Stance Detection: A Review

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Outline

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- Approaches to Stance Detection
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- Application Areas
- Outstanding Issues
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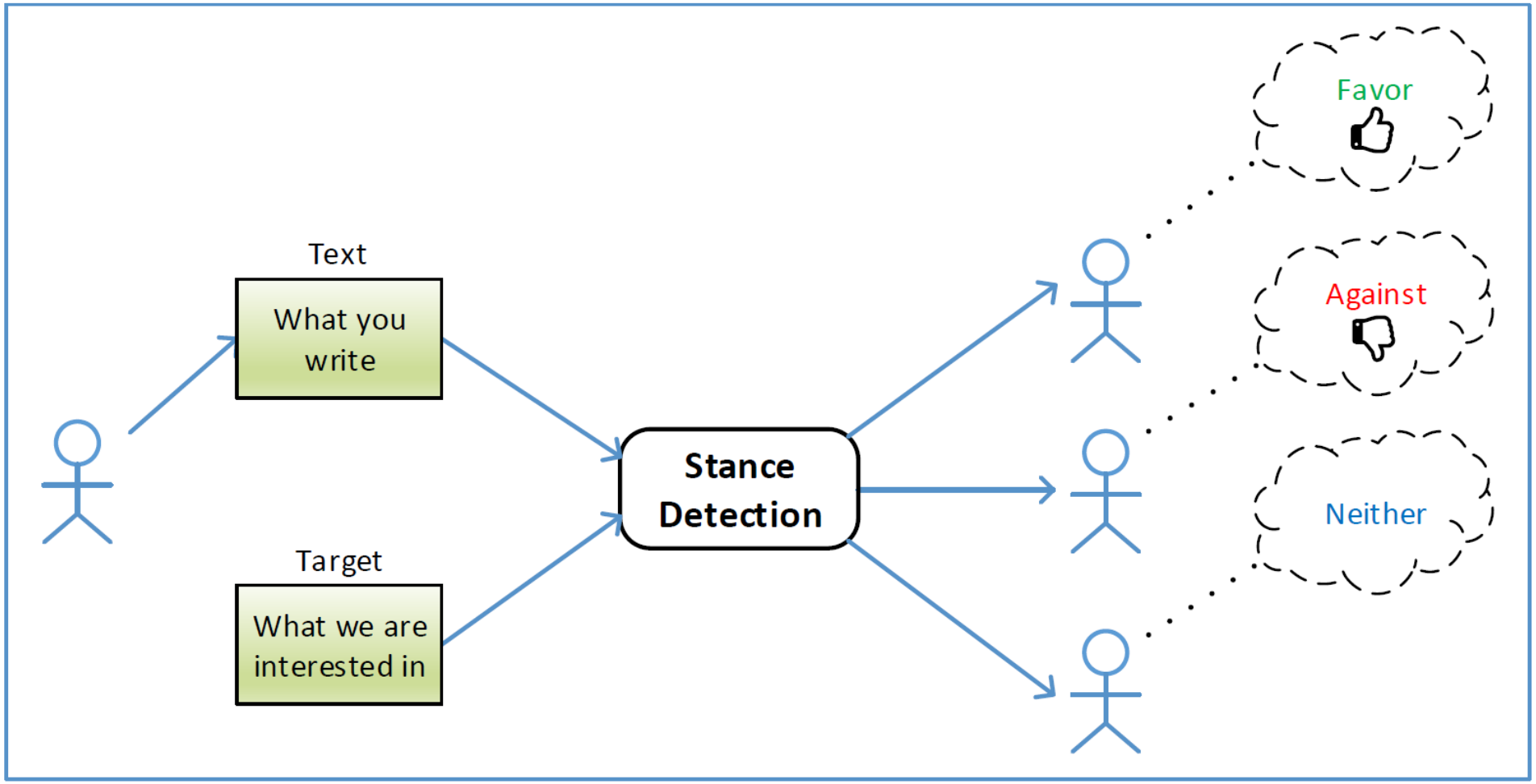
Introduction



Introduction

Definition 1.1 (Stance Detection). For an input in the form of a piece of text and a target pair, stance detection is a classification problem where the stance of the author of the text is sought in the form of a category label from this set: {*Favor*, *Against*, *Neither*}. Occasionally, the category label of *Neutral* is also added to the set of stance categories [Mohammad et al. 2016b] and the target may or may not be explicitly mentioned in the text [Augenstein et al. 2016a; Mohammad et al. 2016b].

