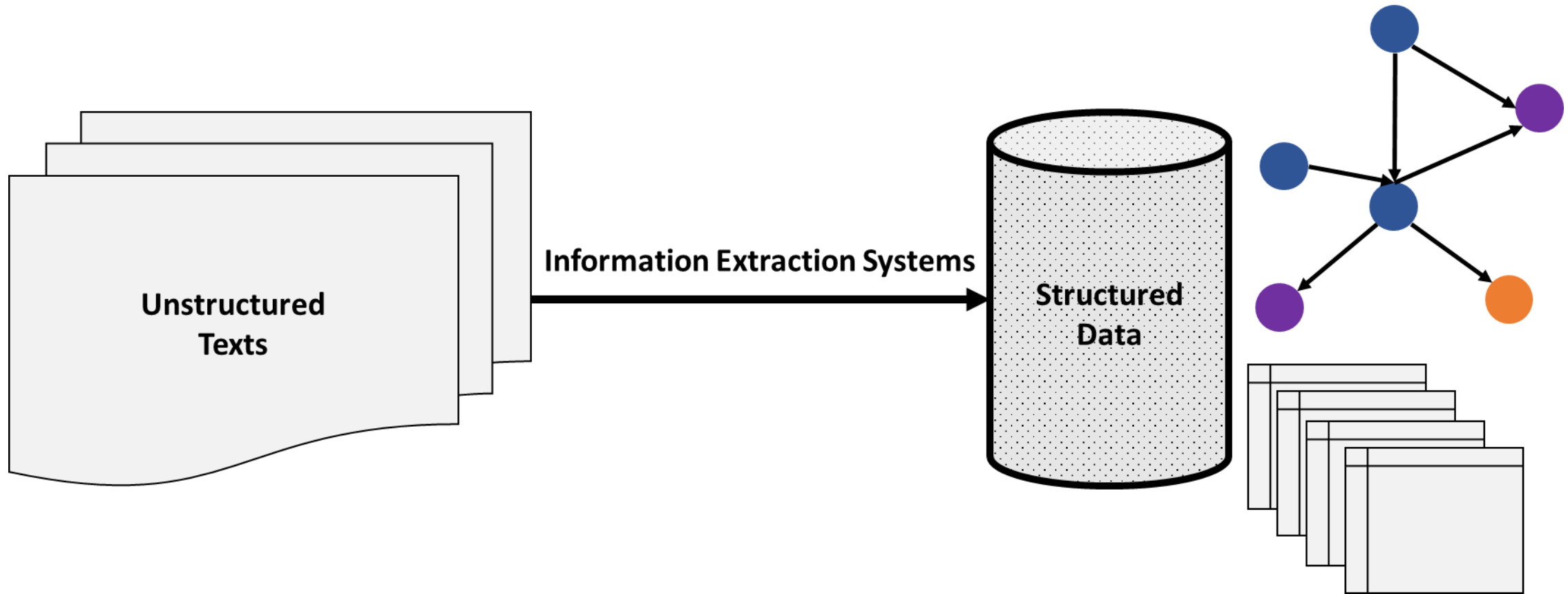


# Agenda

- Introduction (30 min) (Shubhanshu)
- Applications of Information Extraction(IE) (30 min) (Shubhanshu and Shadi)
- Hands on Practice (Shubhanshu)
  - Improving IE on social media data using machine learning (1.5 hrs)
- **Break (30 mins)**
- Collecting and distributing social media data (30 mins)
- Conclusion and future direction (10 mins)

# Introduction

# Information extraction [https://shubhanshu.com/phd\\_thesis/](https://shubhanshu.com/phd_thesis/)



*“Information Extraction refers to the automatic extraction of structured information such as entities, relationships between entities, and attributes describing entities from unstructured sources.”*

*– (Sarawagi, 2008)*

# Types of Text based Media

## Chapter 1

It is a truth universally acknowledged, that a single man in possession of a good fortune, must be in want of a wife.

However little known the feelings or views of such a man may be on his first entering a neighbourhood, this truth is so well fixed in the minds of the surrounding families, that he is considered as the rightful property of some one or other of their daughters.

“My dear Mr. Bennet,” said his lady to him one day, “have you heard that Netherfield Park is let at last?”

Mr. Bennet replied that he had not.

“But it is,” returned she; “for Mrs. Long has just been here, and she told me all about it.”

Mr. Bennet made no answer.

## India vs West Indies | In 1000th ODI, facile win for India against Windies

Amol Karhadkar

AHMEDABAD FEBRUARY 10, 2022 07:15 IST  
UPDATED: FEBRUARY 10, 2022 07:15 IST

**Chahal, Washington and skipper Rohit ensure a victory in historic 1000th ODI for India**



Washington Sundar returned to international cricket in style, Yuzvendra Chahal proved his worth with his wristspin and Rohit Sharma marked his first hit as full-time ODI with a quickfire fifty to ensure a perfect outing during India's 1000th ODI on Sunday.

Once Washington and Chahal broke the backbone of West Indies middle order on a helpful Narendra Modi Stadium strip, despite Jason Holder playing a trademark innings in the latter half, West Indies could manage only 176 before being bowled out in the 44th over.

2022 - [The Hindu](#)

```
Vulphere @ Libera.Chat / #archlinux - HexChat
rver Settings Window Help

a.org/show_bug.cgi?id=1749908 | Help out testing the AUR https://lists.archlinux.org/pipermail/a

[11:11:13] Namarrgon sanchex: are you running iwd and nm at the same time?
[11:12:14] sanchex I am running nm, I don't know if iwd is also running
[11:12:35] Namarrgon did you configure nm to use iwd as the backend instead of wpa_supplicant?
[11:13:07] sanchex No
[11:13:11] Namarrgon then why is iwd running?
[11:13:36] * julia (~quassel@user/julia) has joined
[11:15:58] * DeepDayze has quit (Quit: Leaving)
[11:17:02] sanchex good question
[11:17:45] Namarrgon how did you install arch?
[11:18:08] Namarrgon you're the third one with this issue today
[11:18:23] * gehidore is curious too
[11:18:54] * cabo40 (~cabo40@189.217.81.59) has joined
```

2021 - [Internet Relay Chat - Wikipedia](#)

- *Work on farm Fri. Burning piles of brush WindyFire got out of control. Thank God for good naber He help get undr control Pants-BurnLegWound.*
- *Boom! Ya ur website suxx bro*
- *...dats why pluto is pluto it can neva b a star*
- *michelle obama great. job. and. whit all my. respect she. look. great. congrats. to. her.*

## http client info

@aero.iitkgp.ernet.in  
Tue, 21 Mar 1995 01:33:55 -0500

- Messages sorted by: [ date ] [ thread ] [ subject ] [ author ]
- Next message: cyn@prism.nmt.edu: "Need help!"
- Previous message: jremick@u.washington.edu: "Where I am in here"

I have a running version of lynx here. I am unable to retrieve html documents. should I have a http daemon running on my machine? Could you direct me to some FAQ on http programs and daemons  
Thanks.

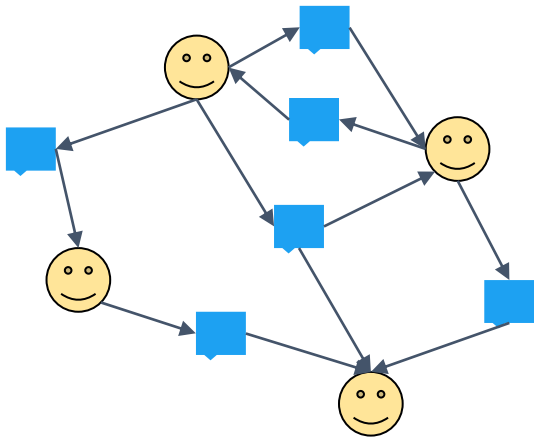
- Next message: : "Need help!"
- Previous message: : "Where I am in here"

1995 - [Usenet](#)

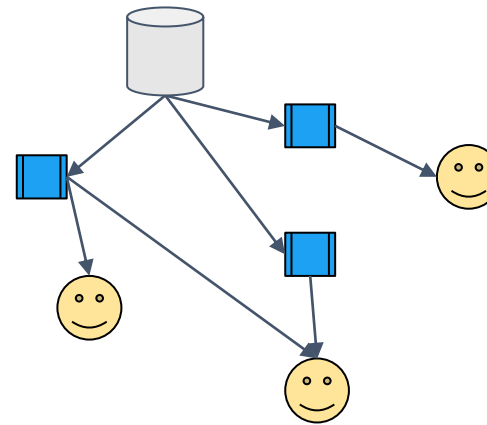
1813 - [Pride and Prejudice, by Jane Austen](#)

2022 - [The Hindu](#) <https://socialmediaie.github.io/tutorials/LREC2022/> 2013 [Social Media](#), Eisenstein NAACL-HLT

# Social Media v/s Traditional Media



**Social Media**



**Traditional Media**

“**User-generated content**—such as **text posts or comments**, digital photos or videos, and data generated through all online interactions — is the lifeblood of social media.”

“Social media **helps the development of online social networks** by connecting a user's profile with those of other individuals or groups.”

Source: [Social media - Wikipedia](#)

“Many social media outlets **differ from traditional media** (e.g., print magazines and newspapers, TV, and radio broadcasting) in many ways, including **quality, reach, frequency, usability, relevancy, and permanence**. Additionally, social media outlets operate in a **dialogic transmission system, i.e., many sources to many receivers**, while **traditional media outlets operate under a monologic transmission model (i.e., one source to many receivers).**”

“For instance, a newspaper is delivered to many subscribers and a radio station broadcasts the same programs to an entire city.”

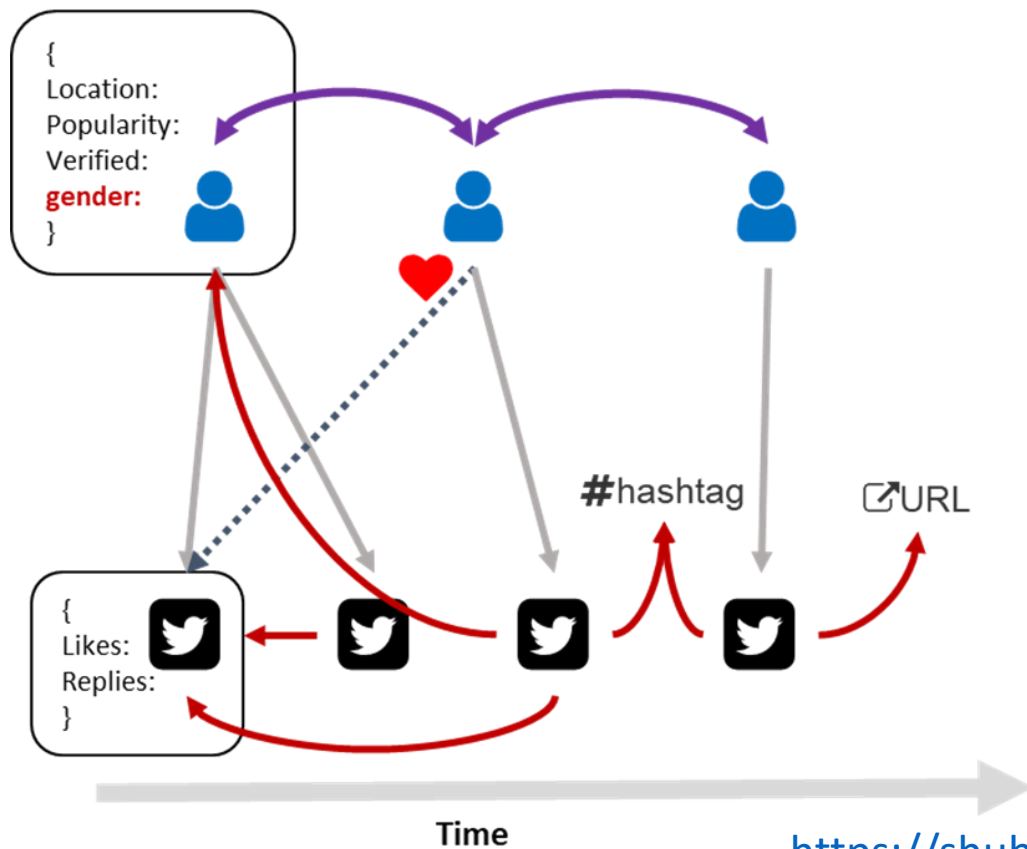
# Digital Social Trace Data [https://shubhanshu.com/phd\\_thesis/](https://shubhanshu.com/phd_thesis/)

Digital Social Trace Data (DSTD) are digital activity traces generated by individuals as part of a social interactions, such as interactions on social media websites like Twitter, Facebook; or in scientific publications.

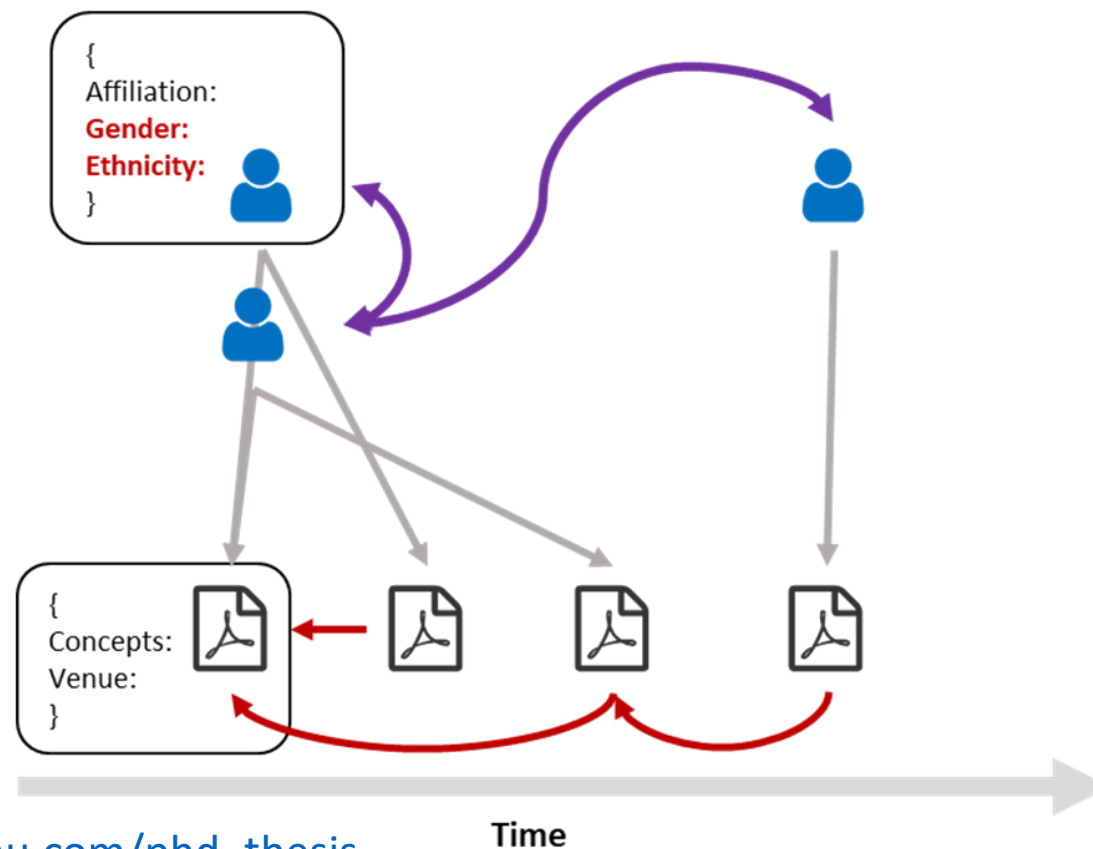
Inspired from Digital Trace Data (Howison et. al, 2011)

# Digital Social Trace Data (DSTD)

## Social media data



## Scholarly publishing data



[https://shubhanshu.com/phd\\_thesis](https://shubhanshu.com/phd_thesis)

### Legend

User	Hashtag	Article	Creation	References
Tweet	URL	<b>Inferred attr.</b>	Interaction	Social connection



# Information extraction tasks [https://shubhanshu.com/phd\\_thesis](https://shubhanshu.com/phd_thesis)

## Corpus level

Key-phrase  
extraction

Taxonomy  
construction

Topic modelling

## Document level

### Classification

- Sentiment
- Hate Speech
- Sarcasm
- Topic
- Spam detection
- Relation Extraction

## Token level

### Tagging

- Named entity
- Part of speech

### Disambiguation

- Word Sense
- Entity Linking

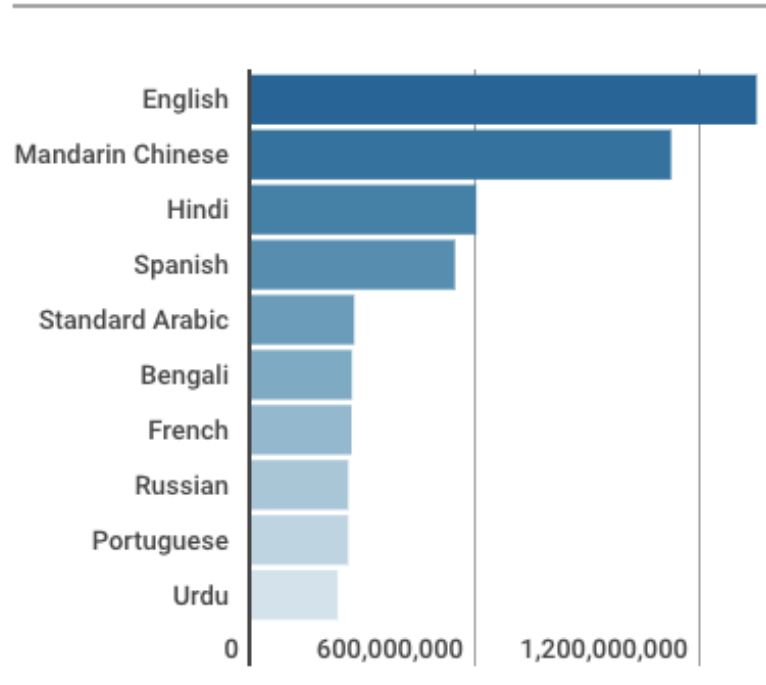
# Why social media data is challenging?

Social Media text often has an inherent structure, which provides context, e.g.

- user mentions
- hashtags
- comment threads
- less formally written language
- lot of unseen words
- typos, etc.


