CoNLL-2013

Frame Semantics for Stance Classification

Kazi Saidul Hasan and Vincent Ng
Human Language Technology Research Institute
The University of Texas at Dallas

Stance Classification

Determine the stance (i.e., *for* or *against*) of a post written for a *two-sided* topic discussed in an online debate forum

A Sample Debate

Should abortion be allowed?	
Yes (*for*)	**No (*against*)**
Women should have the ability to choose what they do with their bodies.	Technically abortion is murder. They are killing the baby without a justified motive.

Our Debate Setting: Ideological Debates

- Various social, political, and ideological issues
  - Abortion, gay rights, gun rights, god’s existence

Goal

To improve the state of the art in supervised stance classification of ideological debates

– by proposing a linguistic and an extra-linguistic extension to state-of-the-art baseline systems

Plan for the Talk

- Two baseline stance classification systems
- Linguistic extension to the baselines
- Extra-linguistic extension to the baselines
- Evaluation

Plan for the Talk

- Two baseline stance classification systems
- Linguistic extension to the baselines
- Extra-linguistic extension to the baselines
- Evaluation

Baseline 1: Anand et al., 2011 (C_b)

- Supervised approach, one stance classifier per domain
  - SVM in our implementation
  - One training/test instance for each post
  - Two labels – *for* and *against*

Feature Type	Features
Basic	Unigrams, bigrams, syntactic and POS generalized dependencies
Sentiment	LIWC counts, opinion dependencies
Argument	Cue words, repeated punctuation, context

Baseline 2: Anand et al.'s system enhanced with Author Constraints (C_b+AC)

- Author constraints (ACs)
  – a type of constraints for postprocessing the output of a stance classifier
  – ensure that all test posts written for the same domain by an author have the same stance

- How to postprocess Anand et al.'s output with ACs?
  – For each author, sum up classification values of her test posts
    - Classification value is the signed distance from the hyperplane
  – If sum > 0, assign *for* to all her test posts; else *against*

Plan for the Talk

- Two baseline stance classification systems
- Linguistic extension to the baselines
- Extra-linguistic extension to the baselines
- Evaluation

Linguistic Extension: Semantic Generalization

- **Aim**: improve a learner's ability to generalize by inducing patterns based on semantic frames and use them as features so that semantically similar sentences can be detected.

- FrameNet (https://framenet.icsi.berkeley.edu/)

Example 1: Some people hate guns.

Example 2: Some people do not like guns.

–Anand et al.'s features cannot detect these semantically similar sentences

Pattern Induction

- Three types of patterns from each sentence:
  1. Subject-Frame-Object (SFO)
  2. Dependency-Frame (DF)
  3. Frame-Element-Topic (FET)

Subject-Frame-Object (SFO)

Capture how a verb (i.e., a frame target) is connected with the topics/frames used as its subject/object.

<Subj_Topic_Fr : Frame : Obj_Topic_Fr : V_Neg : V_Sent>

Example 1: Some people hate guns.

SFO pattern: <people : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Subject-Frame-Object (SFO)

Capture how a verb (i.e., a frame target) is connected with the topics/frames used as its subject/object.

<Subj_Topic_Fr : Frame : Obj_Topic_Fr : V_Neg : V_Sent>

Example 1: Some people hate guns.

SFO pattern: <people : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Subject-Frame-Object (SFO)

Capture how a verb (i.e., a frame target) is connected with the topics/frames used as its subject/object.

<Subj_Topic_Fr : Frame : Obj_Topic_Fr : V_Neg : V_Sent>

↑

Topic/Frame
as subject

Example 1: Some people hate guns.

SFO pattern: <people : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Subject-Frame-Object (SFO)

Capture how a verb (i.e., a frame target) is connected with the topics/frames used as its subject/object.

<Subj_Topic_Fr : Frame : Obj_Topic_Fr : V_Neg : V_Sent>

Topic/Frame as subject

Frame

Example 1: Some people hate guns.