Definition 1.2 (Multi-target Stance Detection). For an input in the form of a piece of text and a set of related targets, multi-target stance detection is a classification problem where the stance of the text author is sought as a category label from this set: {*Favor*, *Against*, *Neither*} for each target and each stance classification (for each target) might have an effect on the classifications for the remaining targets [Sobhani 2017].

Definition 1.3 (Cross-target Stance Detection). Cross-target stance detection is a classification problem where the stance of the text author is sought for a specific target as a category label from this set: {*Favor*, *Against*, *Neither*}, in a settings where stance annotations are available for (though related but) different targets, i.e., there is not enough stance-annotated training data for the target under consideration [Augenstein et al. 2016a; Xu et al. 2018].

Introduction

Definition 1.4 (Rumour Stance Classification). For an input in the form of a piece of text and a rumour pair, rumour stance classification is a problem where the position of the text author towards the veracity of the rumour is sought for, in the form of a category label from this set: {*Supporting*, *Denying*, *Querying*, *Commenting*}. As the set of possible category labels, a subset of this set such as {*Supporting*, *Denying*} is occasionally employed [Zubiaga et al. 2018].

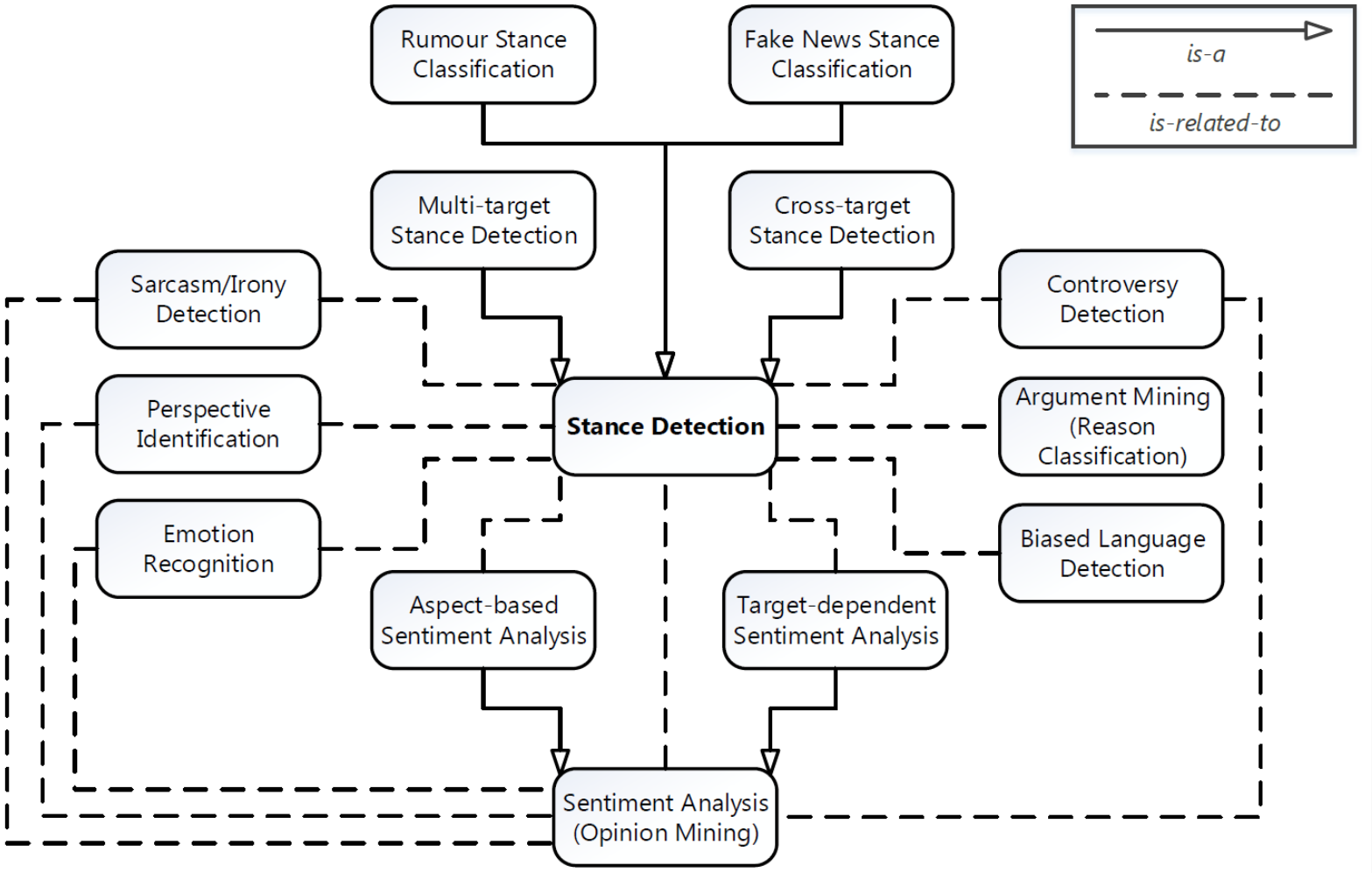
Definition 1.5 (Fake News Stance Detection). For an input in the form of news headline and a news body pair (where the headline and body parts may belong to different news articles), this is a classification problem where the stance of the body towards the claim of the headline is sought for, in the form of a category label from this set: {*Agrees*, *Disagrees*, *Discusses* (the same topic), *Unrelated*}. This problem is defined in order to facilitate the task of fake news detection [FNC 2017].