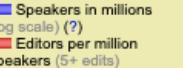



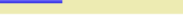
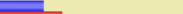
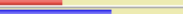


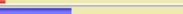
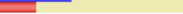

# Language Diversity

Top 10 most spoken languages, 2021



Ethnologue

Source: <https://www.ethnologue.com/guides/ethnologue200>

Languages		Regions	Participation				Active editors				Edits	Usage	Content	
Code ⇒ Project Main Page	Language ⇒ Wikipedia article			Prim.+Sec. Speakers M=millions k=thousands	Editors (5+) per million speakers	Months since 3 or more active editors	5+ edits p/month (3m avg)	100+ edits p/month (3m avg)	Admins	Bots		Views per hour	Article count	
↕	↕	↕		↕	↕	↕	↕	↕	↕	↕	↕	↕	▼	
Σ	All languages	AF AS EU NA SA OC CL W												
en	English	AF AS EU NA OC		1121 M	27		30684	3445	1274	312	9%	31%	4,858,539	5,779,516
ceb	Cebuano	AS		20 M	1		26	2	4	60	99%	19%	1,311	5,379,752
sv	Swedish	EU		10 M	64		641	101	66	40	57%	20%	53,206	3,761,531
de	German	EU		132 M	41		5395	900	198	374	10%	20%	726,852	2,254,737
fr	French	AF AS EU NA OC SA		285 M	17		4864	790	161	107	19%	21%	461,591	2,069,464
nl	Dutch	EU SA		28 M	42		1185	214	45	269	38%	19%	97,322	1,953,504
ru	Russian	AS EU		264 M	12		3188	518	87	84	17%	25%	634,782	1,518,909
es	Spanish	AF AS EU NA SA		513 M	8		4135	544	71	36	17%	37%	417,439	1,496,759
it	Italian	EU		68 M	35		2355	398	109	173	29%	32%	270,709	1,489,914
pl	Polish	EU		43 M	29		1256	237	106	68	34%	19%	185,774	1,313,943

Source: <https://stats.wikimedia.org/EN/Sitemap.htm#comparisons>

I am Japanese.

Translations

- > Ich bin Japaner.
- > Ich bin Japanerin.
- > Είμαι Γερμανός.
- > Mi estas japanino.
- > Mi estas japana.

Source: <https://tatoeba.org/eng/sentences/show/657403>

- > Olen japanilainen.
- > Mä oon japanilainen.
- > Je suis Japonais.
- > אני יפני.
- > אני יפנית.
- > मैं जापानी हूँ।
- > Japán vagyok.
- > Sono giapponese.
- > Io sono giapponese.
- > 私は日本人です。

# NER performance difference

Named entity recognition performance over the evaluation partition of the Ritter dataset (best score in bold).

System	Per-entity F1				Overall		
	Location	Misc	Org	Person	P	R	F1
ANNIE	40.23	0.00	16.00	24.81	36.14	16.29	22.46
DBpedia Spotlight	46.06	6.99	19.44	48.55	34.70	28.35	31.20
Lupedia	41.07	13.91	18.92	25.00	38.85	18.62	25.17
NERD-ML	<b>61.94</b>	23.73	<b>32.73</b>	<b>71.28</b>	52.31	<b>50.69</b>	<b>51.49</b>
Stanford	60.49	<b>25.24</b>	28.57	63.22	<b>59.00</b>	32.00	41.00
Stanford-Twitter	60.87	25.00	26.97	64.00	54.39	44.83	49.15
TextRazor	36.99	12.50	19.33	70.07	36.33	38.84	37.54
Zemanta	44.04	12.05	10.00	35.77	34.94	20.07	25.49

Source: Derczynski, L., Maynard, D., Rizzo, G., van Erp, M., Gorrell, G., Troncy, R., Petrak, J., & Bontcheva, K. (2015). Analysis of named entity recognition and linking for tweets. Information Processing & Management, 51(2), 32–49.  
<https://doi.org/10.1016/j.ipm.2014.10.006>

# Examples of information extraction for social media text

# Text classification

<https://github.com/socialmediaie/SocialMediaIE>

## Input

I know this tweet is late but I just want to say I absolutely fucking hated this season of @GameOfThrones what a waste of time.

Predict

## Output

### abusive

founta			
abusive 0.830	hateful 0.084	normal 0.085	spam 0.002
waseem			
none 0.970	racism 0.002	sexism 0.027	

### sentiment

clarin		
negative 0.956	neutral 0.036	positive 0.008
other		
negative 0.906	neutral 0.063	positive 0.031
politics		
negative 0.917	neutral 0.048	positive 0.035
semeval		
negative 0.966	neutral 0.030	positive 0.004

### uncertainty

sarcasm				
not sarcasm 0.914		sarcasm 0.086		
veridicality				
definitely no 0.033	definitely yes 0.244	probably no 0.112	probably yes 0.189	uncertain 0.422

# Sequence tagging

<https://github.com/socialmediaie/SocialMediaIE>

## Input

john oliver coined the term donal drumph as a joke on his show #LastWeekTonight

Predict

## Output

<b>tokens</b>	john	oliver	coined	the	term	donal	drumph	as	a	joke	on	his	show	#LastWeekTonight
<b>ud_pos</b>	PROPN	PROPN	VERB	DET	NOUN	PROPN	PROPN	ADP	DET	NOUN	ADP	PRON	NOUN	X
<b>ark_pos</b>	^	^	V	D	N	^	^	P	D	N	P	D	N	#
<b>ptb_pos</b>	NNP	NNP	VBD	DT	NN	NNP	NNP	IN	DT	NN	IN	PRP\$	NN	HT
<b>multimodal_ner</b>	PERSON				PERSON									
<b>broad_ner</b>	PERSON													
<b>wnut17_ner</b>	PERSON													
<b>ritter_ner</b>	PERSON													
<b>yodie_ner</b>	PERSON													
<b>ritter_chunk</b>	NP		VP		NP		NP		PP	NP		PP	NP	
<b>ritter_ccg</b>	NOUN.PERSON		VERB.COMMUNICATION		NOUN.COMMUNICATION				NOUN.COMMUNICATION				NOUN.COMMUNICATION	

# Applications of information extraction

Index documents by entities

DocID	Entity	Entity type	WikiURL
1	Roger Federer	Person	URL1
2	Facebook	Organization	URL2
3	Katy Perry	Music Artist	URL3



# Entity mention clustering

**Washington** is a great place.

I just visited **Washington**.

**Washington** was a great president.

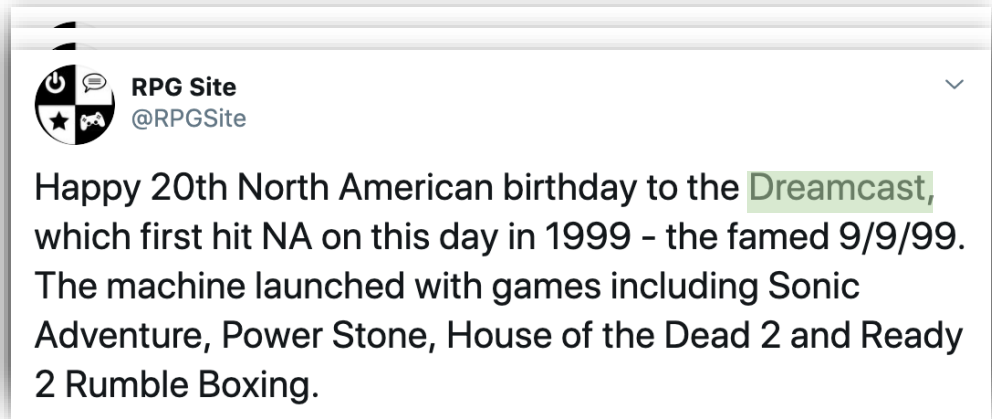
**Washington** made some good changes to constitution.

# Applications of Information extraction

# Applications

- Indexing social media corpora in database
- Network construction from text corpora,
- Visualizing temporal trends in social media corpora using social communication temporal graphs,
- Aggregating text-based signals at user level, Improving text classification using user level attributes,
- Analyzing social debate using sentiment and political identity signals otherwise,
- Detecting and Prioritizing Needs during Crisis Events (e.g., COVID19),
- Mining and Analyzing Public Opinion Related to COVID-19, and
- Detecting COVID-19 Misinformation in Videos on YouTube

# Application of NER: Trends



2 · Trending

**Dreamcast**

46.8K people are Tweeting about this

# Identifying trending topics and events

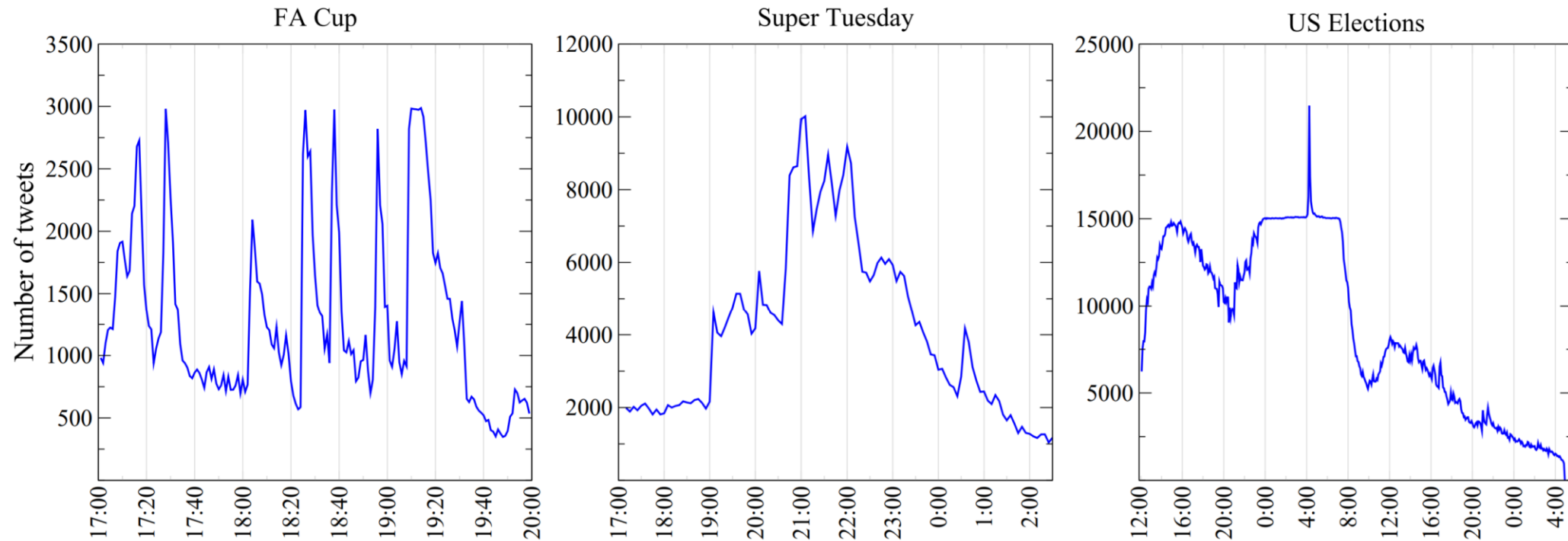
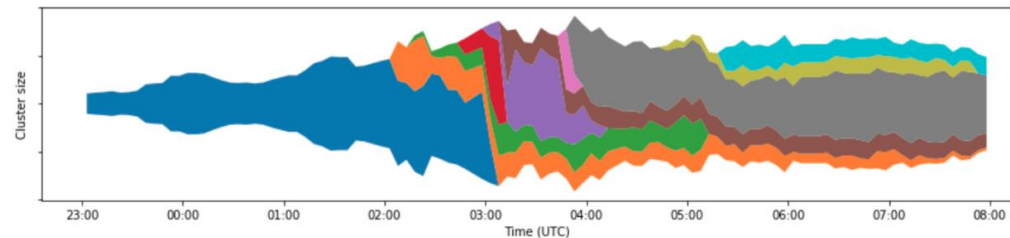
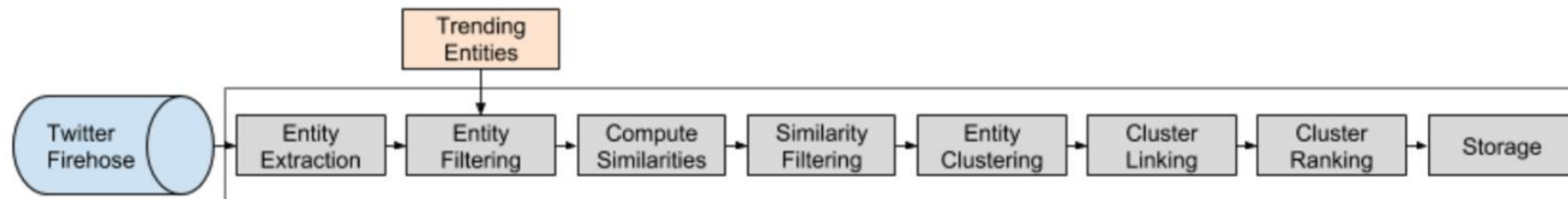


Fig. 2. Twitter activity during events. For the FA Cup, the peaks correspond to start and end of the match and the goals. For the two political collections, the peaks correspond to the main result announcements.

Aiello, Luca Maria, Georgios Petkos, Carlos Martin, David Corney, Symeon Papadopoulos, Ryan Skraba, Ayse Göker, Ioannis Kompatsiaris, and Alejandro Jaimes. "Sensing trending topics in Twitter." IEEE Transactions on Multimedia 15, no. 6 (2013): 1268-1282.

# Application of NER: Events Detection



## Title

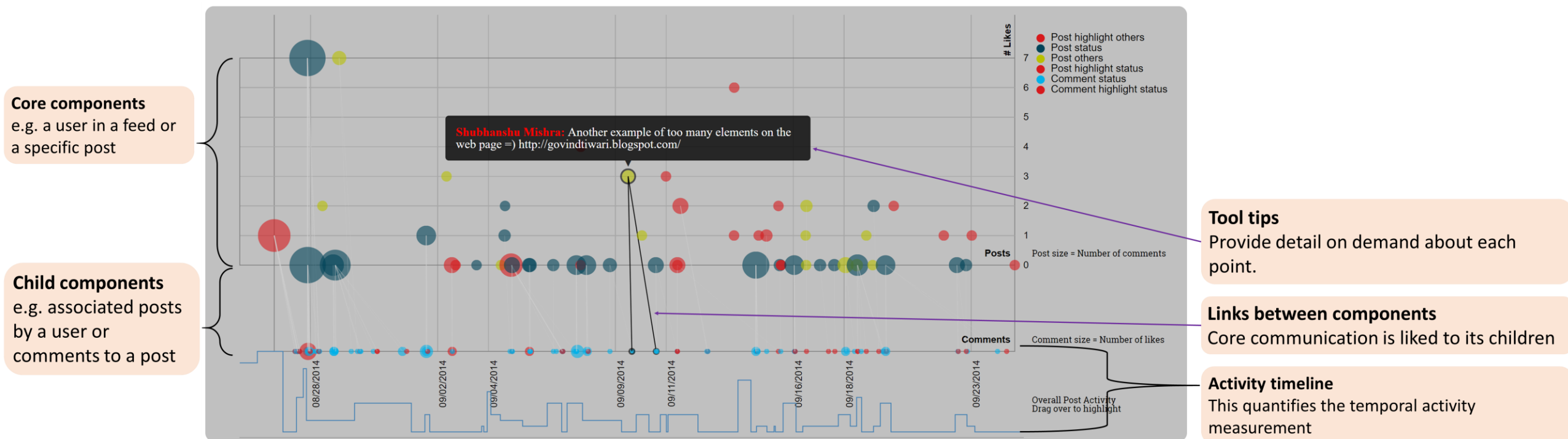
General conversation
Hosts' opening speech
Green Book
Christian Bale receives the best actor in comedy or musical award for "Vice"
General conversation
Christian Bale thanks Satan in his acceptance speech
General conversation
Rami Malek receives the best actor in a drama award for "Bohemian Rhapsody"
Glenn Close receives the best actress in drama award for "The Wife"
Green Book

## Top entities

The 76th Annual Golden Globe Awards 2019, #goldenglobes, Lady Gaga, Sandra Oh, Spider-Man: Into the Spider-Verse, Gaga
Andy Samberg, Black Panther, Sandra Oh, #blackpanther, Jim Carrey, Michael B. Jordan
Green Book, Mahershala Ali, Regina King, #greenbook
The 76th Annual Golden Globe Awards 2019, #goldenglobes, Christian Bale, Sandra Oh, Lady Gaga, Darren Criss, Vice
The 76th Annual Golden Globe Awards 2019, #goldenglobes, Lady Gaga, Jeff Bridges, Darren Criss
Christian Bale, The 76th Annual Golden Globe Awards 2019, Vice, Mitch McConnell, Satan
The 76th Annual Golden Globe Awards 2019, #goldenglobes, Sandra Oh, Alfonso Cuarón, Rami Malek, Roma, Olivia Colman
The 76th Annual Golden Globe Awards 2019, #goldenglobes, Rami Malek, Bohemian Rhapsody, Lady Gaga, Sandra Oh
Glenn Close, Taylor Swift, Lady Gaga, best actress, Glenn, Bradley Cooper
Green Book, Mahershala Ali, Regina King, #greenbook

# Visualizing temporal trends in data

<https://shubhanshu.com/social-comm-temporal-graph/>



# Application of NER: User Interest



## Last Engagements

Twitter (9), India (9), US (7), Pilani (7), NASA (3),

Linkedin (3), Stanford CoreNLP (2)

BITS Pilani (1)

Person

Location

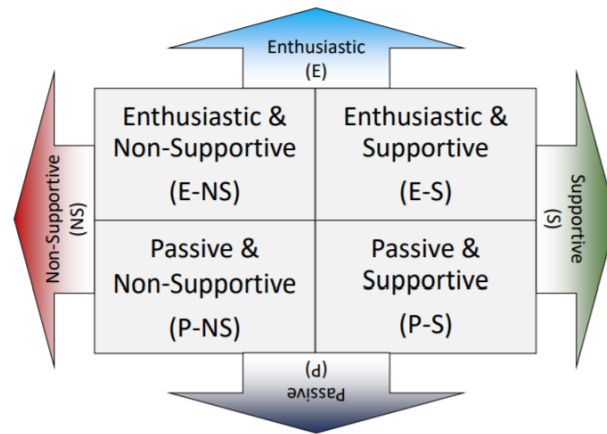
Organization

Product

Other



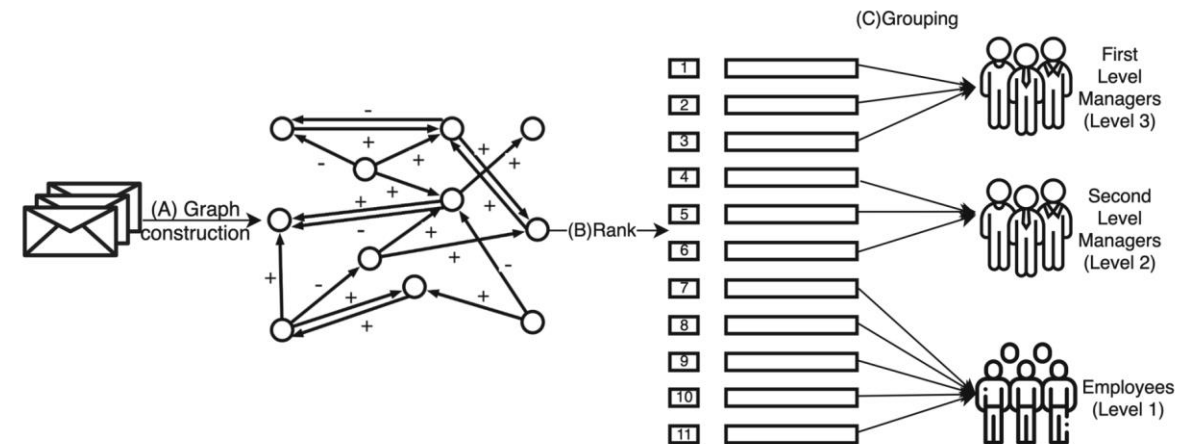
# Network construction from text classification labels and identification of influential users



CTE	Account	CB	PR	Account	LGBT	PR	Account	PR
E/P	USR1	0.191	USR2	0.050	free_equal	0.033		
	Sports_Brain	0.191	USR4	0.050	UN_Women	0.030		
	USR3	0.041	USR5	0.043	USR_FilmExpert	0.030		
S/NS	USR6	0.186	USR2	0.062	free_equal	0.044		
	USR12	0.068	USR4	0.062	HRC	0.033		
	NFL	0.066	USR5	0.054	USR_FilmExpert	0.028		
All	USR7	0.021	USR8	0.009	HRC	0.024		
	NFL	0.015	USR9	0.008	Tedofficialpage	0.010		
	frontlinepbs	0.009	USR10	0.008	USR11	0.010		

**Table 9: Top 3 nodes in the mention network based on different PageRank algorithms (PR=PageRank score). In the All row, ranking and scores are based on overall PageRank. Accounts of individuals were replaced with USR to protect privacy.**


## Using signed networks in Email Corpora



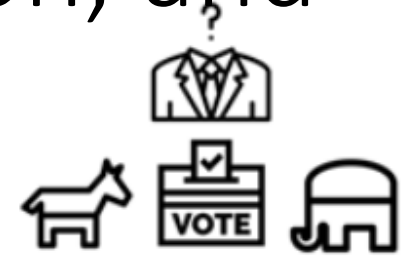
- Mishra, Shubhanshu, and Jana Diesner. "Capturing signals of enthusiasm and support towards social issues from twitter." Proceedings of the 5th International Workshop on Social Media World Sensors. 2019.
- Jiang, Lan, Ly Dinh, Rezvaneh Rezapour, and Jana Diesner. "Which Group Do You Belong To? Sentiment-Based PageRank to Measure Formal and Informal Influence of Nodes in Networks." In International Conference on Complex Networks and Their Applications, pp. 623-636. Springer, Cham, 2020.