SFO pattern: <people : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Subject-Frame-Object (SFO)

Capture how a verb (i.e., a frame target) is connected with the topics/frames used as its subject/object.

<Subj_Topic_Fr : Frame : Obj_Topic_Fr : V_Neg : V_Sent>

Topic/Frame as subject

Frame

Topic/Frame as object

Example 1: Some people hate guns.

SFO pattern: <people : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Subject-Frame-Object (SFO)

Capture how a verb (i.e., a frame target) is connected with the topics/frames used as its subject/object.

<Subj_Topic_Fr : Frame : Obj_Topic_Fr : V_Neg : V_Sent>

Subj_Topic_Fr	Frame	Obj_Topic_Fr	V_Neg
Topic/Frame as subject	Frame	Topic/Frame as object	Verb negated?

Example 1: Some people hate guns.

SFO pattern: <people : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Subject-Frame-Object (SFO)

Capture how a verb (i.e., a frame target) is connected with the topics/frames used as its subject/object.

<Subj_Topic_Fr : Frame : Obj_Topic_Fr : V_Neg : V_Sent>

Subj_Topic_Fr	Frame	Obj_Topic_Fr	V_Neg	V_Sent
↑	↑	↑	↑	↑
Topic/Frame as subject	Frame	Topic/Frame as object	Verb negated?	Verb sentiment

Example 1: Some people hate guns.

SFO pattern: <people : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Subject-Frame-Object (SFO)

Capture how a verb (i.e., a frame target) is connected with the topics/frames used as its subject/object.

<Subj_Topic_Fr : Frame : Obj_Topic_Fr : V_Neg : V_Sent>

Subj_Topic_Fr	Frame	Obj_Topic_Fr	V_Neg	V_Sent
Topic/Frame as subject	Frame	Topic/Frame as object	Verb negated?	Verb sentiment

Example 1: Some people hate guns.

SFO pattern: <people : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Subject-Frame-Object (SFO)

Capture how a verb (i.e., a frame target) is connected with the topics/frames used as its subject/object.

<Subj_Topic_Fr : Frame : Obj_Topic_Fr : V_Neg : V_Sent>

Subj_Topic_Fr	Frame	Obj_Topic_Fr	V_Neg	V_Sent
↑	↑	↑	↑	↑
Topic/Frame as subject	Frame	Topic/Frame as object	Verb negated?	Verb sentiment

Example 1: Some people hate guns.

SFO pattern: <people : $\boxed{\text{EF}}$: Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Subject-Frame-Object (SFO)

Capture how a verb (i.e., a frame target) is connected with the topics/frames used as its subject/object.

<Subj_Topic_Fr : Frame : Obj_Topic_Fr : V_Neg : V_Sent>

Subj_Topic_Fr	Frame	Obj_Topic_Fr	V_Neg	V_Sent
Topic/Frame as subject	Frame	Topic/Frame as object	Verb negated?	Verb sentiment

Example 1: Some people hate guns.

SFO pattern: <people : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Subject-Frame-Object (SFO)

Capture how a verb (i.e., a frame target) is connected with the topics/frames used as its subject/object.

<Subj_Topic_Fr : Frame : Obj_Topic_Fr : V_Neg : V_Sent>

Subj_Topic_Fr	Frame	Obj_Topic_Fr	V_Neg	V_Sent
Topic/Frame as subject	Frame	Topic/Frame as object	Verb negated?	Verb sentiment

Example 1: Some people hate guns.

SFO pattern: <people : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Subject-Frame-Object (SFO)

Capture how a verb (i.e., a frame target) is connected with the topics/frames used as its subject/object.

<Subj_Topic_Fr : Frame : Obj_Topic_Fr : V_Neg : V_Sent>

Subj_Topic_Fr	Frame	Obj_Topic_Fr	V_Neg	V_Sent
Topic/Frame as subject	Frame	Topic/Frame as object	Verb negated?	Verb sentiment

Example 1: Some people hate guns.