Introduction

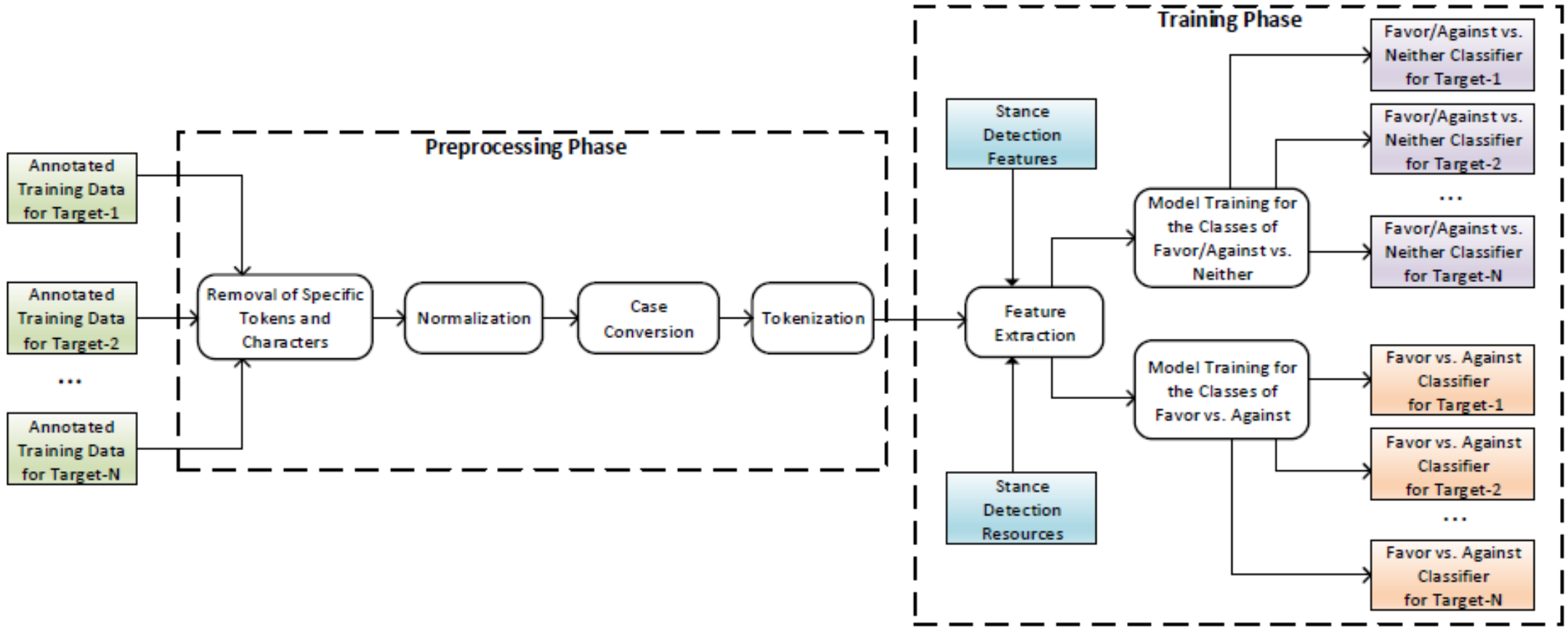
Table 1. Sample Tweets from SemEval 2016 Stance Dataset [Mohammad et al. 2016b].

