Human Language Technology Research Institute

Why are You Taking This Stance? Identifying and Classifying Reasons in Ideological Debates

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- **Post-level reason classification**
  - Given a set of reasons associated with each stance in an online debate, identify those reason(s) that an author used to back up her stance in her debate post

- **Sentence-level reason classification**
  - Identify not only the reason(s) an author used in her post, but also the sentence(s) in the post that she used to describe each of her reasons

Reason Classification: An Example

I feel that abortion should remain legal, or rather, parents should have the power to make the decision themselves. Let us take a look from the social perspective. If parents cannot afford to provide for the child, it is understandable that abortion can remain as one of the options.

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- Examine post- and sentence-level reason classification (RC) in ideological debates
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  - Examine how automatically computed stance information can be profitably exploited for RC
    - **Hypothesis**: the effectiveness of such information would depend in part on the way it is exploited in RC systems
    - Examine a set of stance-supported RC models that differ in terms of modeling sophistication

Plan for the Talk

- Corpus and annotation
- Baseline RC system
- Stance-supported RC systems
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Datasets

- 4 datasets
  - collected from http://www.createdebate.com
  - contain debate posts collected from four debate topics

Topic	Posts	"for" %	Average Sequence Length
Support **Abortion**?	1741	54.9	4.1
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- Posts are not annotated with reasons

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  5. picked and retained only the reason that was highlighted the most for each multi-labeled sentence (< 3% of the sentences)

Reason Annotation: Statistics

Topic	Reason-labeled posts	% Non-NONE sentences	Kappa (sentence)	Kappa (post)
Support **Abortion**?	463	20.4	0.66	0.82
Support **Gay Rights**?	561	29.8	0.63	0.80
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- substantial post-level agreement; high sentence-level agreement

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- Major source of disagreement
  - Annotators, while agreeing on the reason class, differ on how long the text span for a reason should be
  - This hurts sentence-level but not post-level agreement

Plan for the Talk

- Corpus and annotation
- Baseline RC system
- Stance-supported RC systems
- Evaluation

Baseline RC System

- **Sentence-level** reason classifier
  - determines whether a reason is expressed in a sentence
  - if so, assign to the sentence its reason class
- **Training instance creation**
  - Create one for each sentence in each training post
  - Class label: its human-annotated reason label (or NONE if it does not contain a reason)
- **Learning algorithm**
  - Maximum entropy

Baseline RC System: 5 Types of Features

- **N-grams**
  - Unigrams and bigrams
- **Dependency-based features**
  - Argument pairs as features, optionally generalized using POS tags and polarity labels
- **Quotation features**
  - Is the sentence a quote? Does it follow a quote?
- **Positional features**
  - Encode which of the 4 parts of a post the sentence appears in
- **Frame-semantic features**
  - Encode the semantic representation of the sentence's concepts using FrameNet frames

Baseline RC System

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How can we produce **post-level reason labels** for a post?

Baseline RC System

- **Sentence-level** reason classifier

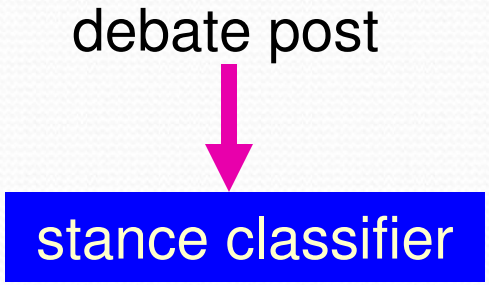
How can we produce **post-level reason labels** for a post?