SFO pattern: <people : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Dependency-Frame (DF)

Capture how a topic/frame is connected to another topic/frame via a dependency relation.

<Dep_Rel : Head_Topic_Fr : Dep_Topic_Fr : H_Neg : H_Sent>

Example 1: Some people hate guns.

DF pattern: <dobj : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Dependency-Frame (DF)

Capture how a topic/frame is connected to another topic/frame via a dependency relation.

<Dep_Rel : Head_Topic_Fr : Dep_Topic_Fr : H_Neg : H_Sent>

Example 1: Some people hate guns.

DF pattern: <dobj : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Dependency-Frame (DF)

Capture how a topic/frame is connected to another topic/frame via a dependency relation.

<Dep_Rel : Head_Topic_Fr : Dep_Topic_Fr : H_Neg : H_Sent>

Dependency relation

Example 1: Some people hate guns.

DF pattern: <dobj : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Dependency-Frame (DF)

Capture how a topic/frame is connected to another topic/frame via a dependency relation.

<Dep_Rel : Head_Topic_Fr : Dep_Topic_Fr : H_Neg : H_Sent>

Dependency relation — Topic/Frame as head

Example 1: Some people hate guns.

DF pattern: <dobj : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Dependency-Frame (DF)

Capture how a topic/frame is connected to another topic/frame via a dependency relation.

<Dep_Rel : Head_Topic_Fr : Dep_Topic_Fr : H_Neg : H_Sent>

Dependency relation — Topic/Frame as head — Topic/Frame as dependent

Example 1: Some people hate guns.

DF pattern: <dobj : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Dependency-Frame (DF)

Capture how a topic/frame is connected to another topic/frame via a dependency relation.

<Dep_Rel : Head_Topic_Fr : Dep_Topic_Fr : H_Neg : H_Sent>

Dep_Rel	Head_Topic_Fr	Dep_Topic_Fr	H_Neg
Dependency relation	Topic/Frame as head	Topic/Frame as dependent	Head negated?

Example 1: Some people hate guns.

DF pattern: <dobj : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Dependency-Frame (DF)

Capture how a topic/frame is connected to another topic/frame via a dependency relation.

<Dep_Rel : Head_Topic_Fr : Dep_Topic_Fr : H_Neg : H_Sent>

Dep_Rel	Head_Topic_Fr	Dep_Topic_Fr	H_Neg	H_Sent
Dependency relation	Topic/Frame as head	Topic/Frame as dependent	Head negated?	Head sentiment

Example 1: Some people hate guns.

DF pattern: <dobj : EF : Weapon : Not_Neg : [-]>

Example 2: Some people do not like guns.

Frame-Element-Topic (FET)

Capture how a topic/frame is contained in an element of another frame.

<Topic_Frame : Frame_Element : Frame : V_Neg : V_Sent>

Topic/Frame	Frame element	Frame	Verb negated?	Verb sentiment

Example 1: Some people hate guns.

FET pattern: <Weapon : Content : EF : Not_Neg : [-]>

Example 2: Some people do not like guns.

Combine C_b and C_s's output heuristically

- C_b: Anand et al.'s system
- C_s: Classifier trained with patterns only

- Rule 1: if C_b can classify a test post *p* confidently, then use C_b's prediction.
- Rule 2: if C_s can classify *p* confidently, use C_s's prediction.
- Rule 3: use C_b's prediction.

Note:

The rules favor C_b than C_s because Accuracy(C_b) > Accuracy(C_s)

Plan for the Talk

- Two baseline stance classification systems
- Linguistic extension to the baselines
- Extra-linguistic extension to the baselines
- Evaluation

Extra-linguistic Extension: Exploiting Same-stance Posts

Aim: to improve the classification of a post by exploiting information from other posts in the test set that are likely to have the same stance

[P_1 – **Pro-abortion**] I don't think abortion should be illegal.

[P_2 – **Pro-abortion**] What will you do if a woman's life is in danger while she's pregnant?

P_1 is arguably easier to classify than P_2 and may help classify P_2.