Tweet	Stance Target	Stance	Sentiment
RT @TheCLF: Thanks to everyone in Maine who contacted their legislators in support of #energyefficiency funding! #MEpoli #SemST	Climate Change is a Real Concern	Favor	Positive
We live in a sad world when wanting equality makes you a troll... #SemST	Feminist Movement	Favor	Negative
I don't believe in the hereafter. I believe in the here and now. #SemST	Atheism	Favor	Neither
@violencehurts @WomenCanSee The unborn also have rights #defendthe8th #SemST	Legalization of Abortion	Against	Positive
I'm conservative but I must admit I'd rather see @SenSanders as president than Mrs. Clinton. #stillvotingGOP #politics #SemST	Hillary Clinton	Against	Negative
I have my work and my faith... If that's boring to some people, I can't tell you how much I don't care. ~Madonna Ciccone #SemST	Atheism	Against	Neither
@BadgerGeno @kreichert27 @jackbahlman Too busy protesting :) #LoveForAll #BackdoorBadgers #SemST	Hillary Clinton	Neither	Positive
@ShowTruth You're truly unwelcome here. Please leave. #ygk #SemST	Legalization of Abortion	Neither	Negative
@Maisie_Williams everyone feels that way at times. Not just women #SemST	Atheism	Neither	Neither

Stance Detection and Related Problems

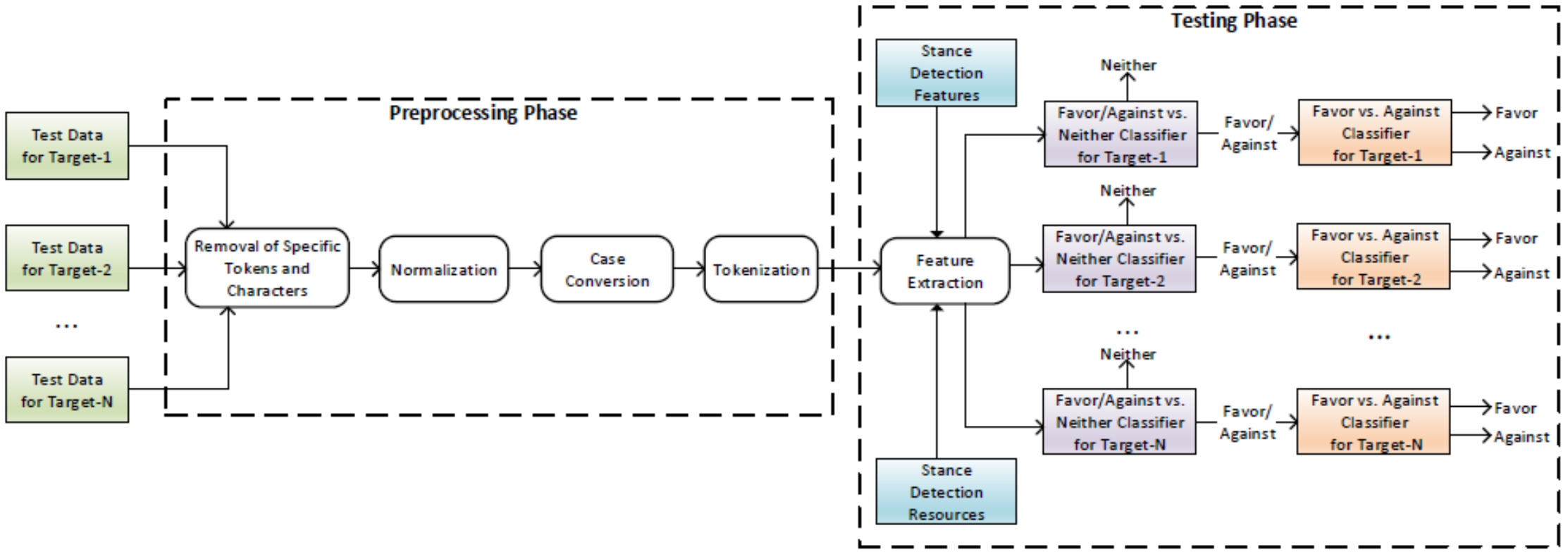


A Generic System Architecture



(a) Training phase.