Take the union of the set of reason labels assigned by the classifier to each of its sentences

Plan for the Talk

- Corpus and annotation
- Baseline RC system
- Stance-supported RC systems
  - 7 systems with varying levels of modeling sophistication
- Evaluation

Pipeline Systems: Architecture



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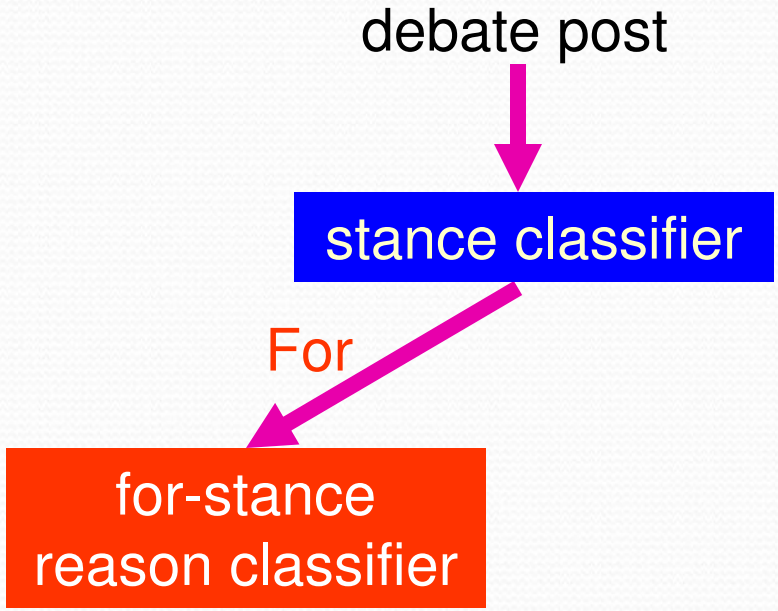

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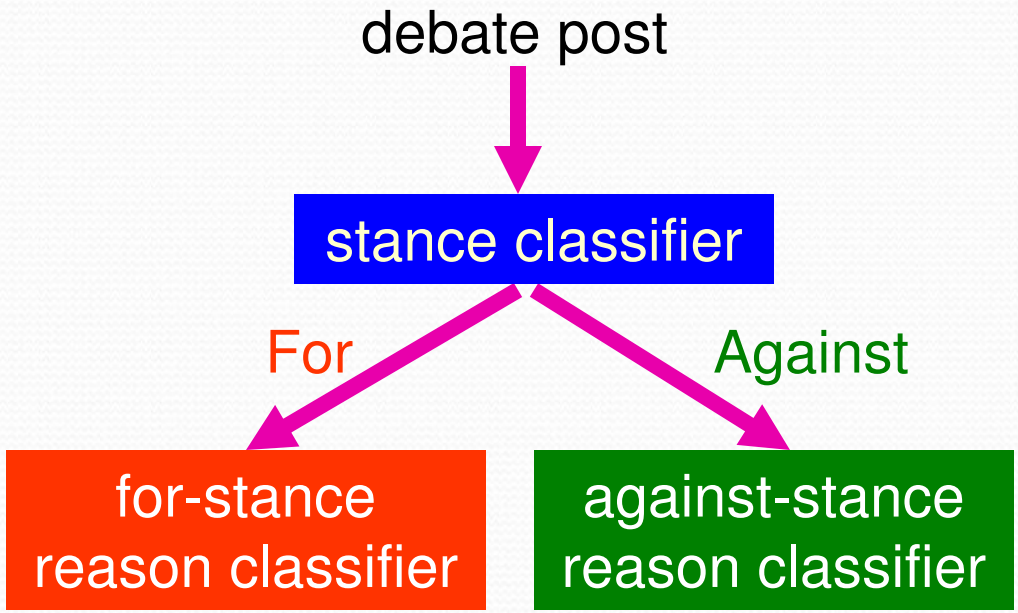