# Lexicon-based approach

Utilizes a lexicon to describe or extract information from a textual content, e.g., lexicon-based sentiment analysis to analyze polarity of text

- What to consider first:
  - How is the lexicon created
  - Scope:
    - Using MPQA lexicon to study hashtags in Tweets 
- Domain Adaptation
  - Fine-tuning of the lexicon to represent the data
- Evaluation of the results
  - Error analysis, hand annotation, close-reading,...

# Sentiment analysis, presidential election, and candidates' ranking



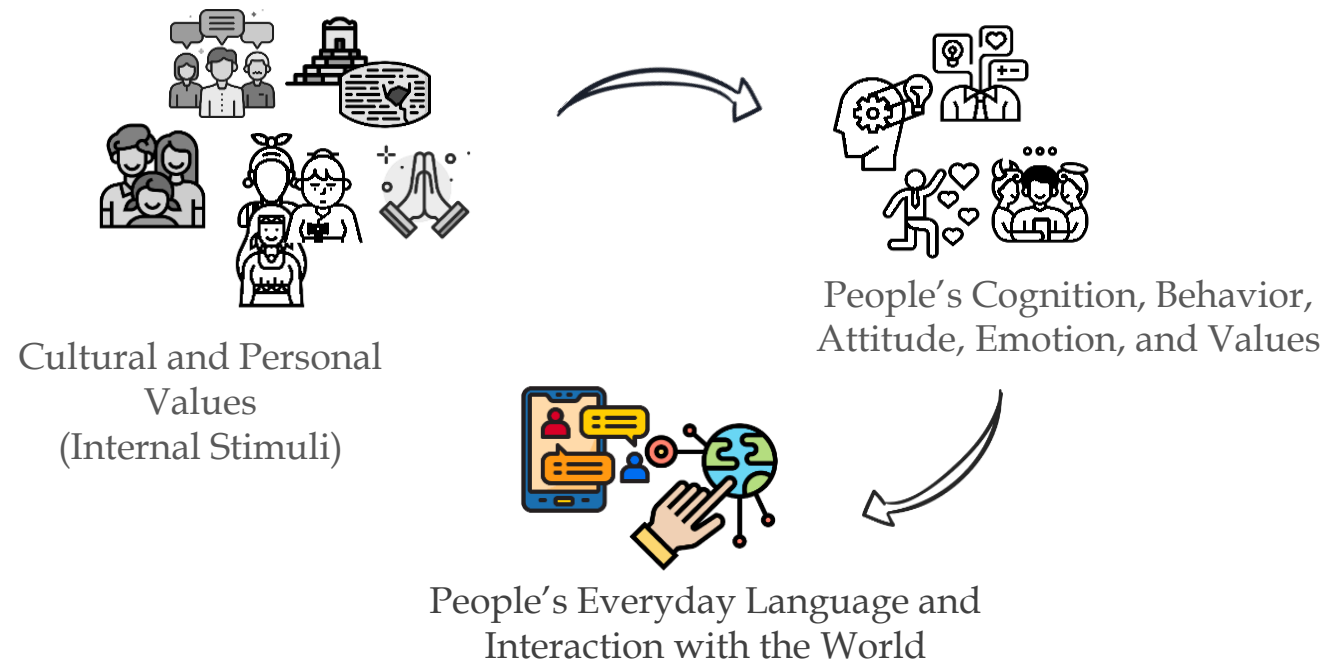
- Aim:
  - Test whether incorporating prevalent hashtags from a given dataset into a sentiment lexicon improves sentiment prediction accuracy
- Method:
  - Used hashtag-enhanced lexicon-based sentiment analysis to analyze tweets that mention the US Presidential candidates to find the correlation between the candidates' likeability in tweets with the actual voting outcomes in the New York State Presidential Primary election
  - Domain adapted the MPQA lexicon:
    - Extracted and annotated top hashtags and added them to the MPQA lexicon

Rezapour, R., Wang, L., Abdar, O., & Diesner, J. (2017). [Identifying the overlap between election result and candidates' ranking based on hashtag-enhanced, lexicon-based sentiment analysis](#). In *2017 IEEE 11th International Conference on Semantic Computing (ICSC)*. (pp. 93-96).

# Using moral foundations to analyze social effects

- Motivation:

“A language is not just words. It’s a culture, a tradition, a unification of a community, a whole history that creates what a community is. It’s all embodied in a language.” (Noam Chomsky)



# Using moral foundations analysis in analyzing social effects (contd.)

- Method:
  - Use Moral Foundations Dictionary (MFD) to extract words with moral weights and use them as features in prediction models
- Limitations with MFD:
  - Number of entries is small and might not capture (all) variations of terms indicative of morality in text data.
  - Entries are not syntactically disambiguated, which can limit the results, e.g., by capturing false positives.
    - Safe (noun) -> does not signal morality
    - Safe (adjective) -> represents care-virtue
- Enhanced MFD:
  - Used wordnet to get synonym, antonym and hypernym of the words and extensively pruned the lexicon

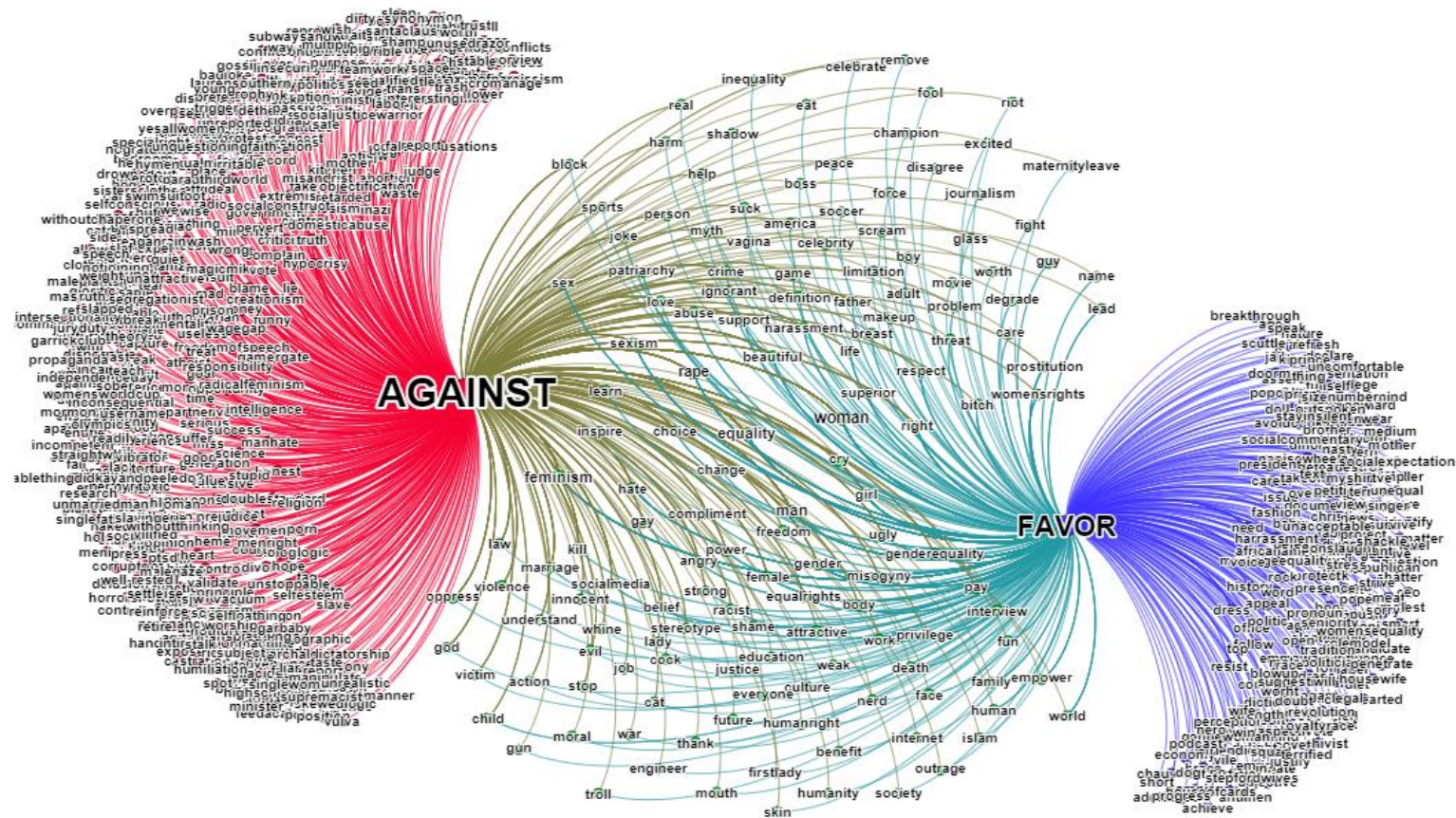
Rezapour, R., Shah, S. H., & Diesner, J. (2019). [Enhancing the measurement of social effects by capturing morality](#). In *Proceedings of the Tenth Workshop on Computational Approaches to Subjectivity, Sentiment and Social Media Analysis (WASSA)*. Annual Conference of the North American Chapter of the Association for Computational Linguistics (NAACL).

Rezapour, R., Dinh, L., & Diesner, J. (2021, August). [Incorporating the Measurement of Moral Foundations Theory into Analyzing Stances on Controversial Topics](#). In *Proceedings of the 32nd ACM Conference on Hypertext and Social Media* (pp. 177-188). <https://socialmediaie.github.io/tutorials/LREC2022/>

Rezapour, Rezvaneh; Diesner, Jana (2019): [Expanded Morality Lexicon](#). University of Illinois at Urbana-Champaign. [https://doi.org/10.13012/B2IDB-3805242\\_V1.1](https://doi.org/10.13012/B2IDB-3805242_V1.1)



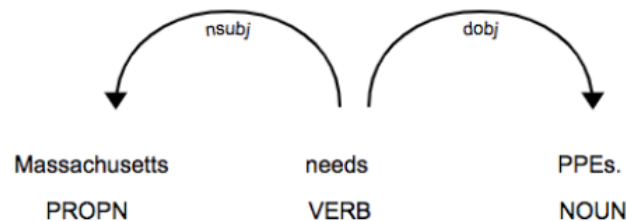
# Analyzing tweets to examine cross-cutting exposure in social media



Rezapour, R., Park, J., Diesner, J. (2020). Detecting Characteristics of Cross-cutting Language Networks on Social Media. In International Sunbelt Social Network Conference, Paris, France.

# Detecting and prioritizing needs during crisis events (i.e., COVID19)

- Method:
  - Created a list of needed resources ranked by priority
    - Extracted phrases and terms closest to the terms “needs” and “supplies”
  - Extracted sentences that specify who-needs-what resources
    - Identified sentences where who is the subject and what is the direct object
    - Selected sentences where the left child of need in the dependency parse tree is a nominal subject (nsubj), and the right child is a direct object (dobj)



Sarol, M. J., Dinh, L., Rezapour, R., Chin, C. L., Yang, P., & Diesner, J. (2020, November). [An Empirical Methodology for Detecting and Prioritizing Needs during Crisis Events](#). In *Proceedings of the 2020 Conference on Empirical Methods in Natural Language Processing: Findings* (pp. 4102-4107).

# More on COVID 19 crisis

- Hate speech detection (Hardage et al. 2020)
- Misinformation related to COVID 19 (Hossain et al. 2020)
- Symptom detection using social media data (Santosh et al. 2020)
- Impact of COVID 19 on language diversity (Dunn et al. 2020)
- Quantifying the effects of COVID 19 on mental health (Biester et al. 2020)



# Methods for Extracting Information from Social Media Data

Machine learning approaches

Rule or Lexicon-based approaches

Network analysis

# GUI tool for using IE to extract networks from text data

- ConText tool: <http://context.ischool.illinois.edu/>
- Bread and butter techniques for text analysis and extracting relational data from text data
- Convert text into network data

# Key challenges for improving IE performance

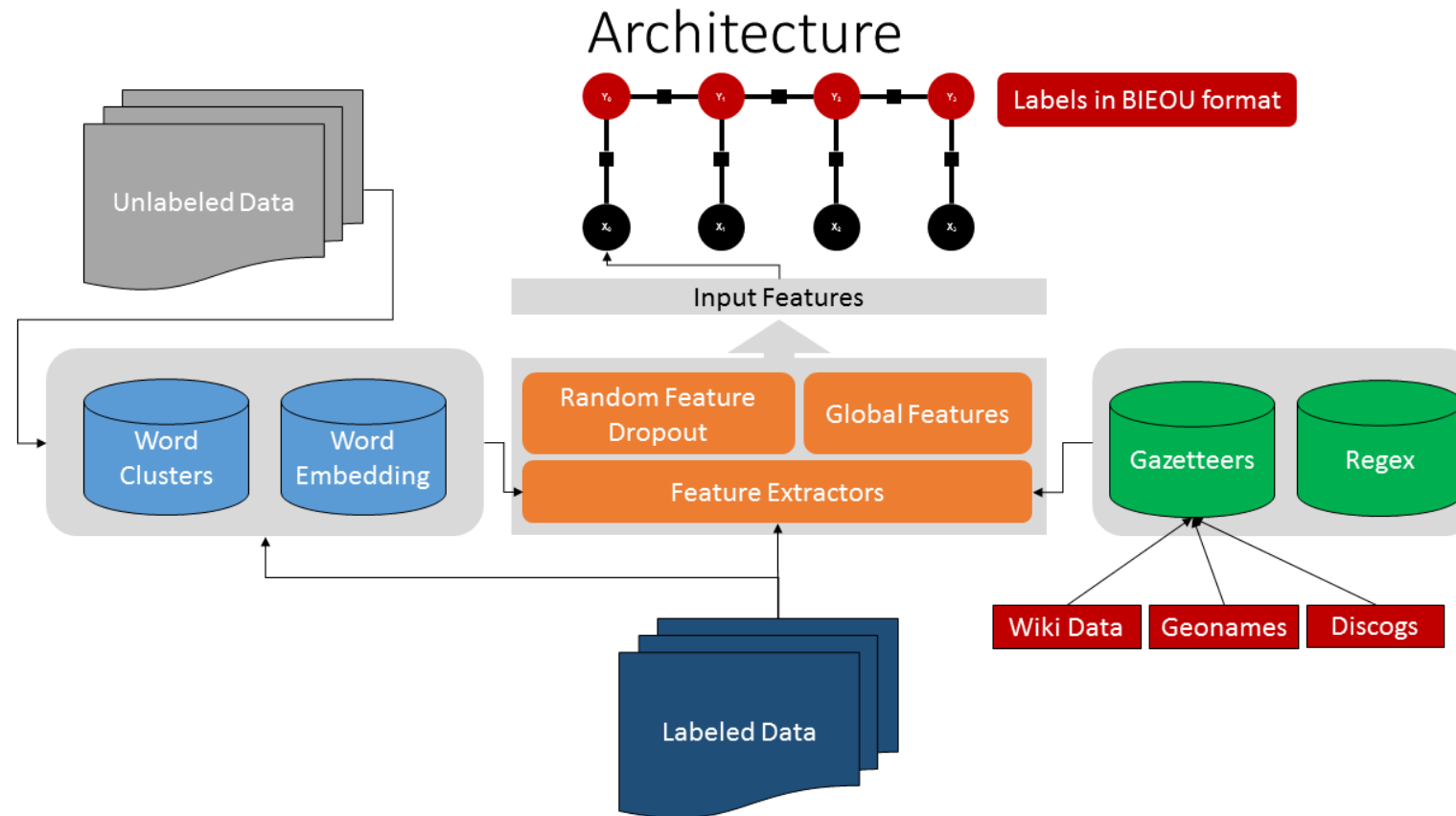
Challenge	Solution
Less data to learn	Multi-task learning, active learning, semi-supervised, or distantly supervised learning
Less languages to learn	Cross lingual alignment, Multilingual Knowledge bases
Less context to learn	Social and Graphical context of the tweet

# Less data to learn: Improve efficiency

- Multi-task learning
- Active Learning
- Semi-supervised learning

# Rule based Twitter NER

Mishra & Diesner (2016). <https://github.com/napsternxg/TwitterNER>



Mishra, Shubhanshu, & Diesner, Jana (2016). Semi-supervised Named Entity Recognition in noisy-text. In Proceedings of the 2nd Workshop on Noisy User-generated Text (WNUT) (pp. 203–212). Osaka, Japan: The COLING 2016 Organizing Committee. Retrieved from <https://aclweb.org/anthology/papers/W/W16/W16-3927/>

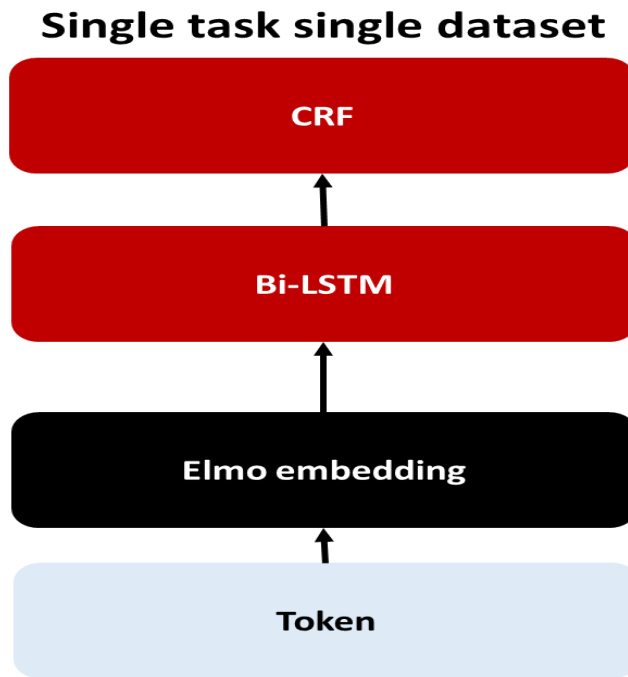
# Evaluating Twitter NER (F1-score)

Mishra & Diesner (2016).