A Generic System Architecture



(b) Testing phase.

A Historical Perspective

Earlier Work on Stance Detection [2006 - 2015]

- Earlier work are carried out on
  - Congressional-floor debates
  - Company internal discussions
  - Online social, political, and ideological debates (in public forums)
  - Online debates about products
  - Spontaneous speech (a single study by Levow et al. (2014))
  - Student essays
  - Tweets (few studies)
- Approaches in earlier work
  - Few rule-based methods
  - Supervised learning methods (SVM, decision tree, random forest, HMM, CRF, ILP, …)

A Historical Perspective

Stance Detection Competitions [2016 - 2017]

- **SemEval-2016 shared task on stance detection in English tweets**

  (Mohammad et al., 2016)

  - **Targets:** Atheism, Climate change is a real concern, Feminist movement, Hillary Clinton, Legalization of abortion, Donald Trump

- **NLPCC-ICCPOL-2016 shared task on stance detection in Chinese microblogs**

  (Xu et al., 2016)

  - **Targets:** iPhone SE, Set off firecrackers in the Spring Festival, Russia's anti terrorist operations in Syria, Two child policy, Prohibition of motorcycles and restrictions on electric vehicles in Shenzhen, Genetically modified food, Nuclear test in DPRK

- **IberEval-2017 shared task on stance detection in Spanish and Catalan tweets**

  (Taulé et al., 2017)

  - **Target:** Independence of Catalonia

Approaches to Stance Detection

Table 5. Temporal Distribution of Published Papers on Stance Detection

Publication Year	Number of Papers
2006 – 2010	5
2011 – 2014	8
2015 – 2016	38
2017 – 2019	78