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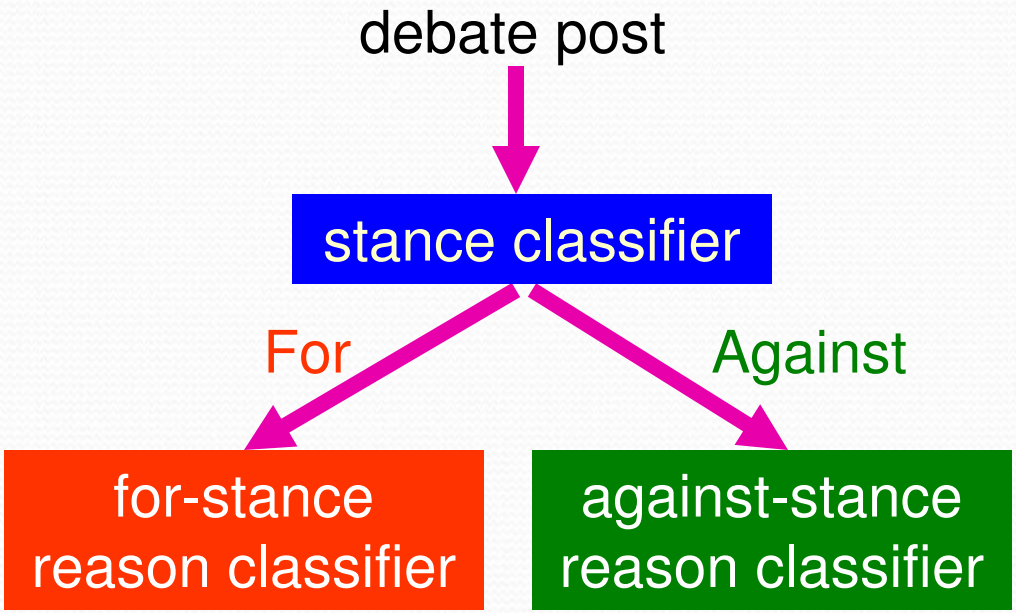

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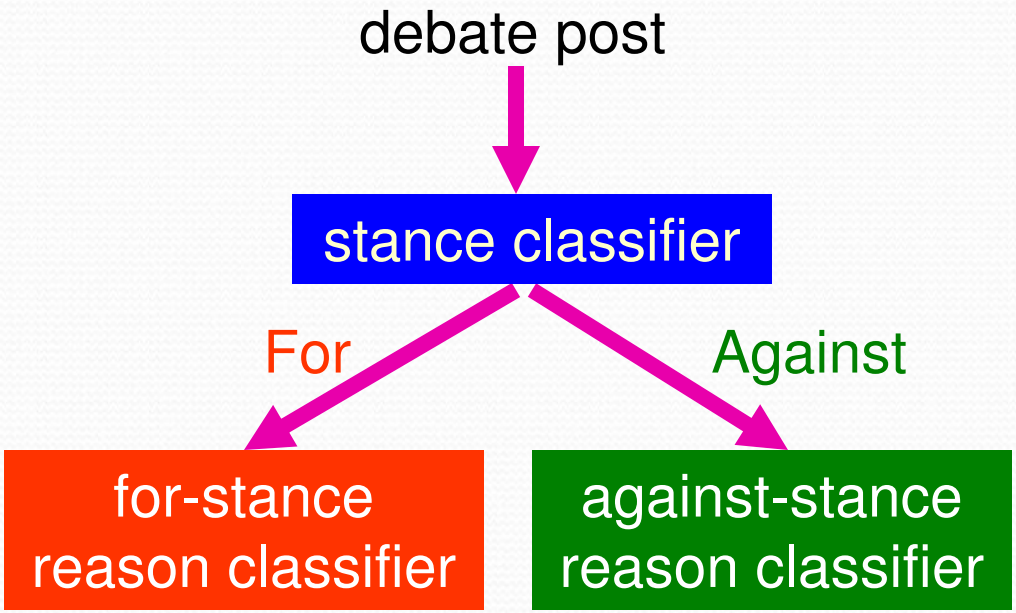

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  - Against-stance classifier: trained only on the against-posts