Rank	1	2	3	4	5	6	7	8	9	10	TD	TDT <sub>E</sub>
<b>10-types</b>	52.4	46.2	44.8	40.1	39.0	37.2	<b>37.0</b>	36.2	29.8	19.3	<b>46.4</b>	<b>47.3</b>
<b>No-types</b>	65.9	63.2	60.2	59.1	55.2	51.4	<b>47.8</b>	46.7	44.3	40.7	<b>57.3</b>	<b>59.0</b>
<b>company</b>	57.2	46.9	43.8	31.3	38.9	34.5	<b>25.8</b>	42.6	24.3	10.2	42.1	46.2
<b>facility</b>	42.4	31.6	36.1	36.5	20.3	30.4	<b>37.0</b>	40.5	26.3	26.1	37.5	34.8
<b>geo-loc</b>	72.6	68.4	63.3	61.1	61.1	57.0	<b>64.7</b>	60.9	47.4	37.0	70.1	71.0
<b>movie</b>	10.9	5.1	4.6	15.8	2.9	0.0	<b>4.0</b>	5.0	0.0	5.4	0.0	0.0
<b>musicartist</b>	9.5	8.5	7.0	17.4	5.7	37.2	<b>1.8</b>	0.0	2.8	0.0	7.6	5.8
<b>other</b>	31.7	27.1	29.2	26.3	21.1	22.5	<b>16.2</b>	13.0	22.6	8.4	31.7	32.4
<b>person</b>	59.0	51.8	52.8	48.8	52.0	42.6	<b>40.5</b>	52.3	34.1	20.6	51.3	52.2
<b>product</b>	20.1	11.5	18.3	3.8	10.0	7.3	<b>5.7</b>	15.4	6.3	0.8	10.0	9.3
<b>sportsteam</b>	52.4	34.2	38.5	18.5	34.6	15.9	<b>9.1</b>	19.7	11.0	0.0	31.3	32.0
<b>tvshow</b>	5.9	0.0	4.7	5.4	7.3	9.8	<b>4.8</b>	0.0	5.1	0.0	5.7	5.7
<b>Rank</b>	1	2	3	4	5	6	<b>7</b>	8	9	10	~2	~2

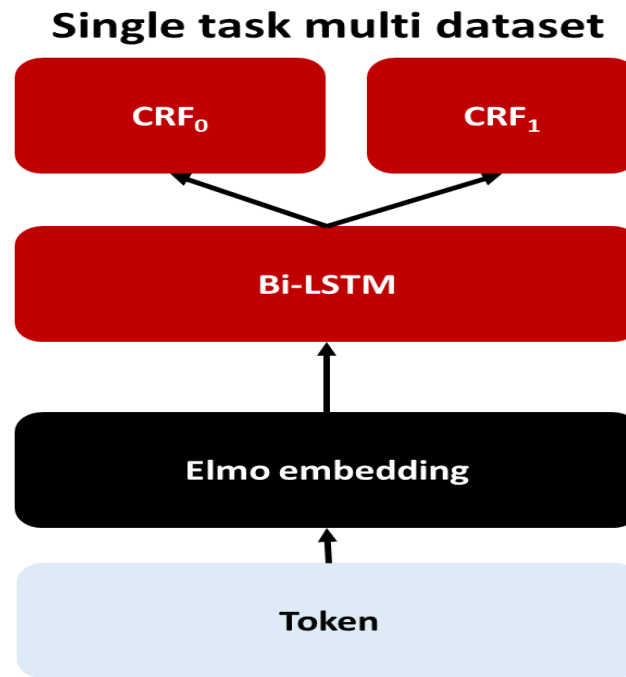
# Multi-task-multi-dataset learning

Mishra 2019, HT' 19



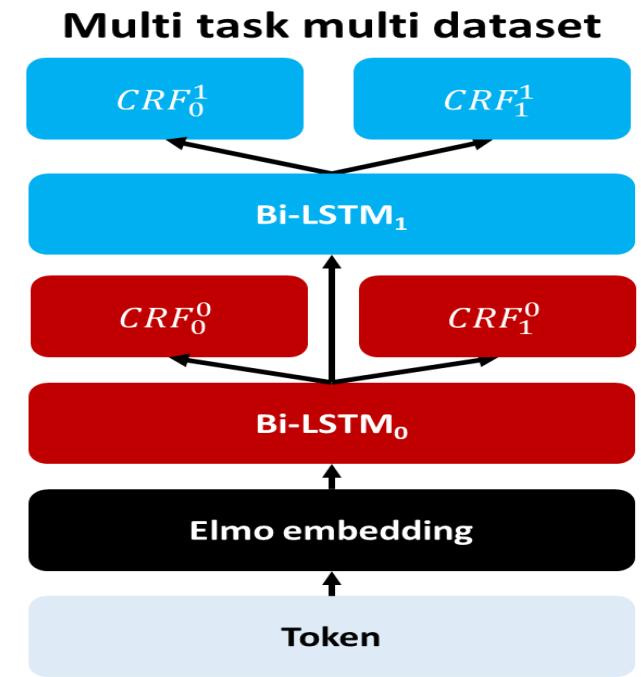
(A)

**S - Single**



(B)

**MD – Multi-dataset**  
**MTS – Multi task Shared**



(C)

**MTL – Multi task Stacked**  
**(Layered)**

Shubhanshu Mishra. 2019. Multi-dataset-multi-task Neural Sequence Tagging for Information Extraction from Tweets. In Proceedings of the 30th ACM Conference on Hypertext and Social Media (HT '19). ACM, New York, NY, USA, 283-284. DOI: <https://doi.org/10.1145/3342220.3344929>

# Evaluating MTL models

Mishra 2019, HT' 19

## Part of speech tagging (overall accuracy)

Data	Our best	SOTA	Diff %
DiMSUM2016	86.77	82.49	5%
Owoputi	91.76	88.89	3%
TwitIE	91.62	89.37	3%
Ritter	92.01	90	2%
Tweetbankv2	92.44	93.3	-1%
Foster	69.34	90.4	-23%
lowlands	68.1	89.37	-24%

## Super sense tagging (micro f1)

Data	Our best	SOTA	Diff %
Ritter	59.16	57.14	3.5%
Johannsen2014	42.38	42.42	-0.1%

## Chunking (micro f1)

Data	Our best	SOTA	Diff %
Ritter	88.92	None	NA

## Named entity recognition (micro f1)

Data	Our best	SOTA	Diff %
BROAD	77.40	None	NA
YODIE	65.39	None	NA
Finin	56.42	32.43	74.0%
MSM2013	80.46	58.72	37.0%
Ritter	86.04	82.6	4.2%
MultiModal	73.39	70.69	3.8%
Hege	89.45	86.9	2.9%
WNUT2016	53.16	52.41	1.4%
WNUT2017	49.86	49.49	0.8%

Shubhanshu Mishra. 2019. Multi-dataset-multi-task Neural Sequence Tagging for Information Extraction from Tweets. In Proceedings of the 30th ACM Conference on Hypertext and Social Media (HT '19). ACM, New York, NY, USA, 283-284. DOI: <https://doi.org/10.1145/3342220.3344929>



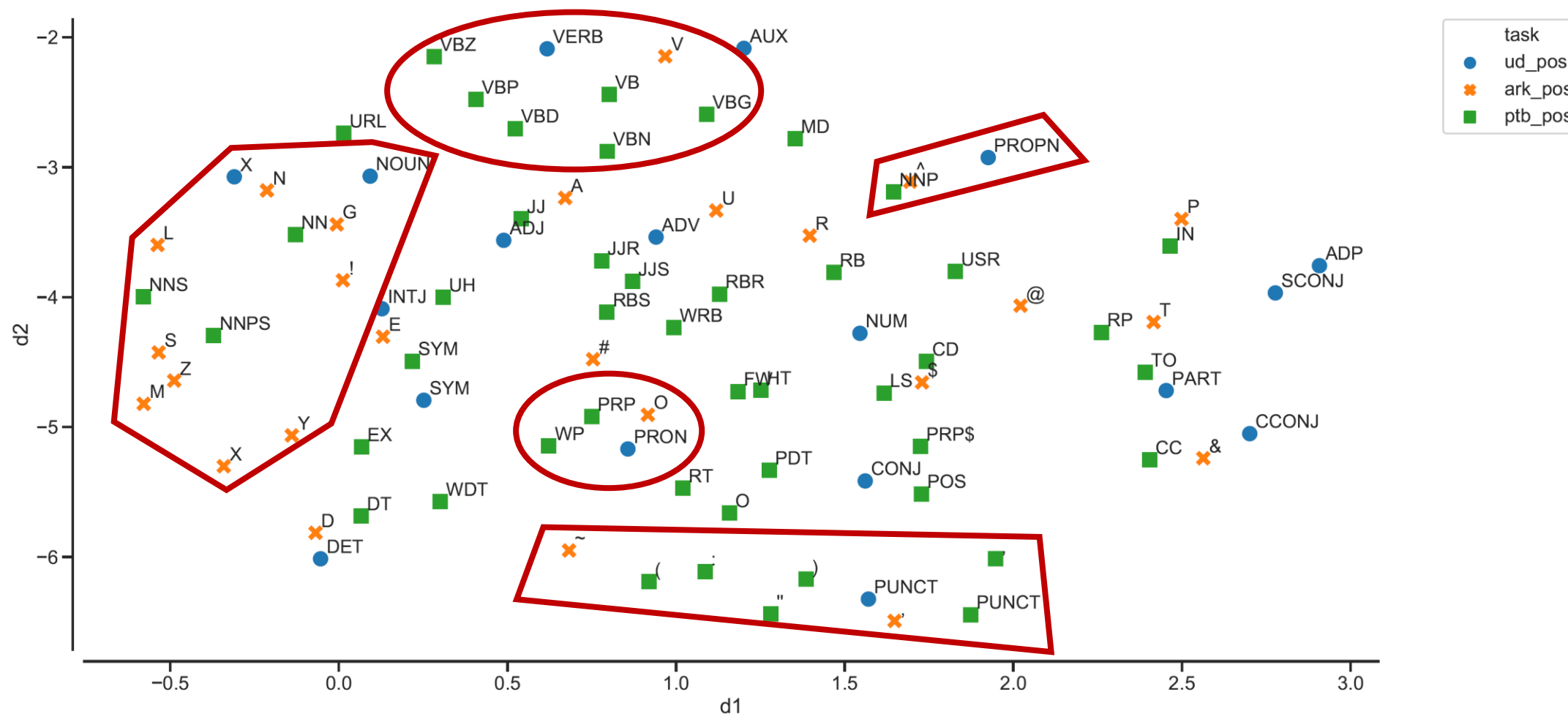
# Training

Mishra 2019, HT' 19

- Sample mini-batches from a task/data
  - Compute loss for the mini-batch
  - Individual loss is the log loss for conditional random field
  - Update the model except the Elmo module
  - During an epoch go through all tasks and datasets
  - Train for a max number of epochs
  - Use early stopping to stop training
- Models trained on single datasets have prefix **S**
  - Models trained on all datasets of same task have prefix **MD**
  - Models trained on all datasets have prefix **MTS** for multitask models with **shared module**, and **MTL** for **stacked modules**
  - Models with LR=1e-3 and no L2 regularization have suffix **"\*"**
  - Models trained without NEEL2016 have suffix **"#"**

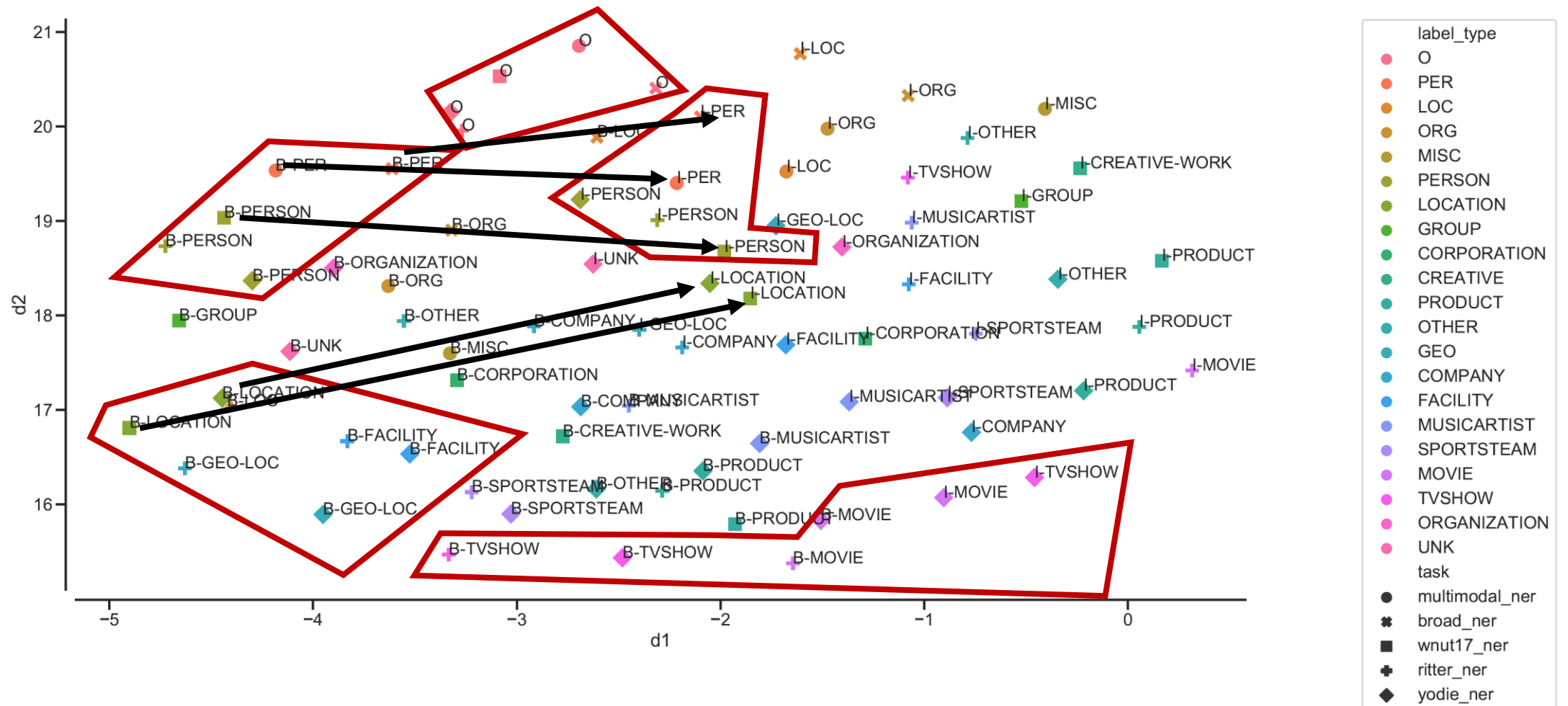
# Label embeddings (POS)

- MDMT model learns similarity between labels without this knowledge being encoded in the model
- This leads to consistent relationship between similar labels across datasets



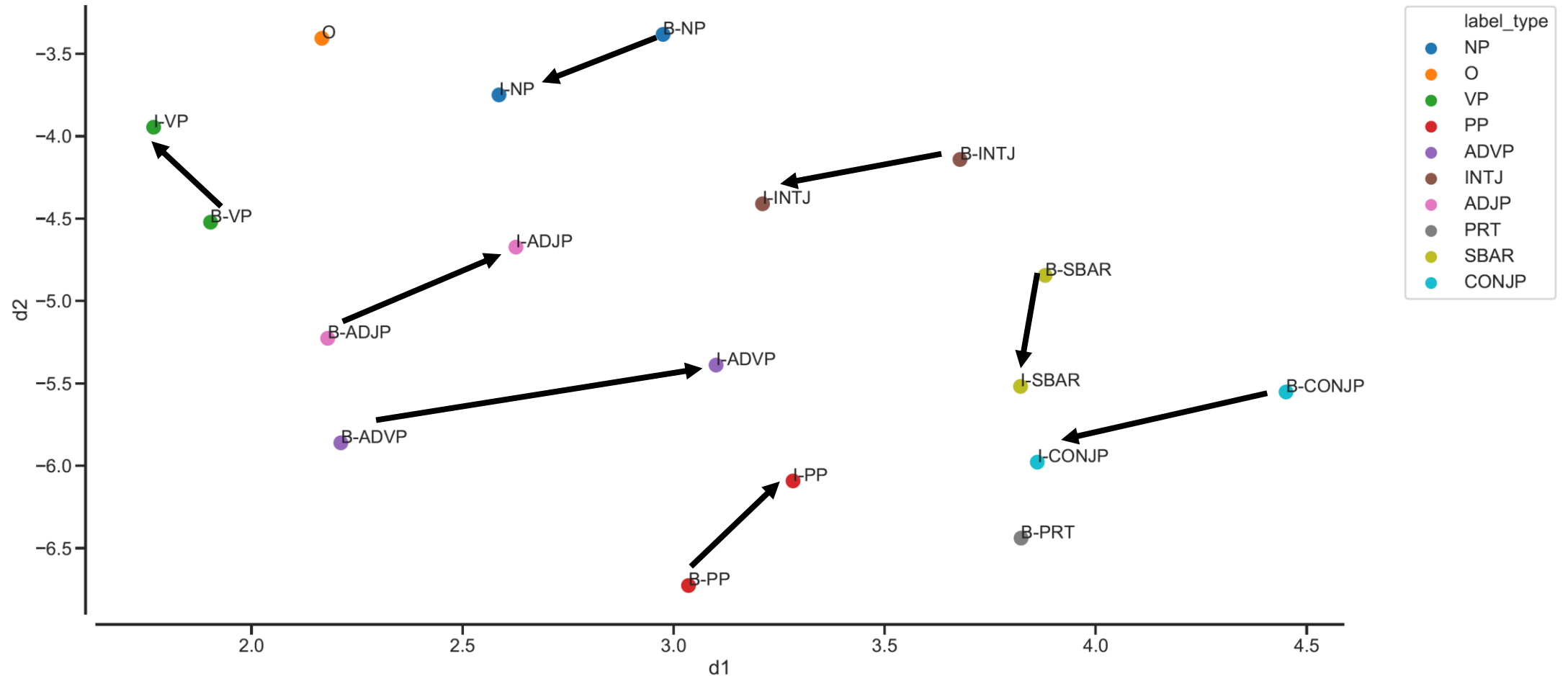
# Label embeddings (NER)

- MDMT model learns similarity between labels without this knowledge being encoded in the model
- This leads to consistent relationship between similar labels across datasets