Approaches to Stance Detection

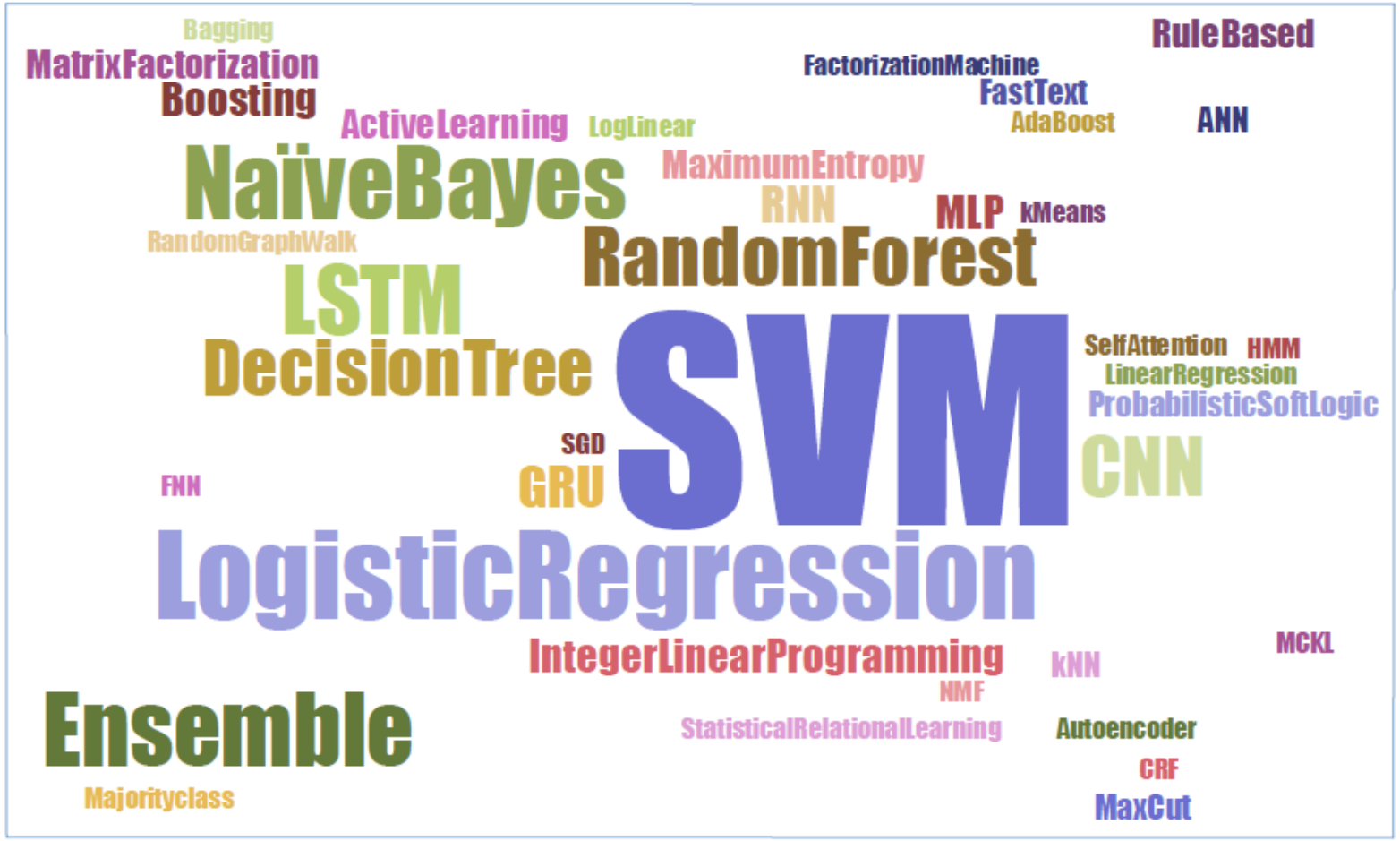


Fig. 4. A word cloud of the algorithms used for stance detection problem in the published papers included in this survey paper.

Approaches to Stance Detection

- **Feature-based machine learning approaches**
  - SVM, Logistic Regression, Naïve Bayes, Decision Trees, ANN, ILP, kNN, …
- **Deep learning approaches**
  - LSTM (RNN), RNN, GRU (RNN), CNN
- **Ensemble learning approaches**
  - Random Forest, Majority Voting, Proprietary ensemble learners, Boosting, Bagging, …

Datasets

Authors	Domain	Annotation Classes	Target(s)	Size
[Mohammad et al. 2016a]	Tweets (English)	Favor, Against, Neither	Atheism, Climate change is a real concern, Feminist movement, Hillary Clinton, Legalization of abortion, Donald Trump	4,870 tweets
[Mohammad et al. 2017]	Tweets (English)	Favor, Against, Neither for stance; Positive, Negative, and Neither for sentiment	Atheism, Climate change is a real concern, Feminist movement, Hillary Clinton, Legalization of abortion, Donald Trump	4,870 tweets
[Xu et al. 2016b]	Microblogs (Chinese)	Favor, Against, None	iPhone SE, Set off firecrackers in the Spring Festival, Russia's anti terrorist operations in Syria, Two child policy, Prohibition of motorcycles and restrictions on electric vehicles in Shenzhen, Genetically modified food, Nuclear test in DPRK	4,000 annotated and 2,400 unannotated tweets
[Taulé et al. 2017]	Tweets (Catalan & Spanish)	Favor, Against, None	Independence of Catalonia	5,400 tweets in Spanish and 5,400 tweets in Catalan

Datasets

Authors	Domain	Annotation Classes	Target(s)	Size
[Sobhani et al. 2017]	Tweets (English)	Favor, Against, Neither	{Clinton-Sanders}, {Clinton-Trump}, {Cruz-Trump}	4,455 tweets
[Küçük 2017b]	Tweets (Turkish)	Favor, Against	Galatasaray, Fenerbahçe	700 tweets
[Küçük and Can 2018]	Tweets (Turkish)	Favor, Against	Galatasaray, Fenerbahçe	1,065 tweets
[Murakami and Raymond 2010]	Online debates (Japanese)	Support, Oppose	Selected five ideas	481 comments about five ideas
[Darwish et al. 2017]	Tweets (Arabic)	Favor (Positive), Against (Negative)	Transfer of two islands from Egypt to Saudi Arabia	33,024 tweets
[Lai et al. 2018]	Tweets (Italian)	Favor, Against, None	2016 referendum on reform of the Italian Constitution	993 triplets (2,889 tweets)
[Hercig et al. 2017]	News comments (Czech)	In Favor, Against, Neither	Miloš Zeman, Smoking ban in restaurants	5,423 news comments