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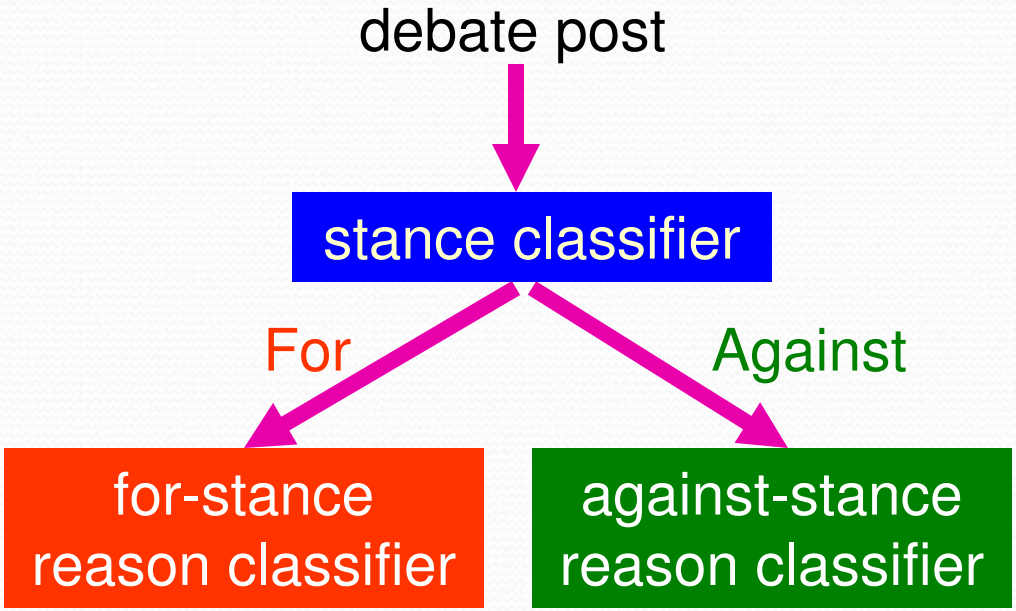

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$$P(r \mid s, t)$$

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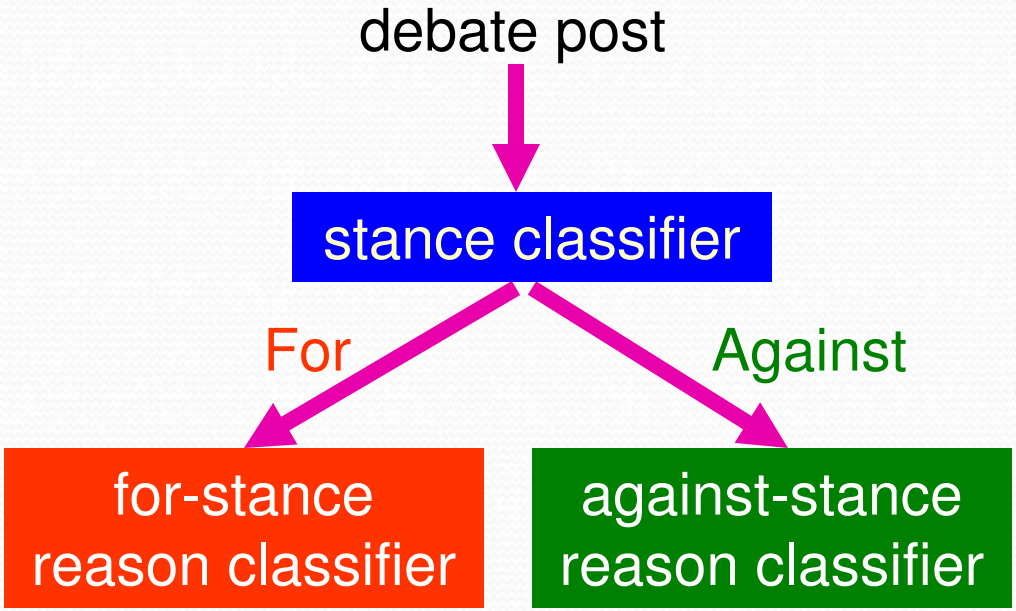