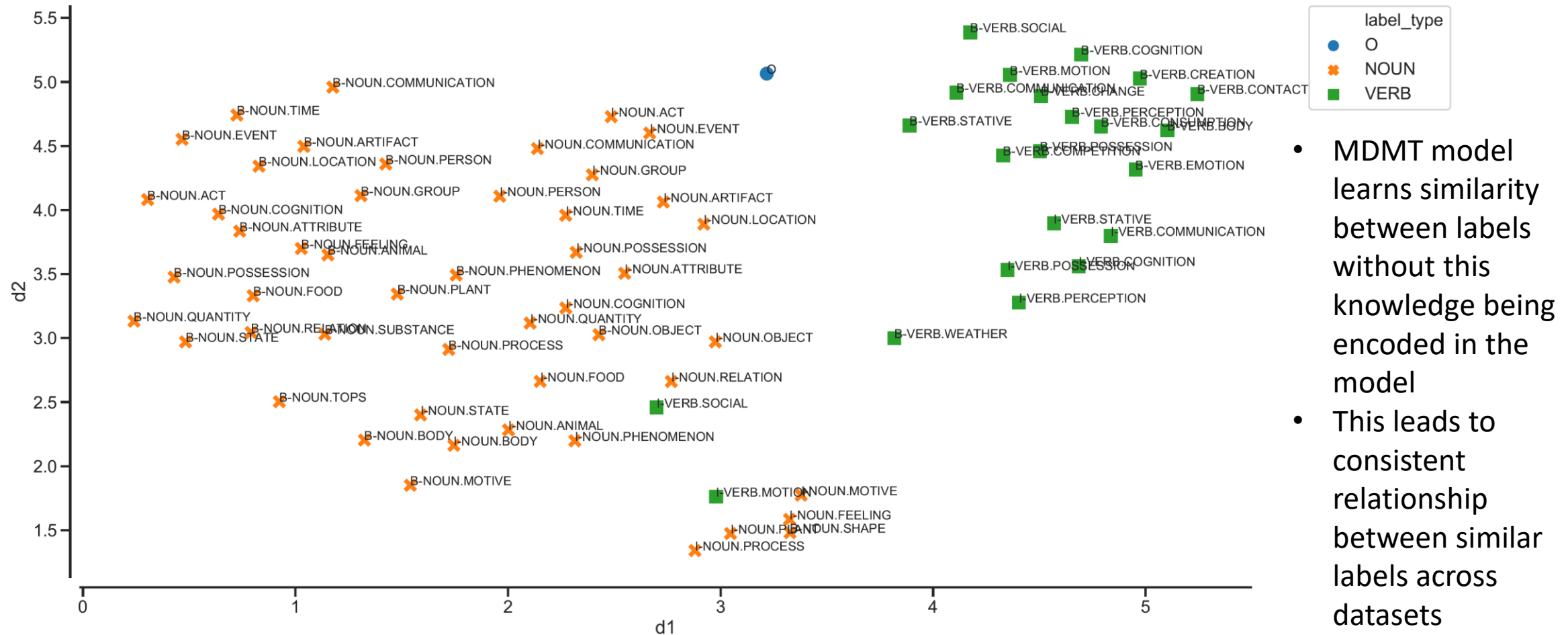


# Label embeddings (chunking)

- MDMT model learns similarity between labels without this knowledge being encoded in the model
- This leads to consistent relationship between similar labels across datasets

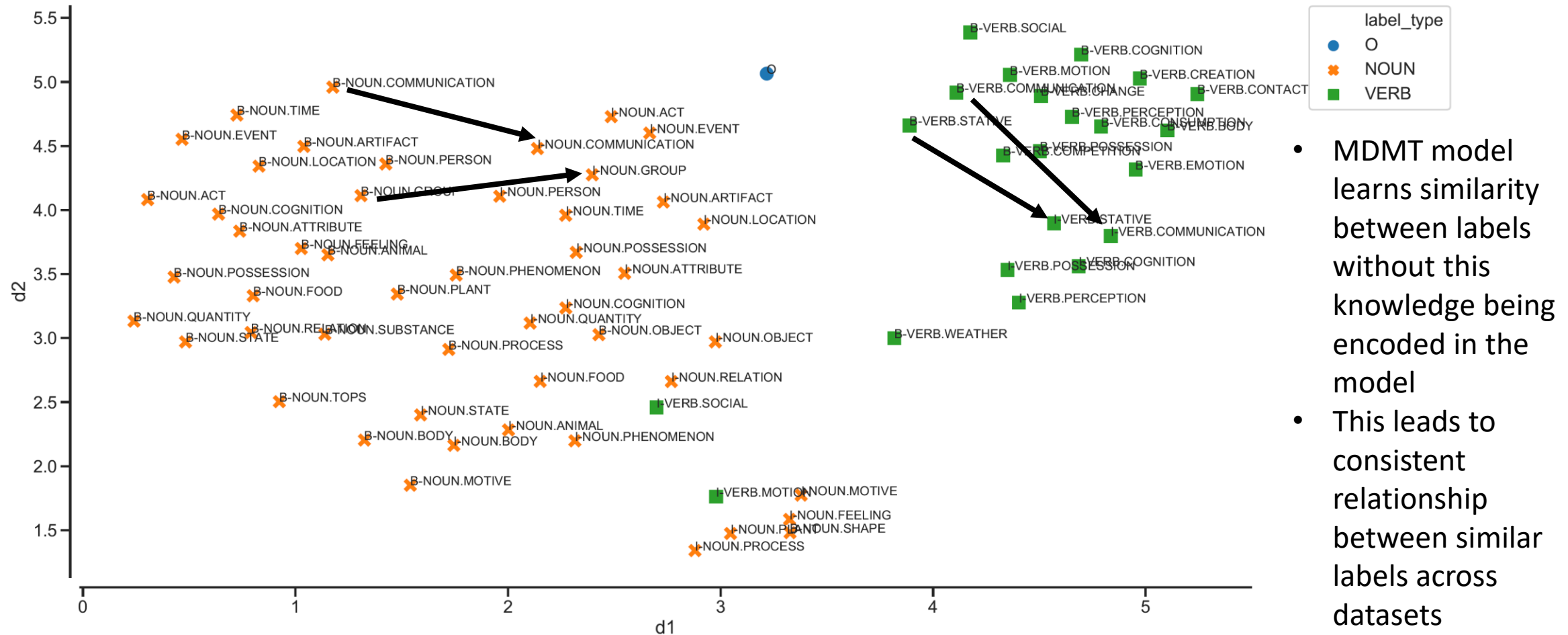


# Label embeddings (super-sense tagging)



- MDMT model learns similarity between labels without this knowledge being encoded in the model
- This leads to consistent relationship between similar labels across datasets

# Label embeddings (super-sense tagging)



- MDMT model learns similarity between labels without this knowledge being encoded in the model
- This leads to consistent relationship between similar labels across datasets

# Web based UI <https://github.com/socialmediaie/SocialMediaIE>

## Input

john oliver coined the term donal drumph as a joke on his show #LastWeekTonight

Predict

## Output

tokens	john	oliver	coined	the	term	donal	drumph	as	joke	on	his	show	#LastWeekTonight			
ud_pos	PROPN	PROPN	VERB	DET	NOUN	PROPN	PROPN	ADP	DET	NOUN	ADP	PRON	NOUN	X		
ark_pos	^	^	V	D	N	^	^	P	D	N	P	D	N	#		
ptb_pos	NNP	NNP	VBD	DT	NN	NNP	NNP	IN	DT	NN	IN	PRP\$	NN	HT		
multimodal_ner	PER						PER									
broad_ner	PER															
wnut17_ner	PERSON															
ritter_ner	PERSON															
yodie_ner	PERSON															
ritter_chunk	NP		VP		NP		NP		PP	NP		PP	NP			
ritter_ccg	NOUN.PERSON		VERB.COMMUNICATION		NOUN.COMMUNICATION						NOUN.COMMUNICATION				NOUN.COMMUNICATION	

# Multi-task-multi-dataset learning - classification

data	split	tokens	tweets	vocab
Airline	dev	20079	981	3273
	test	50777	2452	5630
	train	182040	8825	11697
Clarin	dev	80672	4934	15387
	test	205126	12334	31373
	train	732743	44399	84279
GOP	dev	16339	803	3610
	test	41226	2006	6541
	train	148358	7221	14342
Healthcare	dev	15797	724	3304
	test	16022	717	3471
	train	14923	690	3511
Obama	dev	3472	209	1118
	test	8816	522	2043
	train	31074	1877	4349
SemEval	dev	105108	4583	14468
	test	528234	23103	43812
	train	281468	12245	29673

Sentiment classification

data	split	tokens	tweets	vocab
Founta	dev	102534	4663	22529
	test	256569	11657	44540
	train	922028	41961	118349
WaseemSRW	dev	25588	1464	5907
	test	64893	3659	10646
	train	234550	13172	23042

Abusive content identification

data	split	tokens	tweets	vocab
Riloff	dev	2126	145	1002
	test	5576	362	1986
	train	19652	1301	5090
Swamy	dev	1597	73	738
	test	3909	183	1259
	train	14026	655	2921

Uncertainty indicator classification

<https://github.com/socialmediaie/SocialMediaIE>



# Sentiment classification results

<https://github.com/socialmediaie/SocialMediaIE>

file	Airline		Clarin		GOP		Healthcare		Obama		SemEval	
model	r	v	r	v	r	v	r	v	r	v	r	v
<b>S bilstm</b>	8	80.46	8	65.71	5	67.05	6	63.88	9	59.0	9	65.57
<b>MD bilstm</b>	9	79.77	9	65.28	8	65.95	9	60.95	8	59.6	6	67.05
<b>MTS bilstm</b>	11	63.21	10	47.37	10	56.78	10	60.25	11	38.9	11	40.43
<b>MTL bilstm</b>	10	63.70	11	47.00	11	45.21	11	59.69	10	44.6	10	49.92
<b>S bilstm *</b>	6	81.69	3	<b>67.71</b>	3	<b>67.55</b>	3	<b>65.97</b>	1	<b>62.6</b>	7	66.47
<b>MD bilstm *</b>	5	81.85	7	66.23	7	66.50	4	64.85	3	<b>61.7</b>	3	<b>68.98</b>
<b>MTS bilstm *</b>	7	81.65	6	66.55	4	67.45	2	<b>66.81</b>	7	60.3	1	<b>69.52</b>
<b>MTL bilstm *</b>	2	<b>82.22</b>	4	67.60	2	<b>68.10</b>	1	<b>67.09</b>	6	61.3	2	<b>69.10</b>
<b>S cnn *</b>	3	<b>82.10</b>	1	<b>68.18</b>	1	<b>68.89</b>	8	62.34	1	<b>62.6</b>	8	66.19
<b>MD cnn *</b>	1	<b>82.54</b>	5	67.01	6	66.65	7	63.18	5	61.5	4	68.04
<b>MTS cnn *</b>	4	82.06	2	<b>67.72</b>	9	64.81	5	64.57	3	<b>61.7</b>	5	67.63

## Abusive content identification

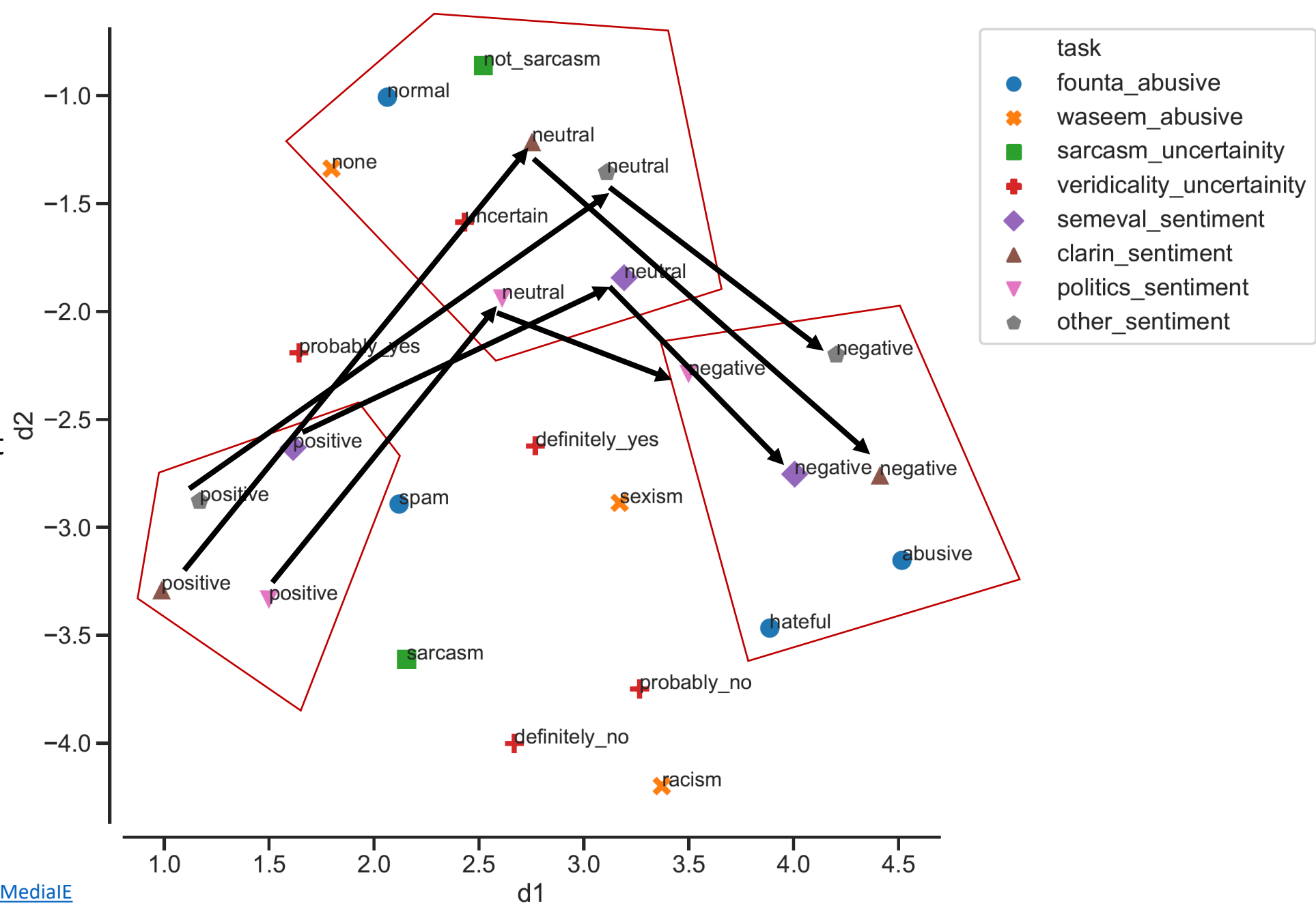
file	Founta		WaseemSRW	
model	r	v	r	v
S bilstm	8	79.33	8	81.72
MD bilstm	9	79.03	9	81.31
MTS bilstm	11	61.48	11	68.57
MTL bilstm	10	69.26	10	70.13
S bilstm *	1	80.6	3	82.95
MD bilstm *	2	80.35	2	83.22
MTS bilstm *	6	80.11	7	81.99
MTL bilstm *	4	80.23	5	82.78
S cnn *	3	80.25	4	82.89
MD cnn *	5	80.18	1	84.42
MTS cnn *	7	79.92	6	82.67

## Uncertainty indicators

file	Riloff		Swamy	
model	r	v	r	v
S bilstm	6	81.22	5	38.80
MD bilstm	9	79.28	1	39.34
MTS bilstm	10	58.84	10	27.87
MTL bilstm	11	58.01	11	23.50
S bilstm *	3	83.43	1	39.34
MD bilstm *	7	80.94	1	39.34
MTS bilstm *	5	82.60	6	38.25
MTL bilstm *	2	83.98	1	39.34
S cnn *	1	85.64	7	35.52
MD cnn *	4	83.15	8	32.79
MTS cnn *	8	80.11	9	31.15

# Label embeddings

- MDMT model learns similarity between labels without this knowledge being encoded in the model
- This leads to consistent relationship between similar labels across datasets



# Web based UI

<https://github.com/socialmediaie/SocialMediaE>

## Input

I know this tweet is late but I just want to say I absolutely fucking hated this season of  
@GameOfThrones  
what a waste of time.

Predict

## Output

### abusive

founta			
abusive 0.830	hateful 0.084	normal 0.085	spam 0.002
waseem			
none 0.970	racism 0.002	sexism 0.027	

### sentiment

clarin		
negative 0.956	neutral 0.036	positive 0.008
other		
negative 0.906	neutral 0.063	positive 0.031
politics		
negative 0.917	neutral 0.048	positive 0.035
semeval		
negative 0.966	neutral 0.030	positive 0.004

### uncertainty

sarcasm				
not sarcasm 0.914		sarcasm 0.086		
veridicality				
definitely no 0.033	definitely yes 0.244	probably no 0.112	probably yes 0.189	uncertain 0.422

# Incremental learning of text classifiers with human-in-the-loop

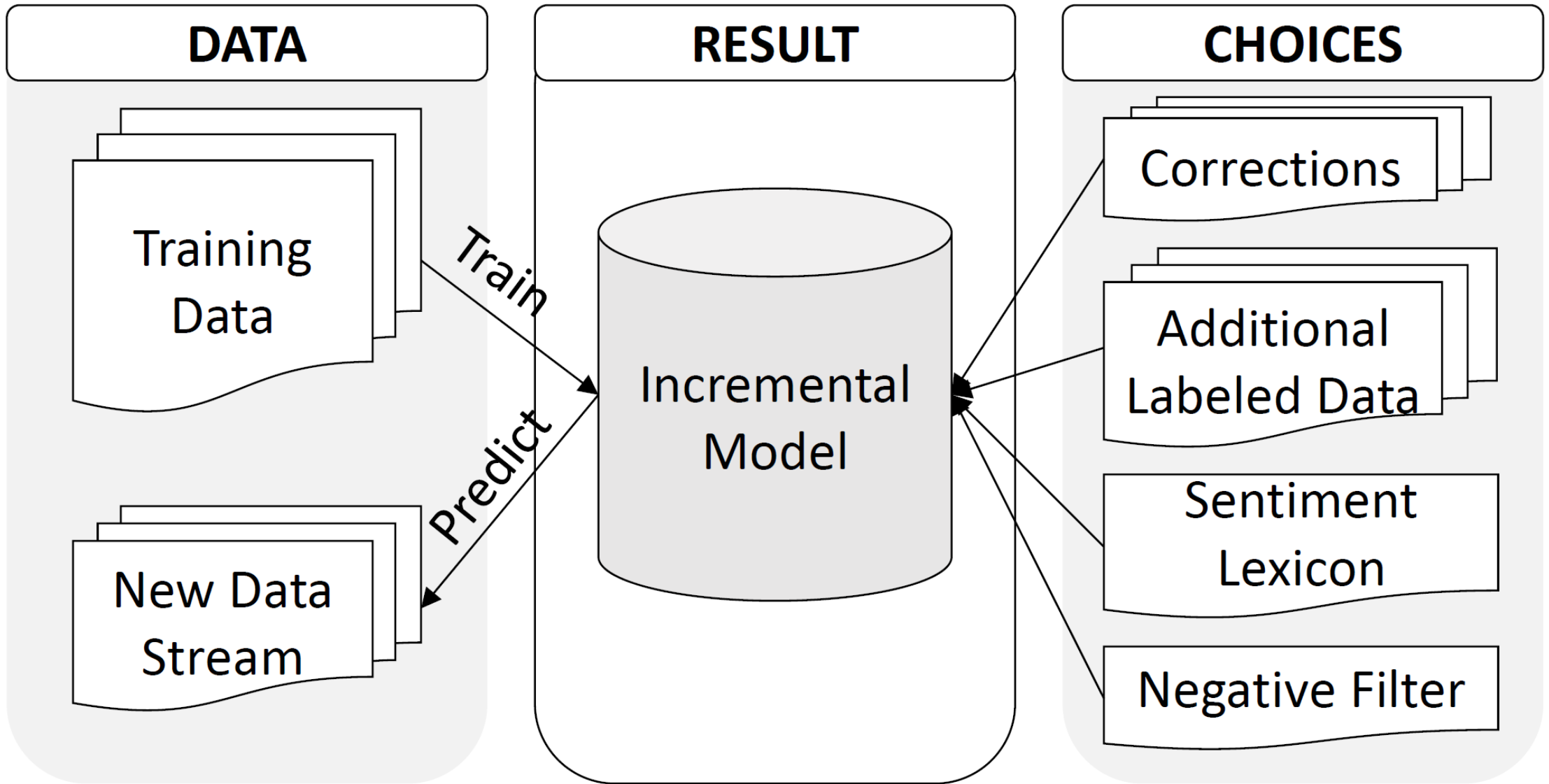
- Given a large unlabeled corpus, can we label it efficiently using fewer human annotations?
- Can existing models be updated efficiently to work with new data?
- Proposal:
  - Use active learning for data labeling
  - Use incremental learning algorithms for model updates
- Highly application to social media data:
  - Streaming data
  - Model should adapt to new data

Mishra, Shubhanshu, Jana Diesner, Jason Byrne, and Elizabeth Surbeck. 2015. "Sentiment Analysis with Incremental Human-in-the-Loop Learning and Lexical Resource Customization." In *Proceedings of the 26th ACM Conference on Hypertext & Social Media - HT '15*, 323–25. New York, New York, USA: ACM Press.  
<https://doi.org/10.1145/2700171.2791022>.