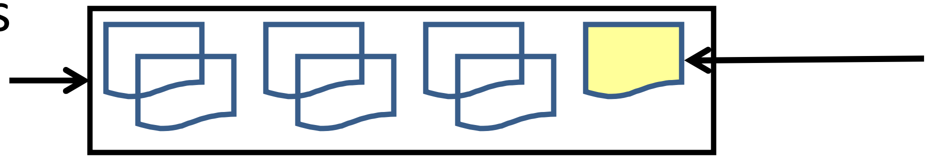
Using Similar-minded Authors

- Goal: for each author in the test set, identify the *k* authors most likely to have the same stance

- Train an author-agreement classifier
  - Each instance corresponds to a pair of authors
  - Labels - same or different stance
  - *k* to be determined using development data

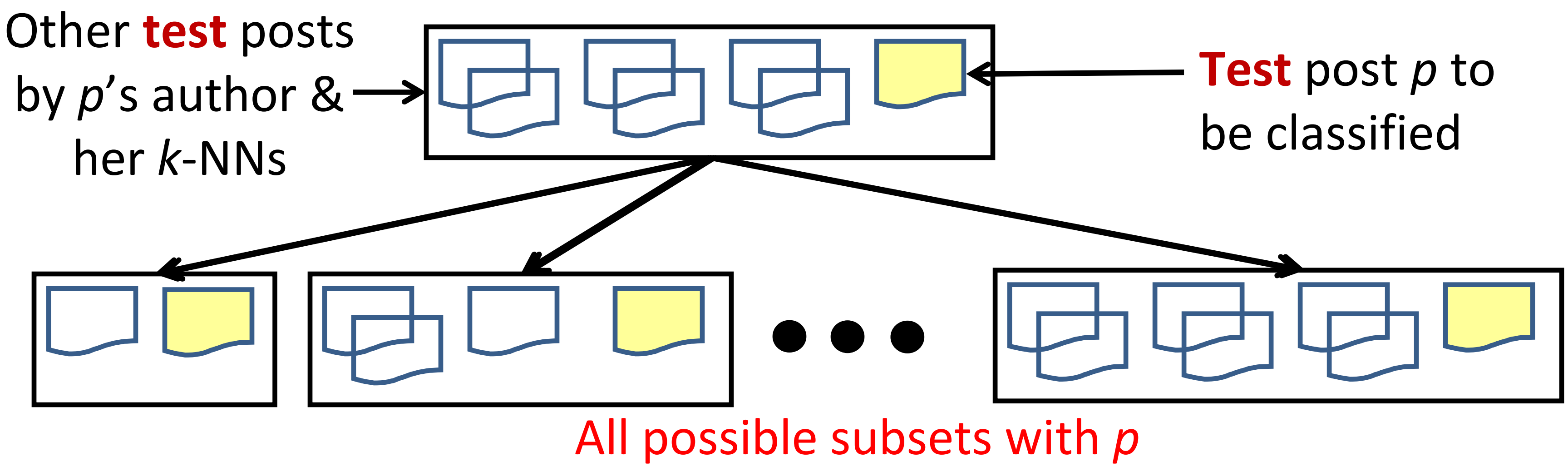
Using Similar-minded Authors

Other **test** posts by *p*'s author & her *k*-NNs

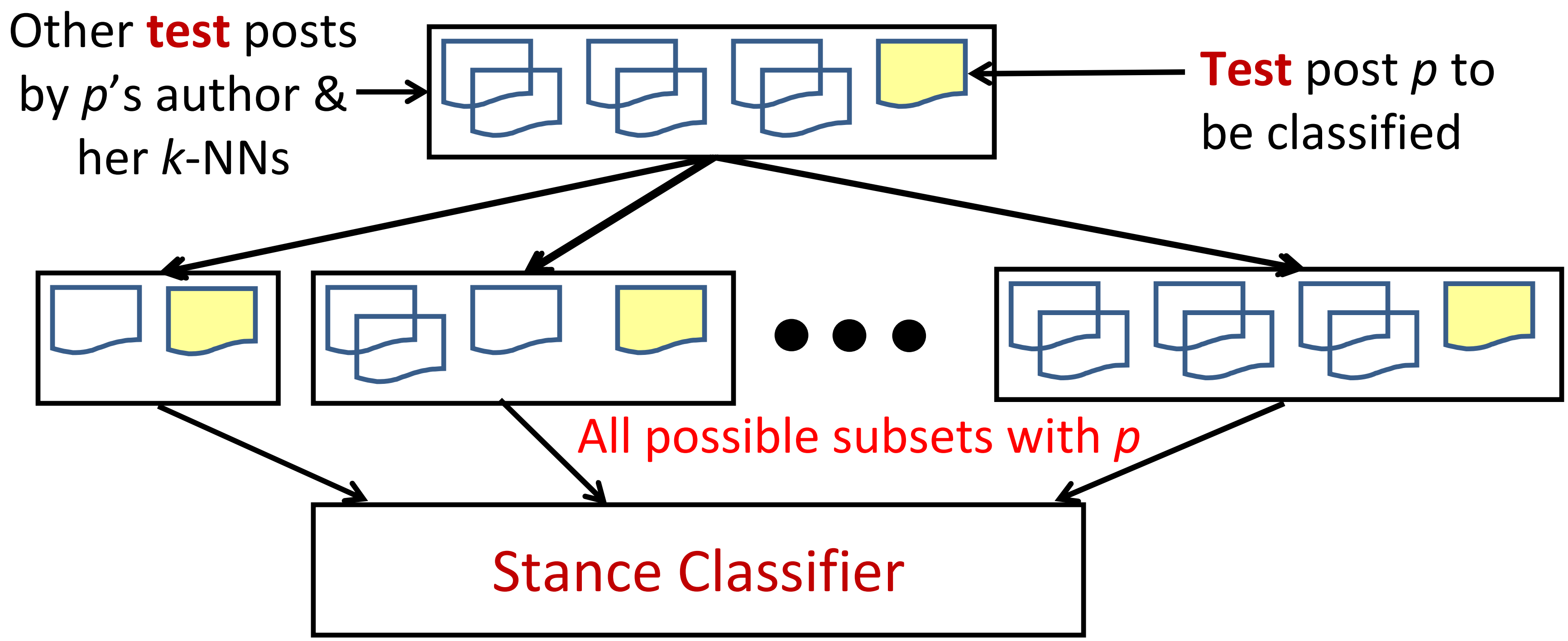


Test post *p* to be classified

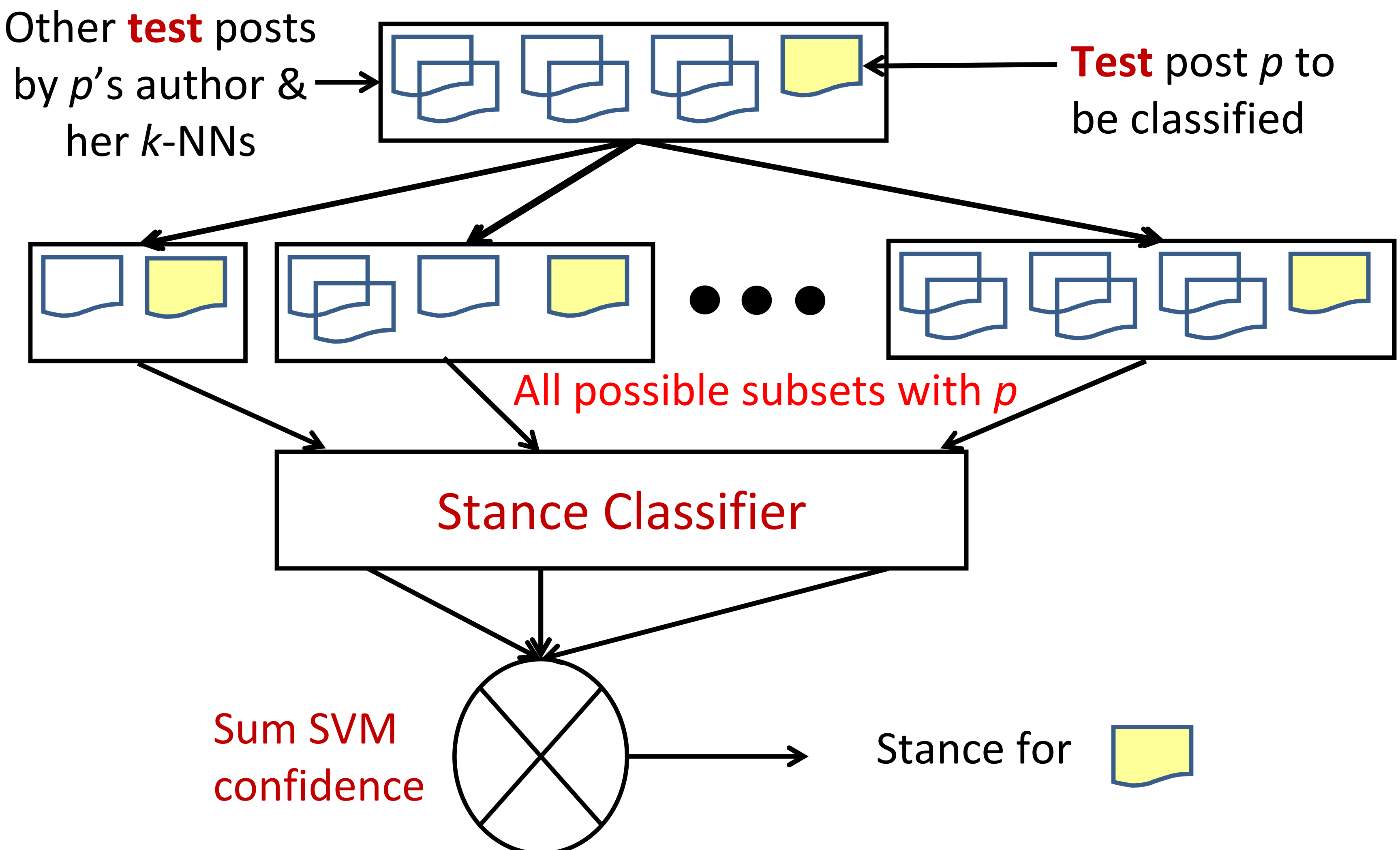
Using Similar-minded Authors