Evaluation Metrics

$$F = \frac{F_{Favor} + F_{Against}}{2} \qquad F_{Favor} = \frac{2 * P_{Favor} * R_{Favor}}{P_{Favor} + R_{Favor}} \qquad F_{Against} = \frac{2 * P_{Against} * R_{Against}}{P_{Against} + R_{Against}}$$

$$P_{Favor} = \frac{Correct_{Favor}}{Correct_{Favor} + Spurious_{Favor}} \qquad P_{Against} = \frac{Correct_{Against}}{Correct_{Against} + Spurious_{Against}}$$

$$R_{Favor} = \frac{Correct_{Favor}}{Correct_{Favor} + Missing_{Favor}} \qquad R_{Against} = \frac{Correct_{Against}}{Correct_{Against} + Missing_{Against}}$$

$$F = \frac{F_{Favor} + F_{Against} + F_{Neither}}{3}$$

$$Accuracy = \frac{Correct\ classifications}{All\ classifications}$$

Software and Tools

- Few papers present visualization systems/tools for stance detection.

- Many papers use the following machine learning tools, libraries in their stance detection experiments:
  - Weka
  - Scikit-learn package
  - Keras
  - Theano
  - Gensim
  - SVM^{light}
  - FastText
  - Brainy

Stance Detection Experiments on Turkish Tweets

Table 1. A Summary of the Three Versions of the Stance-Annotated Tweet Data Set

Stance Data Set	# of Annotators	# of Tweets Annotated				
		For Target-1		For Target-2		TOTAL
		Favor	Against	Favor	Against	
Version-1	1	175	175	175	175	**700**
Version-2	2	173	173	173	167	**686**
Version-3	2	269	268	269	259	**1,065**

Target-1: Galatasaray Target-2: Fenerbahçe

https://github.com/dkucuk/Stance-Detection-Turkish-V1
https://github.com/dkucuk/Stance-Detection-Turkish-V2
https://github.com/dkucuk/Stance-Detection-Turkish-V3

Stance Detection Experiments on Turkish Tweets

Table 6. Evaluation Results of the SVM Classifiers Utilizing Unigrams+Hashtag Use+Named Entities as Features, with Named Entities Extracted by the NER Tool.

Target	Class	Stance Data Set								
		Version-1			Version-2			Version-3		
		P (%)	R (%)	F (%)	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)
Target-1	Favor	75.6	90.3	82.3	74.5	87.9	80.6	77.5	93.3	84.7
	Against	87.9	70.9	78.5	85.2	69.9	76.8	91.5	72.8	81.1
	Average	**81.8**	**80.6**	**80.4**	**79.9**	**78.9**	**78.7**	**84.5**	**83.1**	**82.9**
Target-2	Favor	71.8	84.6	77.7	73.9	93.1	82.4	78.6	90.0	83.9
	Against	81.3	66.9	73.4	90.2	65.9	76.1	87.7	74.5	80.6
	Average	**76.5**	**75.7**	**75.5**	**81.9**	**79.7**	**79.3**	**83.1**	**82.4**	**82.3**

Küçük, D., & Can, F. (2018). *Stance Detection on Tweets: An SVM-based Approach*. arXiv preprint arXiv:1803.08910.

Application Areas

- Opinion surveys/polling
- Trend and market analysis/forecast
- Recommendation systems
- Public health surveillance
- Information retrieval
- Stance summarization
- **Rumour classification**
- **Fake news detection**
- Automatic fact checking

Outstanding Issues

- Cross-lingual and multilingual stance detection
- Stance detection in other media content and robots
- Stance detection for decision making
- Stance detection in data streams

Conclusions

- Stance detection is usually defined as the automatic determination of the position of a post owner (as in favor of or against) towards a specific target, based on the content of the post.

- In general, stance detection is performed on the following text genres:
  - microblogs (tweets, mostly),
  - posts published in online debate forums,
  - news articles and comments.

- Along with a number of related problems such as sentiment analysis, controversy detection, and argument mining, **it is a crucial process to elicit useful information from the underlying content**, most of the time, regarding **controversial issues or elections/ referendums**.

Thank You