# Active Learning

1. Given a model and unlabeled data
2. Select samples from the unlabeled data to be annotated, based on selection criterion
3. Update model with collected labeled examples
4. Repeat steps 2 to 3 till desired accuracy is reached or data exhausted

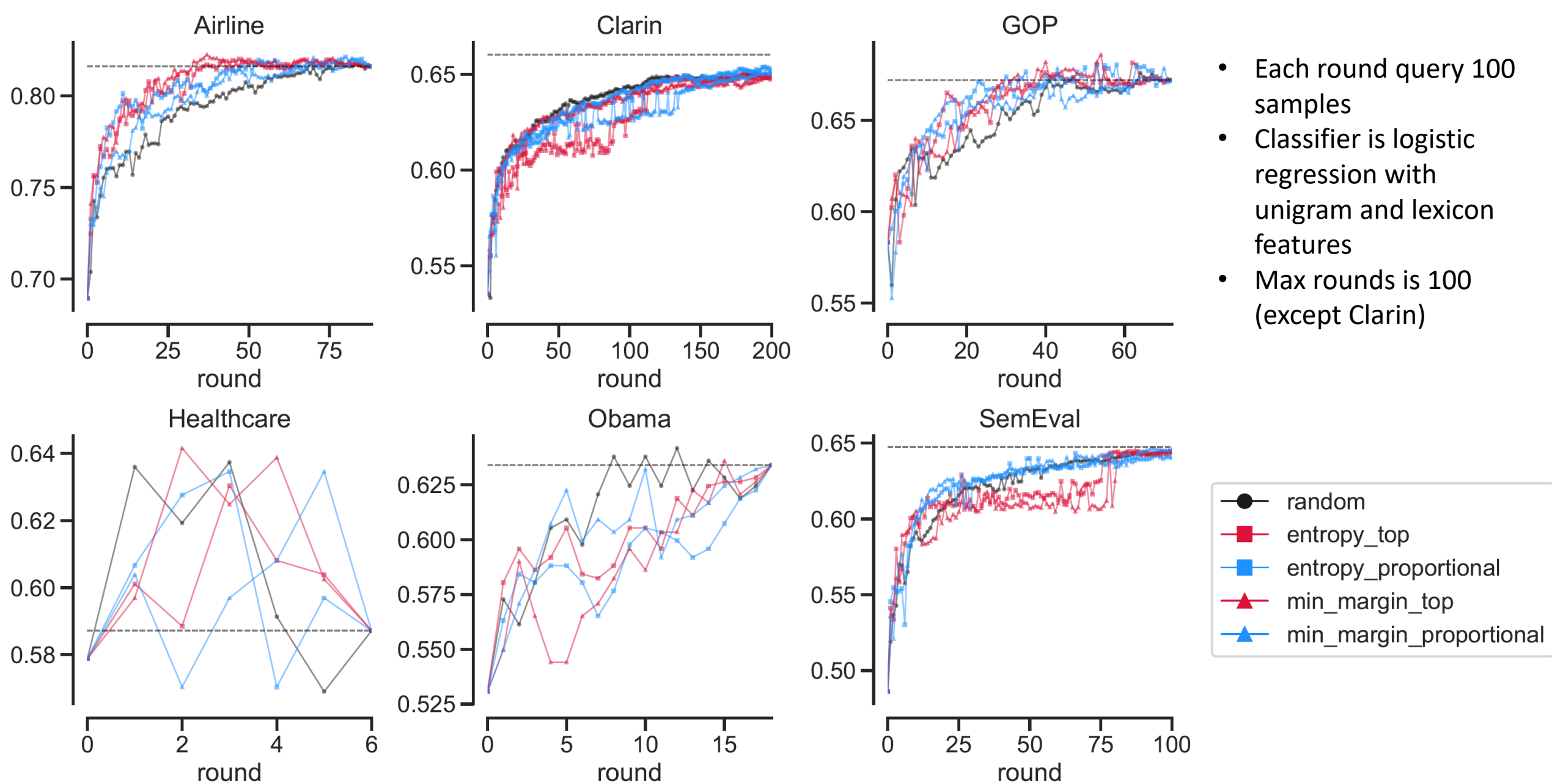
Mishra et al. (2015)



Mishra et al. (2015)

04/10/2022

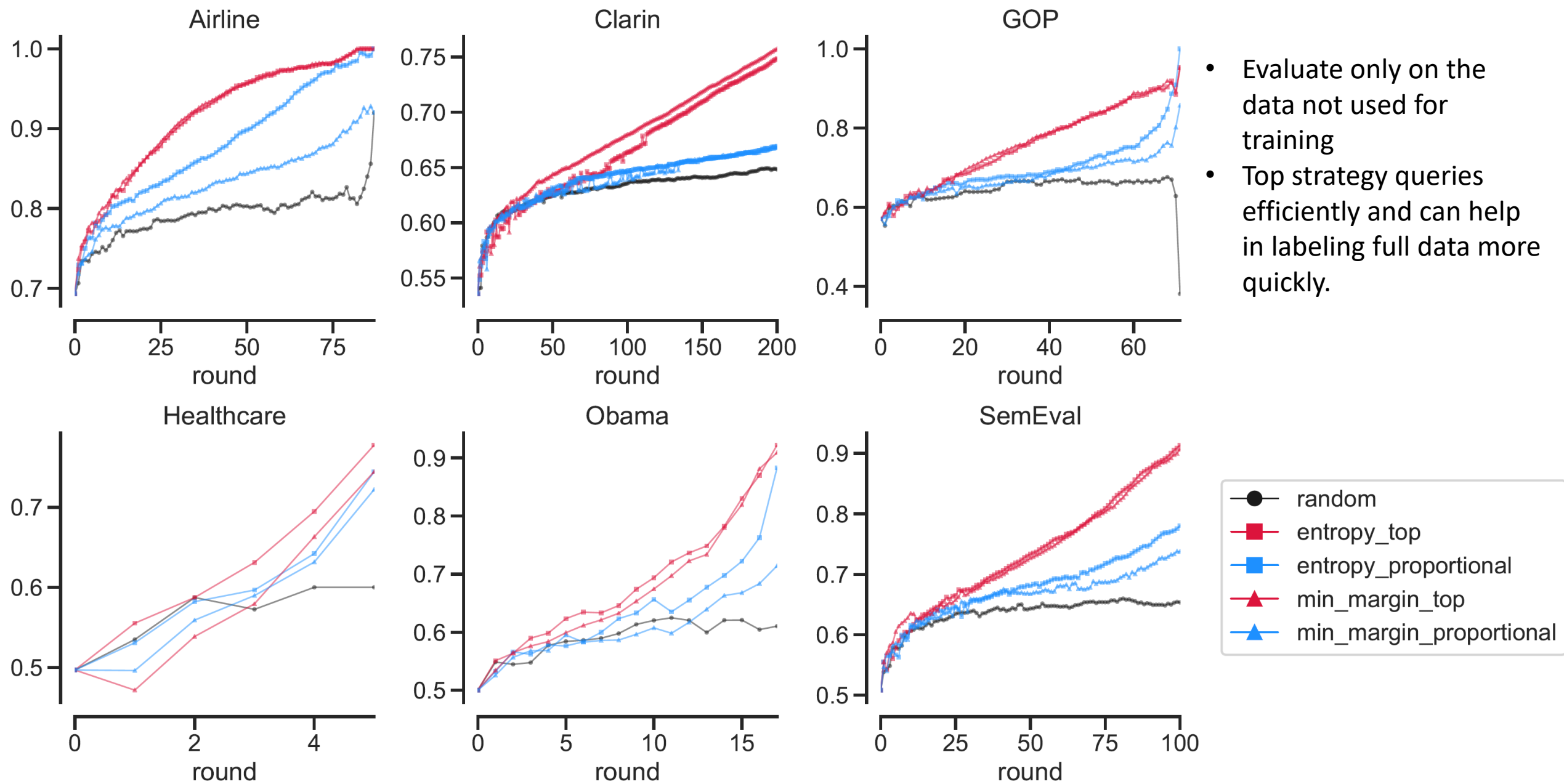
<https://socialmediaie.github.io/tutorials/LREC2022/>



Data ordered alphabetically and X and Y axes are not shared.

<https://github.com/socialmediaie/SocialMediaIE>





Data ordered alphabetically and X and Y axes are not shared.

<https://github.com/socialmediaie/SocialMediaIE>

# Less languages to learn: Multilingual learning to improve coverage

**Stripe** org acquires **Nigeria** loc's **Paystack** org for \$200M+ to expand into **the African continent** loc <https://tcrn.ch/3j2mnS3> by @ingridlunden

**Stripe** org rachète la startup **nigériane** loc **Paystack** org pour 200 millions de dollars afin de s'implanter sur **le continent Africain** loc <https://tcrn.ch/3j2mnS3> @ingridlunden

**स्ट्राइप** org ने \$200M+ में **नाइजीरिया** loc के **पेस्टैक** org को **अफ्रीकी महाद्वीप** loc में विस्तारित करने के लिए अधिग्रहित किया <https://tcrn.ch/3j2mnS3> @ingridlunden

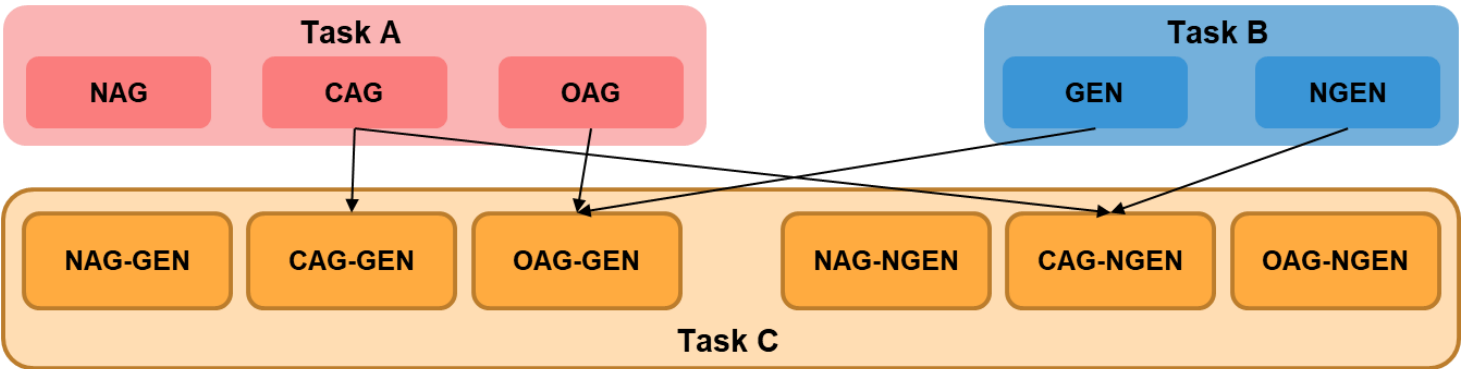
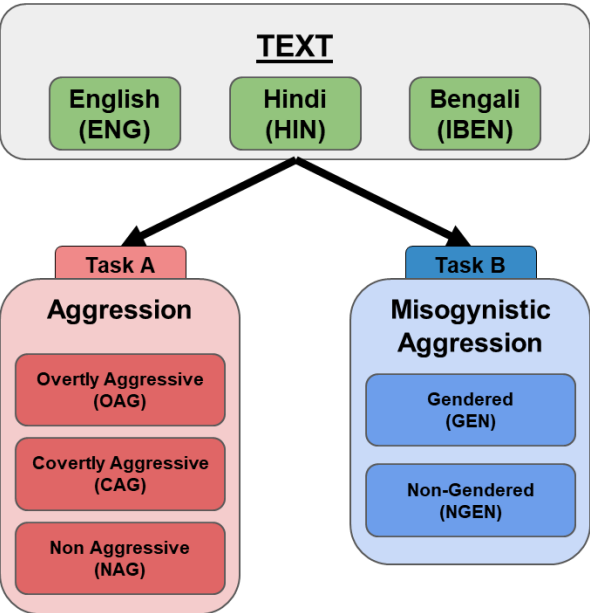
## NER trained on tweets using Multilingual Word Embeddings and BiLSTM

Language Testing Dataset	English CoNLL-03	German CoNLL-03	Dutch CoNLL-02	Spanish CoNLL-02	French xLIME	Italian xLIME	Turkish JRC	Hindi SEAS	Arabic CS-18
Lookup	36.6	22.8	36.8	29.7	15.6	23.3	22.9	<b>20.4</b>	16.7
Mono Training	40.2	35.5	39.4	27.4	27.7	<b>29.3</b>	24.8	11.8	<b>22.8</b>
Mul Training	38.3	36.6	43.2	29.1	26.4	28.9	28.0	9.8	14.0
Mono Training + WikiANN	<b>47.2</b>	<b>41.2</b>	<b>55.4</b>	37.6	30.3	28.4	27.8	14.0	21.9
Mul Training + WikiANN	43.2	39.6	52.8	<b>44.0</b>	<b>32.6</b>	25.4	<b>28.6</b>	8.3	11.3

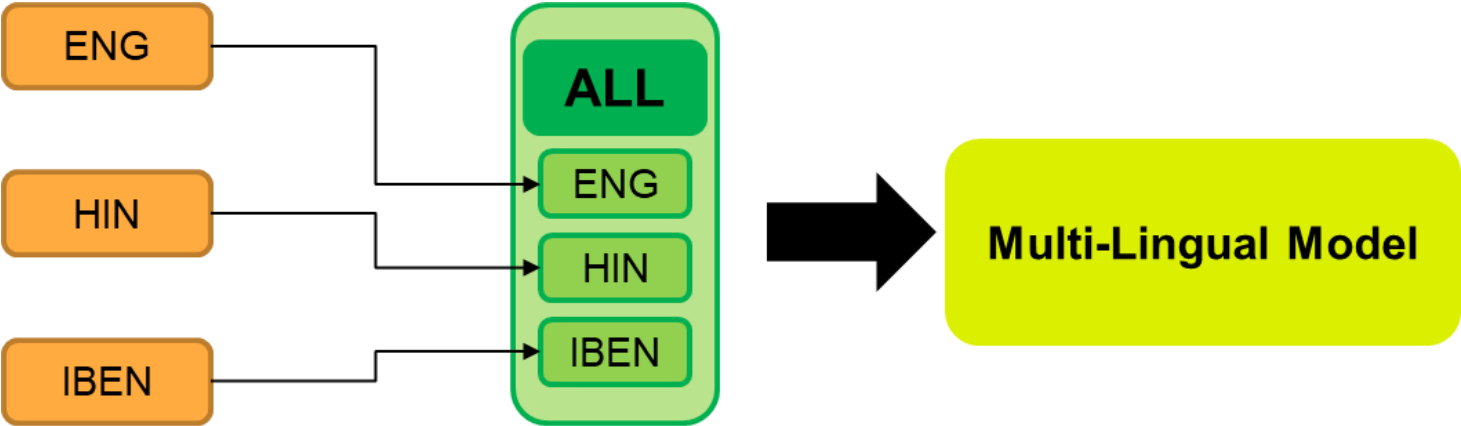
Table 1: Entity-Level Micro-Average F1-scores for the PERSON, LOCATION and ORGANIZATION types

**Table Source:** Ramy Eskander, Peter Martigny, Shubhanshu Mishra. [Multilingual Named Entity Recognition in Tweets using Wikidata](#) in WeCNLP 2020

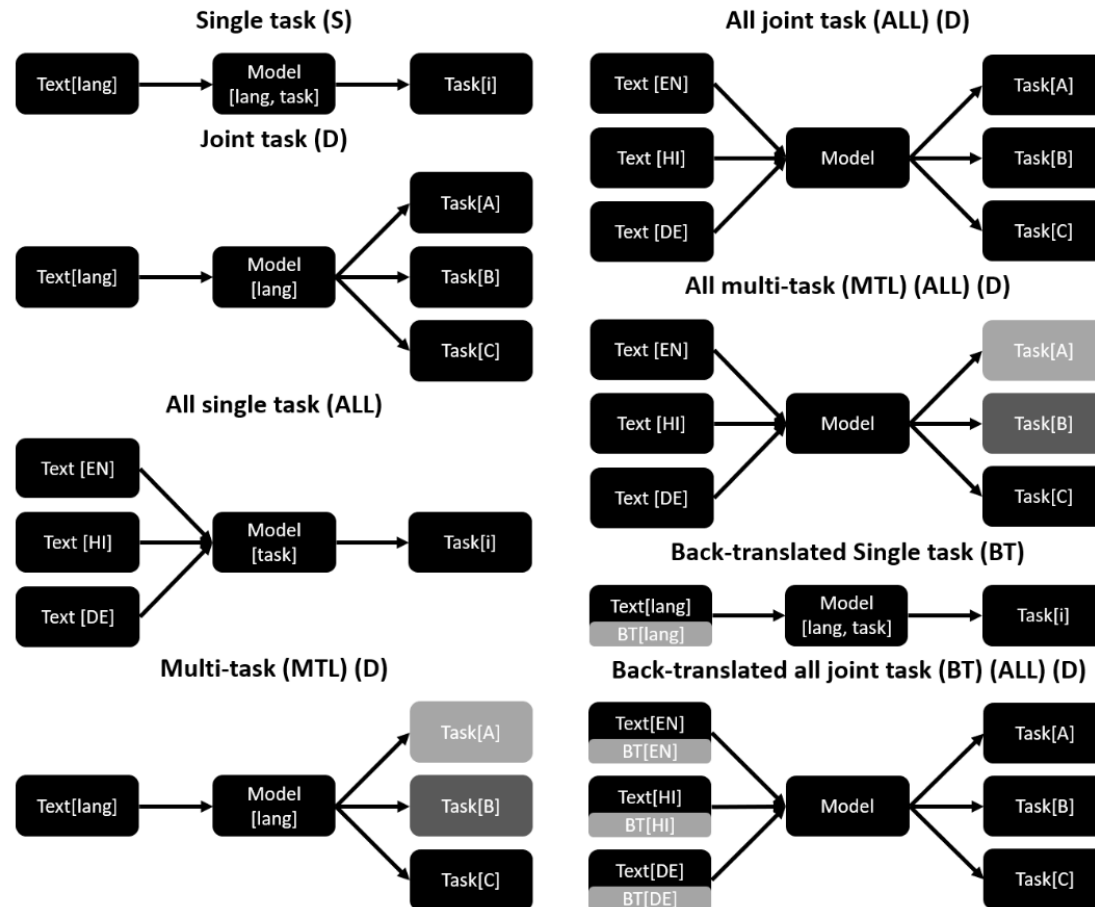
# Multilingual transformer models for hate and abusive speech



$$P(\text{NAG}) = P(\text{NAG-GEN}) + P(\text{NAG-NGEN})$$



# Multilingual learning for hate speech detection



Mishra, S., Prasad, S. & Mishra, S. Exploring Multi-Task Multi-Lingual Learning of Transformer Models for Hate Speech and Offensive Speech Identification in Social Media. SN COMPUT. SCI. 2, 72 (2021). <https://doi.org/10.1007/s42979-021-00455-5>