Using Similar-minded Authors



Using Similar-minded Authors



Plan for the Talk

- Two baseline stance classification systems
- Linguistic extension to the baselines
- Extra-linguistic extension to the baselines
- Evaluation

Experimental Setup

- 4 Datasets
  - Collected from http://www.createdebate.com

Domain	Posts	"for" %	Thread Length
ABO (support abortion?)	1741	54.9	4.1
GAY (support gay rights?)	1376	63.4	4.0
OBA (support Obama?)	985	53.9	2.6
MAR (legalize marijuana?)	626	69.5	2.5

Experimental Setup

- Performance metric – accuracy
- 5-fold cross validation

Summary of Results

- Anand+AC significantly outperforms Anand by 4.6 points

Summary of Results

- Anand+AC significantly outperforms Anand by 4.6 points

- Anand+Patterns+AC significantly beats Anand+AC by 2.5 points

Summary of Results

- Anand+AC significantly outperforms Anand by 4.6 points
- Anand+Patterns+AC significantly beats Anand+AC by 2.5 points
- Two extensions yield an overall improvement of 6.4 points over Anand+AC

Conclusions

- Proposed a linguistic and an extra-linguistic extension to our two baselines
  1. Semantic generalization
  2. Exploiting same-stance posts

- Outperformed an improved version of Anand et al.'s approach significantly by 2.6–7.0 accuracy points