Code: [https://github.com/socialmediaie/MTML\\_HateSpeech](https://github.com/socialmediaie/MTML_HateSpeech)

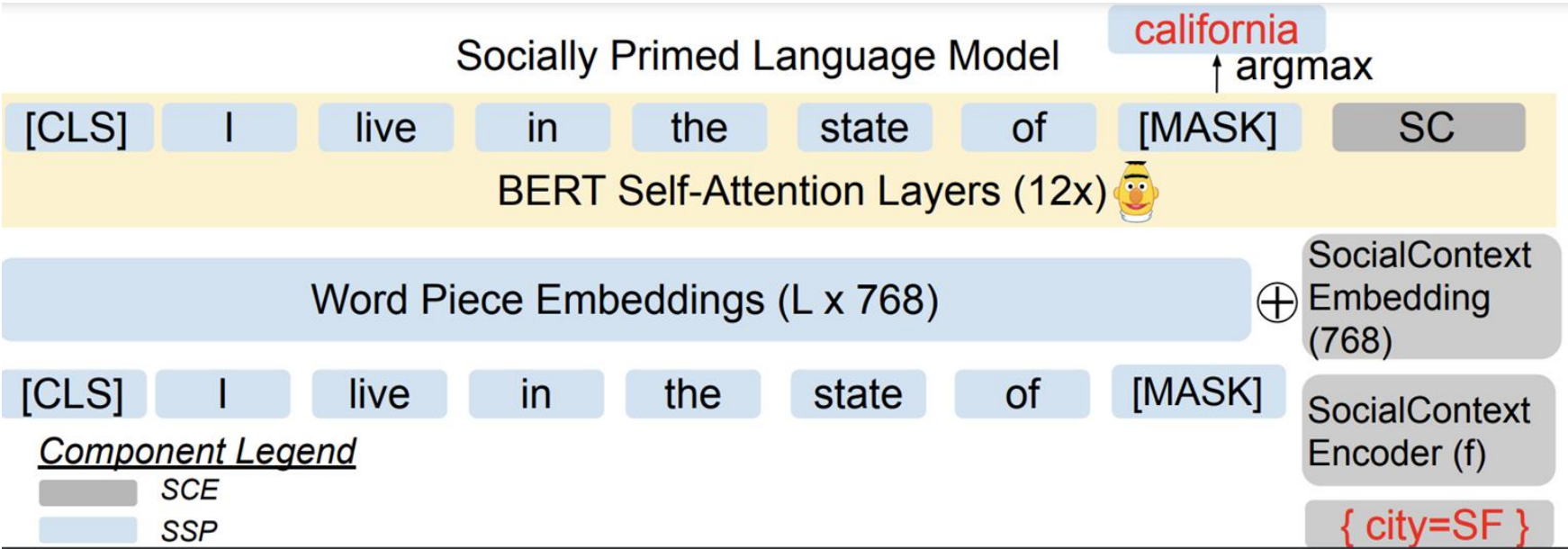
Fig. 2: An overview of various model architectures we used. Shaded task boxes represent that we first compute a marginal representation of labels only belonging to that task before computing the loss.

# Multilingual Language Model Pretraining

	Hindi		Japanese		Arabic	
<b>NER</b>	F <sub>1</sub>	$\Delta\%$	F <sub>1</sub>	$\Delta\%$	F <sub>1</sub>	$\Delta\%$
mBERT	21.1	0.0	16.5	0.0	32.1	0.0
+TPP (ONE)	<b>24.3</b>	15.2	<b>29.9</b>	81.4	<b>39.4</b>	22.8
+TPP (ALL)	23.2	10.3	27.4	66.4	38.5	19.9
<b>Sentiment</b>	F <sub>1</sub>	$\Delta\%$	F <sub>1</sub>	$\Delta\%$	F <sub>1</sub>	$\Delta\%$
mBERT	31.7	0.0	55.0	0.0	51.5	0.0
+TPP (ONE)	<b>32.7</b>	3.0	66.4	20.6	58.3	13.2
+TPP (ALL)	32.4	2.3	<b>67.7</b>	23.1	<b>58.5</b>	13.7
<b>UD POS</b>	acc.	$\Delta\%$	acc.	$\Delta\%$	acc.	$\Delta\%$
mBERT	67.4	0.0	52.7	0.0	64.0	0.0
+TPP (ONE)	<b>71.5</b>	6.0	<b>57.6</b>	9.2	<b>67.1</b>	4.8
+TPP (ALL)	66.4	-1.5	52.7	0.1	<b>65.0</b>	1.5

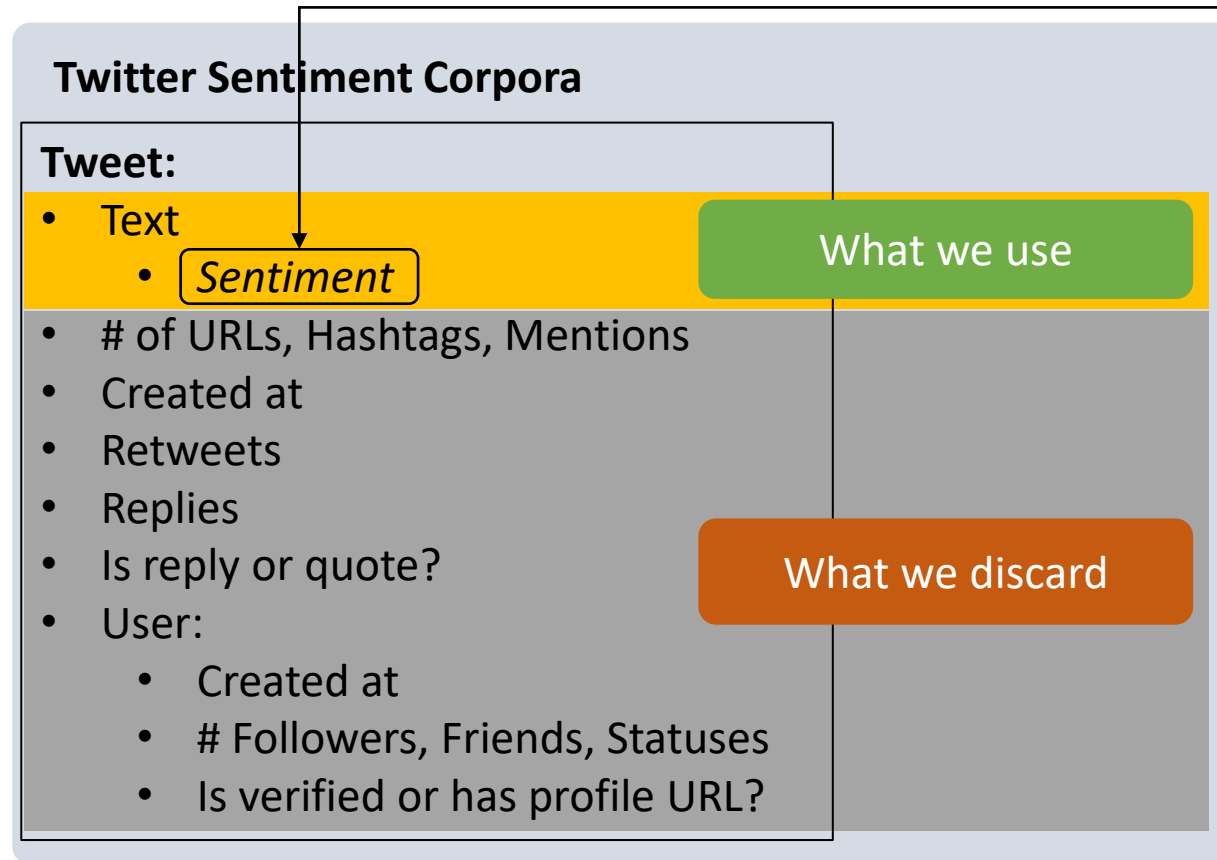
- **NER:** 37% relative improvement in F1.
- **Sentiment:** 12% relative improvement in F1.
- **UD POS:** 6.7% relative improvement in accuracy.

# Less context to learn: Include tweet context



Input Sentence	Social Context	Top 10 predicted tokens
I reside in the state of [MASK]	San Diego	california, ca, texas, mexico
I reside in the state of [MASK]	Dallas	texas, houston, mexico, california, tx
I reside in the state of [MASK]	Tampa	florida, georgia, fl, texas, jacksonville
The most popular nfl team in our state is [MASK]	San Diego	. the 49ers seattle patriots

# Improving sentiment classification using user and tweet metadata



Sentiment is usually identified as **positive**, **negative**, and **neutral**.

- Are our corpora biased to certain meta-data attributes?
- Can those biases propagate into systems trained on these corpora?
- How correlated are these meta-data features with the annotated sentiment?
- Do these correlations hold outside of the annotated data for the same users?
- Can sentiment classifiers exploit this bias to do well on these datasets?

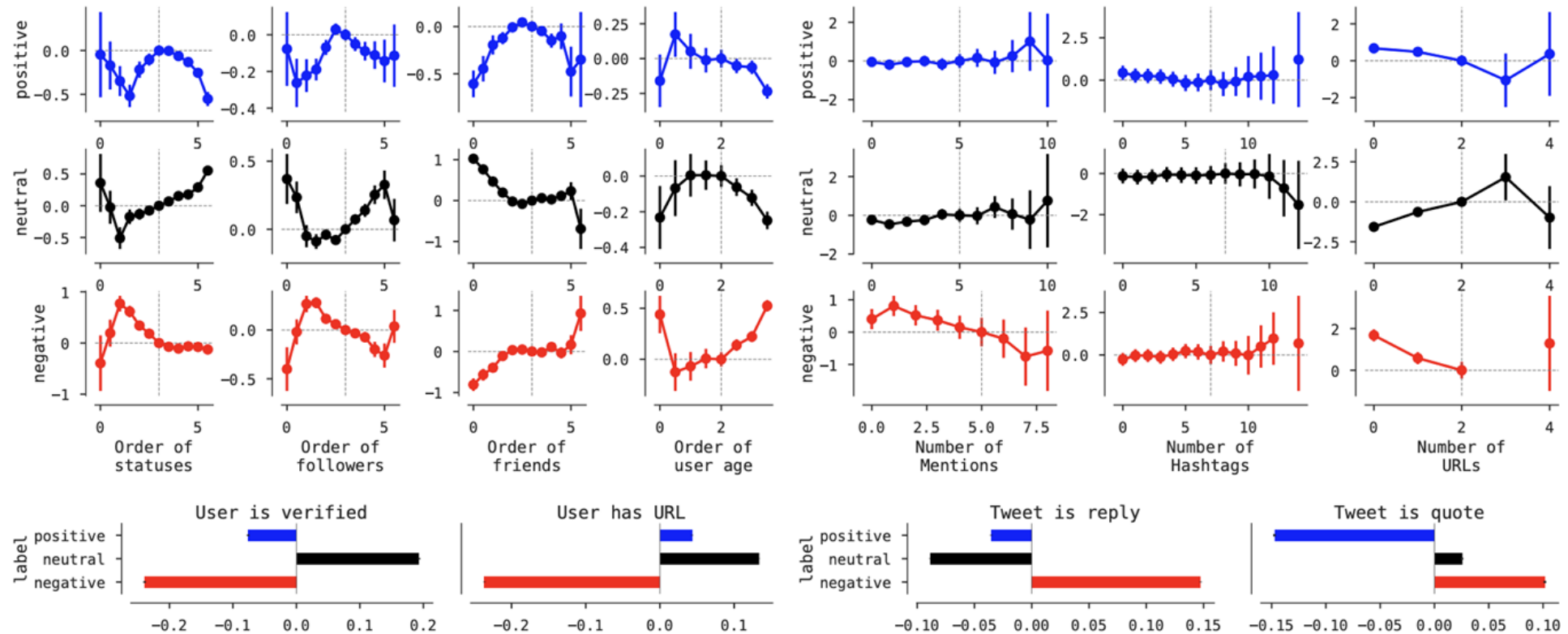
# Types of metadata and what they quantify

Quantification	User metadata
Activity level	# Statuses
Social Interest of the user	# Friends
Social status	# Followers
Account age	# days since account creation to posted tweet
Profile authenticity	Presence of URL on the profile or if the profile is verified

Quantification	Tweet metadata
Topical variety	# hashtags
Reference to sources	# URLs
Reference to network	# user mentions
Part of conversation	Is reply
Reference to conversation	Is quote



# User metadata v/s Sentiment



(a) User-level meta-data

(b) Tweet-level meta-data

**Figure 3: Meta-data features vs. sentiment classes. Y-axis in top plots and X-axis in bottom plots, is log-odds ratio, with respect to point at dashed lines.**

# Using metadata features can improve sentiment classification

Dataset	Model	Acc.	P	R	F1	KLD
Airline	meta	63.9	61.1	36.8	32.8	0.663
	text	80.0	78.3	69.0	72.4	0.026
	joint	80.3	76.6	72.0	<b>74.0</b>	0.005
Clarin	meta	45.7	42.1	40.9	37.8	0.238
	text	64.1	64.5	62.2	62.9	0.012
	joint	64.1	64.0	63.0	<b>63.4</b>	0.000
GOP	meta	59.9	54.3	37.5	33.6	0.776
	text	66.4	63.7	51.4	53.6	0.111
	joint	65.6	59.9	56.5	<b>57.8</b>	0.006
Healthcare	meta	56.7	36.8	39.4	35.1	0.717
	text	64.2	71.3	49.5	51.0	0.233
	joint	65.6	61.6	58.3	<b>59.5</b>	0.007
Obama	meta	39.3	37.0	35.1	32.0	0.282
	text	61.5	64.8	59.7	60.9	0.030
	joint	62.3	63.2	61.6	<b>62.2</b>	0.002
SemEval	meta	47.0	31.0	36.2	33.0	0.845
	text	65.5	64.1	58.0	59.5	0.032
	joint	65.6	62.7	60.5	<b>61.4</b>	0.001

Boost in F1 is mostly due to better recall. Precision is lower.

MESC might be helping with tweets with high OOV rates, where text classifiers don't do well.

# Hands on session using SocialMediaIE

Links to install instructions and google colaboratory notebook at:

<https://socialmediaie.github.io/tutorials/LREC2022/>

# Initial setup

- Open google Colab notebook specified at:  
<https://socialmediaie.github.io/tutorials/LREC2022/#software-setup>
- On Colab click **Connect**
- Follow along during the session.
- Meanwhile you can also follow the steps on the link above to install SocialMediaIE locally on your machine.
- If you face any issues with installation, please report an issue at:  
<https://github.com/socialmediaie/SocialMediaIE/issues>

# List of social media IE tools

- SocialMediaIE - <https://github.com/socialmediaie/SocialMediaIE>
- TwitterNER - <https://github.com/socialmediaie/TwitterNER> (more lightweight NER focused on English tweets)
- Social Communication Temporal Graph - <https://github.com/napsternxg/social-comm-temporal-graph/> (visualizing temporal networks)
- ConText - <https://github.com/uiuc-ischool-scanr/ConText> (generate networks from text data)
- SAIL - <https://github.com/uiuc-ischool-scanr/SAIL> (active learning for text classification, python version coming soon at <https://github.com/socialmediaie/>)

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- Bertweet – large scale pre-trained Roberta model - <https://huggingface.co/vinai/bertweet-base>
- BERTweet NER - [https://huggingface.co/socialmediaie/bertweet-base\\_wnut17\\_ner](https://huggingface.co/socialmediaie/bertweet-base_wnut17_ner)

# Using SocialMediaIE for IE from text

- Notebook link:  
[https://github.com/socialmediaie/tutorials/blob/master/docs/LREC2022/LREC\\_2022\\_Tutorial\\_SocialMediaIE.ipynb](https://github.com/socialmediaie/tutorials/blob/master/docs/LREC2022/LREC_2022_Tutorial_SocialMediaIE.ipynb) (Click on Open in Colab)
- Use one multi-task model to extract POS, named entities, chunks, and super-sense tags from text efficiently
- Use one multi-task model to label sentiment, abusive content, and uncertainty (sarcasm and veridicality) from text efficiently
- Copy the model output JSON to our UI interface  
<https://socialmediaie.github.io/PredictionVisualizer/> to see visual representation of the labels
- Try on your own text data
- Try to run SocialMediaIE on your local machine

# Other models for multi-task learning

- Hierarchical labels or multi-label settings
  - Mishra, S., Prasad, S., & Mishra, S. (2020). Multilingual Joint Fine-tuning of Transformer models for identifying Trolling, Aggression and Cyberbullying at TRAC 2020. In *Proceedings of the Second Workshop on Trolling, Aggression and Cyberbullying* (pp. 120–125). Marseille, France: European Language Resources Association (ELRA). Retrieved from <https://www.aclweb.org/anthology/2020.trac-1.19>. Code: <https://github.com/socialmediaie/TRAC2020>
  - Mishra, S., & Mishra, S. (2019). 3Idiots at HASOC 2019: Fine-tuning Transformer Neural Networks for Hate Speech Identification in Indo-European Languages. In *FIRE (Working Notes)* (pp. 208-213). Retrieved from <http://ceur-ws.org/Vol-2517/T3-4.pdf>. Code: <https://github.com/socialmediaie/HASOC2019>



# Visualize temporal network of social media data in your browser

- Social Communication Temporal Graph:  
<https://shubhanshu.com/social-comm-temporal-graph/>
- [Recent tweet comparison](#) – Compare user-tweet network on tweets about 2 search queries
- [Recent Tweet Sentiments](#) – Compare user and tweet level sentiment on tweets about a single search query
- [Wikipedia Revisions](#) – Compare Wikipedia edit activity across 2 pages and identify common users

# Collecting and distributing social media data

# Use of social media data for research

- Publicly available online data provides a unique source of rich input for analyzing and studying people, their behavior, and feelings
- Availability of different tools from domains such as NLP and ML made it easier for everyone to perform various types of data analysis
- Things to consider before using any data:
  - How the data is it collected
  - Is the data reusable for your research
  - Is the data representative enough
  - Does the data or method answer your research question
  - How generalizable is the findings?



# Publicly available social media data

- Many researchers make annotated social media data publicly available **for academic research**.
- Good place for benchmarking or evaluating your models.
- Many datasets available for text classification.
- Few for information extraction via sequence tagging (but still enough)
- Varied annotation practices and data scope:
- We have curated a large collection of social media corpuses from academic research at: <https://socialmediaie.github.io/MetaCorpus/>

# Using Twitter API and Tweet Downloader

Key benefits	Access Twitter's real-time and historical public data with additional features and functionality that support collecting more precise, complete, and unbiased datasets. <a href="#">More details on included endpoints</a>
Tweet cap	10 million Tweets / month
Query rules	1024 characters, 1000 streaming rules
Streaming rates	50 requests / 15 minutes, per app
Technical support	Developer documentation, tutorials, support content, and community forums
Cost	Free

## New Tweet downloader

Along with the SDKs, we have a new addition to the [Twitter API Tools](#) <sup>26</sup> called the Tweet Downloader. The downloader provides Academic Researchers a quick and easy way to access historical Twitter data from the [full-archive search endpoint](#) <sup>11</sup> via a no-code web interface. Like the [Query Builder](#) <sup>7</sup>, the UI offers the same, easy-to-use form to build and group search queries where you can then save the matching Tweets in either JSON or CSV format to your machine.

To get started with the downloader, you must provide a Bearer Token with [Academic Research access](#) <sup>14</sup>. This tool is only available to developers with access to the full-archive search endpoints (available via Academic Research access).

## Tweets Downloader features:

- Build search query via a user-friendly web interface
- No coding needed
- Start/End date picker
- Ability to download data in either CSV or JSON format
- Run multiple queries at the same time
- Continue downloading if there are API timeouts or page reloads

- How to build Twitter search queries: <https://developer.twitter.com/en/docs/twitter-api/tweets/search/integrate/build-a-query>
- Academic Research Access: <https://developer.twitter.com/en/products/twitter-api/academic-research>
- Twitter API v2 Docs: <https://developer.twitter.com/en/docs/twitter-api>
- [A guide to teaching with the Twitter API v2](#)

# Tagging data

[https://shubhanshu.com/phd\\_thesis](https://shubhanshu.com/phd_thesis)

## Part of speech tagging

### Super sense tagging

data	split	labels	sequences	vocab	tokens
Ritter	train	40	551	3174	10652
	dev	37	118	1014	2242
	test	40	118	1011	2291
Johannsen2014	test	37	200	1249	3064

### Chunking

data	split	boundaries	labels	labels	sequences	vocab	tokens
Ritter	train	[I, B, O]	[ADJP, PP, INTJ, ADVP, PRT, NP, SBAR, VP, CONJP]	9	551	3158	10584
	dev	[I, B, O]	[ADJP, PP, INTJ, ADVP, PRT, NP, SBAR, VP]	8	118	994	2317
	test	[I, B, O]	[ADJP, PP, INTJ, ADVP, PRT, NP, SBAR, VP]	8	119	988	2310

data	split	labels	sequences	vocab	tokens
Owoputi	train	25	1547	6572	22326
	dev	23	327	2036	4823
	test	23	500	2754	7152
TwitIE	dev	43	269	1229	2998
	test	45	632	3539	12196
Ritter	train	45	632	3539	12196
	dev	38	71	695	1362
	test	42	84	735	1627
Tweetbankv2	dev	17	710	3271	11759
	train	17	1639	5632	24753
	test	17	1201	4699	19095
DiMSUM2016	train	17	4799	9113	73826
	test	17	1000	4010	16500
Foster	test	12	250	1068	2841
lowlands	test	12	1318	4805	19794

## Named entity recognition

data	split	labels	sequences	vocab	tokens
YODIE	train	13	396	2554	7905
	test	13	397	2578	8032
Ritter	train	10	1900	7695	36936
	dev	10	240	1731	4612
	test	10	254	1776	4921
WNUT2016	train	10	2394	9068	46469
	test	10	3850	16012	61908
	dev	10	1000	5563	16261
WNUT2017	train	6	3394	12840	62730
	dev	6	1009	3538	15733
	test	6	1287	5759	23394
NEEL2016	train	7	2588	9731	51669
	dev	7	88	762	1647
	test	7	2663	9894	47488
Finin	train	3	10000	19663	172188
	test	3	5369	13027	97525
Hege	test	3	1545	4552	20664
BROAD	train	3	5605	19523	90060
	dev	3	933	5312	15169
	test	3	2802	11772	45159
MultiModal	train	4	4000	20221	64439
	dev	4	1000	6832	16178
	test	4	3257	17381	52822
MSM2013	train	4	2815	8514	51521
	test	4	1450	5701	29089

# Classification data

[https://shubhanshu.com/phd\\_thesis](https://shubhanshu.com/phd_thesis)

data	split	tokens	tweets	vocab
Airline	dev	20079	981	3273
	test	50777	2452	5630
	train	182040	8825	11697
Clarin	dev	80672	4934	15387
	test	205126	12334	31373
	train	732743	44399	84279
GOP	dev	16339	803	3610
	test	41226	2006	6541
	train	148358	7221	14342
Healthcare	dev	15797	724	3304
	test	16022	717	3471
	train	14923	690	3511
Obama	dev	3472	209	1118
	test	8816	522	2043
	train	31074	1877	4349
SemEval	dev	105108	4583	14468
	test	528234	23103	43812
	train	281468	12245	29673

**Sentiment classification**

data	split	tokens	tweets	vocab
Founta	dev	102534	4663	22529
	test	256569	11657	44540
	train	922028	41961	118349
WaseemSRW	dev	25588	1464	5907
	test	64893	3659	10646
	train	234550	13172	23042

**Abusive content identification**

data	split	tokens	tweets	vocab
Riloff	dev	2126	145	1002
	test	5576	362	1986
	train	19652	1301	5090
Swamy	dev	1597	73	738
	test	3909	183	1259
	train	14026	655	2921

**Uncertainty indicator classification**

# Collecting new social media data

- **Twarc** is a good tool to collect Twitter data:  
<https://twarc-project.readthedocs.io/en/latest/>
- It requires that you have a Twitter Developer API key -  
<https://developer.twitter.com/en/apps>
- It also allows you to also hydrate tweet IDs to tweet json using the API
- Often a file with one tweet ID per line can be hydrated as:  

```
twarc hydrate ids.txt > data.jsonl  
twarc search blacklivesmatter > tweets.jsonl  
twarc followers jack > users.jsonl  
twarc users ids.txt > users.jsonl
```



# Responsible handling of social media data

# Personally Identifiable Information (PII) and Ownership

- **Status quo:**

- Tech innovation often precedes policy
- Collection, storage, fusion, mining of large-scale user data/ personally identifiable data fast, cheap, easy
- Technically feasible versus legal versus ethical

- **Common misassumptions:**

- Publicly available data can be accessed, downloaded, stored, analyzed
- People who post information online don't expect privacy and do consent to the data being used for research
- Creator of data (author) is the owner of the data
- Anonymity equals privacy

# Why is responsible data handling hard? Multitude of regulations!

## 1. **Governmental, institutional, and communal norms and regulations**

- Health Insurance Portability and Accountability Act (HIPAA), Fair Information Practice Principles (FIPPs), Menlo Report (Ethical Principles Guiding Information and Communication Technology Research, 2012), and many more

1. **Intellectual property**
2. **Privacy and security law and regulations**

## 2. **Terms of use/ service**

## 3. **Technical constraints** (robots.txt, APIs)

## 4. **Personal values**

- People apply them consciously or unconsciously
- Depend on gender (Gilligan 1987), culture (Graham et al. 2011)
- 16+: Conventional morality (comply with (group) norms) versus 10-15% post-conv. morality (own principles) (Kohlberg 1984)



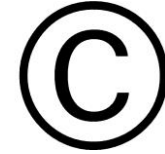
Learn more at

- Diesner, J., & Chin, C. (2015). Usable Ethics: Practical considerations for responsibly conducting research with social trace data. Workshop: Beyond IRBs: Ethical Review Processes for Big Data Research, Future of Privacy Forum, Washington DC.
- Diesner, J., & Chin, C. (2016). Gratis, libre, or something else? Regulations and misassumptions related to working with publicly available text data. ETHI-CA<sup>2</sup> Workshop (ETHics in Corpus Collection, Annotation & Application), 10th Language Resources and Evaluation Conference (LREC), Portoroz, Slovenia.
- Diesner, J., & Chin, C. (2016). Seeing the forest for the trees: Understanding and implementing regulations for the collection and analysis of human centered data. Human-Centered Data Science (HCDS) Workshop, 19th ACM Conference on Computer-Supported Cooperative Work and Social Computing (CSCW 2016).

# Data are Property, Property is Protected

- United States Constitution, Article I, Section 8:  
“The Congress shall have Power [...] To promote the **Progress** of Science and useful Arts, by securing for limited Times to Authors and Inventors the **exclusive Right** to their respective Writings and Discoveries.”
  - Copyright, and fair use (depends on country)
  - Patents
  - Trademarks
  - Trade Secrets

# Data are Property, Property is Protected



## 1. Copyright

- Protectable: original, fixed in a tangible medium, non-functional expressions
- Protection starts at moment of creation
- Not protectable: facts and ideas
- © means: Nobody can copy, distribute, create derivatives, perform, display expressions that are copyright protected without consent from the copyright owner.
- Neither registration with US copyright office nor copyright symbol required for ensuring copyright protection
  - Registration required for suing for copyright infringement
- Exception: fair use: allows the use of very small portions of copyrighted material without permission from owner, e.g., for education, research, news reporting (depends on country)
- Baseline: creator of data is owner, exceptions:
  - Contracts (work for hire)
  - Terms of service

# Building on top of classic copyright

- Creative Commons

- ① Attribution: You let others copy, distribute, display, and perform your copyrighted work — and derivative works based upon it — but only if they give credit the way you request.

- ② Share Alike: You allow others to distribute derivative works only under a license identical to the license that governs your work.

- Also known as Copyleft

- ③ Noncommercial: You let others copy, distribute, display, and perform your work — and derivative works based upon it — but for non-commercial purposes only.

- ④ No Derivative Works: You let others copy, distribute, display, and perform only verbatim copies of your work, not derivative works based upon it.

# Using Creative Commons Licenses to ensure Open Knowledge

- Wikipedia
  - Text available under Creative Commons Attribution ShareAlike License
  - Constraints:
    - ① • Attribution—You must attribute the work in the manner specified by the author or licensor
    - ② • Share Alike—If you alter, transform, or build upon this work, you may distribute the resulting work only under the same, similar or a compatible license.

# In what sense are online data public?

- Open Data, Open Science, Open you name it...
  - Gratis (free as in free beer) versus libre (free as in free speech) (Floss, Stallman, GNU)
  - User-generated data from 3<sup>rd</sup> party platforms often “free to see”
- GNU General Public License (GPL), originally authored by Richard Stallman
  - “**“free” in the sense of freedom**: [...] freedom to copy and redistribute it, with or without modifying it, either commercially or noncommercially.”
  - Author and publisher get credit for their work without being responsible for modifications made by others
  - State of the art for Open Source (software) development projects
    - For example [Github, Sourceforge](https://socialmedicine.github.io/tutorials/LREC2022/)



# Scraping public data – technical aspects

- APIs -> use that if available before thinking about scraping
- robots.txt -> consider those if you collect data directly
- Scraping: manual (time consuming) or automated (crawler) (noisy)

# Scraping - legal aspects

- End user license agreements (EULA):
  - Shrink wrap contracts: unsigned permit understandings (assumption: user agrees by opening the product)
  - For websites aka browse-wrap, click-wrap, web-wrap
    - Can change often
    - Vague
    - Inconstant across sites
    - Lack context
  - For more, see Fiesler, Bearn and Keegan (2020)

# Scraping public data - legal aspects

- ToS are contract law
- Problem: ToS can violate the Computer Fraud and Abuse Act CFAA (1984), which is a federal law against hacking (unauthorized access to a computer)
  - Does the CFAA make ToS violates a federal crime?
    - United States of America v. Aaron Swartz (2011)
  - Browsewrap agreements not enforceable:
    - “Terms of Use” hyperlinks “not sufficiently conspicuous” (obvious) for “reasonably prudent internet consumer” (plaintiff did not manifest unambiguous assent to be bound by Terms of Use”) (Long v. Provide Commerce, Inc., 2016 WL 1056555, Cal Ct. App., 03/17/2016)

# Scraping public data - legal aspects

- Creating sock puppet accounts and collect data to research algorithmic discrimination online does not violate CFAA
- Sandvig v. Barr, filed by American Civil Liberties Union (ACLU) on behalf of academics, computer scientists, journalists, ruling came out in March 2020
- “Researchers who test online platforms for discriminatory and rights-violating data practices perform a public service. They should not fear federal prosecution for conducting the 21st-century equivalent of anti-discrimination audit testing.”  
(<https://www.aclu.org/press-releases/federal-court-rules-big-data-discrimination-studies-do-not-violate-federal-anti>)

# Scraping public data - legal aspects

- HiQ versus LinkedIn, legal decision (2017, see Fiesler for details):
  - HiQ, a talent management service, violated ToS -> received cease and desist letter from LinkedIn to stop scraping
  - By virtue of being published publicly, a website authorizes the public to access it
  - Revoking access on case-by-case basis problematic (can be discriminatory)
  - CFAA does not apply to scrape non-password protected data
- Line in the sand: access control such as passwords

# Scraping public data - ethical aspects

- Scraping can be illegal but ethical
- Scraping can be legal but unethical
- Expectations of users: data available beyond website (download, redistributed) and for research?
- Contextual privacy (Nissenbaum 2020)
- More on data: working with online data kind of archival research (Kosinski et al. 2015)
  - No consent needed if 1) users consciously made their data public, 2) collected data anonymized, 3) researchers do not interact with participants, 4) no identifiable user information published

# How to decide if and how to collect online data?

- Scraping, crawling: Consider access control
- Do a holistic case by case assessment (Fiesler, 2019)
  - Amplification?
  - Inference?
  - Seek guidance from members of community
- **Include information about your ethical consideration and reasoning in your papers**

# Social data from online sources: collection/ acquisition methods

- (omitting interaction methods (elicitation, user studies) and crowdsourcing)
- Reuse existing data
  - Benchmarks
  - Archival data, repositories:  
<https://datasetsearch.research.google.com>  
<https://www.kaggle.com/datasets>  
<https://datacatalogue.cessda.eu/> (social science data)
- APIs, scraping, crawling
  - Code -> maintenance, chasing a moving target, dependencies
- 3rd party services (e.g., BrandWatch, Crimson Hexagon, Pushshift)
- Buy data
- Shared issues:
  - **provenance, quality and biases, sampling, context of data production and collection impact data, ethics**



# Data documentation – Why?

- Make important aspects explicit
- Avoid pitfalls with important aspects, e.g., discriminatory outcomes
  - Digital social data increasingly used to develop policy, decision making, design products and services
  - Not just an observational tool
- Standardization to ease collaboration/ communication, esp. in interdisciplinary teams
- Improve transparency, accountability, reproducibility, responsibility
  - Starting with collection, preprocessing, representation/ indexing/ storage, provenance
- Select appropriate datasets

# Pitfalls of working with digital (social) data

- Concerns/ pitfalls
  - Opportunistic use
  - Biases introduced in data itself or measurement (data collection, methods, can depend on research context -> case by case assessment necessary, again)
    - Social, technical, and methodological roots of biases
  - Lack of consensus on vocabulary and taxonomy for biases and measurement issues
  - Data quality
- For more: boyd and Crawford 2012, Olteanu 2019

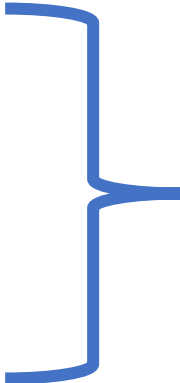
# Datasheets for datasets

- Gibru et al. 2020, industry (Google, Microsoft)/ academia project, originally for ML datasets
- Audiences:
  - Dataset creators: **reflect** on:
    - Workflow: process of creation, distribution, maintenance of dataset;
    - Assumptions, risks or harms, implications of use
  - Consumers: informed choice about use
- Producing a datasheet not an automated process, dependent on domain and specific case
- Design:
  - iterative
  - Yes/ no questions discouraged

# Datasheets for datasets: Questions for developers

- Workflow questions

- Motivation
- Composition
- Collection
- Preprocessing, cleaning, labeling

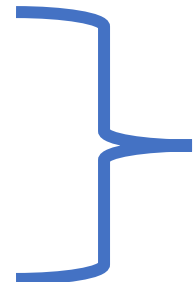


Read before the step, answer  
once task is completed

- Uses

- Distribution

- Maintenance



Provide answers before  
executing the step

# Model cards for model reporting

- By Mitchell et al, 2019 (Google)
- Machine learning models involved in high-stakes tasks, incl. hiring, law enforcement, health care, education
- Goals:
  - Standardize ethical practice and reporting
  - Allow others to assess and compare models for deployment in terms of performance AND ethical, inclusive and fair considerations
  - Identify systematic errors of model performance before deployment
  - Inform users about what ML systems can and cannot do
  - Types of errors a ML system will make
  - Create more fair and inclusive outcomes with using ML systems

# Model cards for model reporting

- Model cards: Transparent model reporting in terms of:
  - Performance characteristics (metrics, what feature impact performance)
  - Intended use contexts
  - Benchmarking (evaluating) human-centric ML systems under predefined conditions, here via **disaggregated evaluation** by unitary and intersectional groups (cultural, demographic, phenotype; incl. race and gender)
- Alternative solutions:
  - Qual and quant algorithmic auditing by 3<sup>rd</sup> parties
  - Adversarial testing by technical and non-technical analysis
  - Inclusive user feedback

# Model cards for model reporting: sections

- Model details
  - Not a requirement to compromise private information or reveal proprietary training methods
- Intended use, incl. out of scope use
- Factors, incl. groups, instrumentation, environment
- Metrics
- Evaluation data
- Training data
- Quantitative analysis, disaggregated (broken down by factors) -> aim for parity (as a dimension of fairness)
- Ethical considerations
- Caveats and recommendations

# Other data documentation efforts

- DDI: <https://ddialliance.org/>: “The Data Documentation Initiative (DDI) is an international standard for describing the data produced by surveys and other observational methods in the social, behavioral, economic, and health sciences.”
- Industry-wide documentation of best documentation practices in ML and AI:  
<https://partnershiponai.org/workstream/about-ml/>
- Dataset Nutrition Labels: Holland, S., et al. (2020). "The dataset nutrition label." Data Protection and Privacy: Data Protection and Democracy 1.
- Factsheets: Arnold, M., et al. (2019). "FactSheets: Increasing trust in AI services through supplier's declarations of conformity." IBM Journal of Research and Development 63(4/5): 6: 1-6: 13.
  - Characteristics of AI services



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# Thank you

- Questions
- Tweet to us at:
  - Shubhanshu Mishra - [@TheShubhanshu](https://twitter.com/TheShubhanshu)
  - Rezvaneh (Shadi) Rezapour - [@shadi\\_rezapour](https://twitter.com/shadi_rezapour)
  - Jana Diesner - [@janadiesner](https://twitter.com/janadiesner) [@DiesnerLab](https://twitter.com/DiesnerLab)
- All material presented here can be found at:  
<https://socialmediaie.github.io/tutorials/LREC2022/>
- If you have questions or feature requests about any of the tools open an issue on github e.g. for SocialMediaE at:  
<https://github.com/socialmediaie/SocialMediaE/issues>

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