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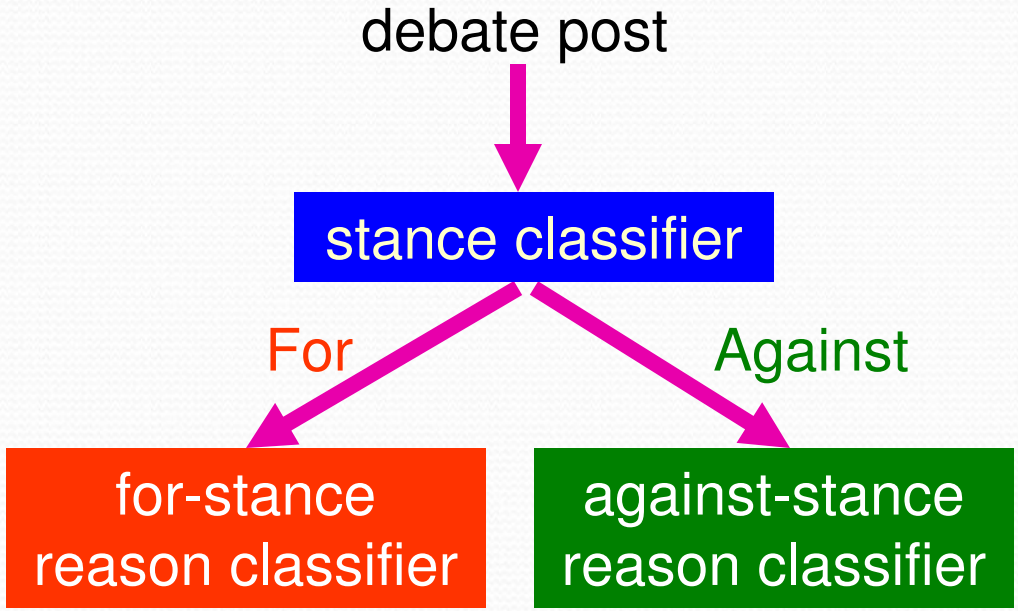

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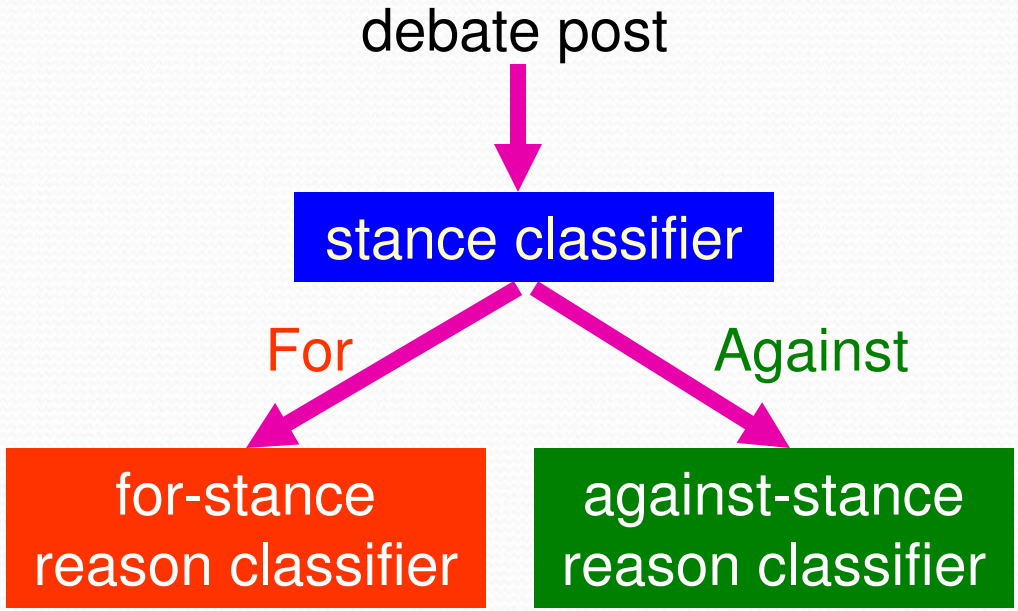

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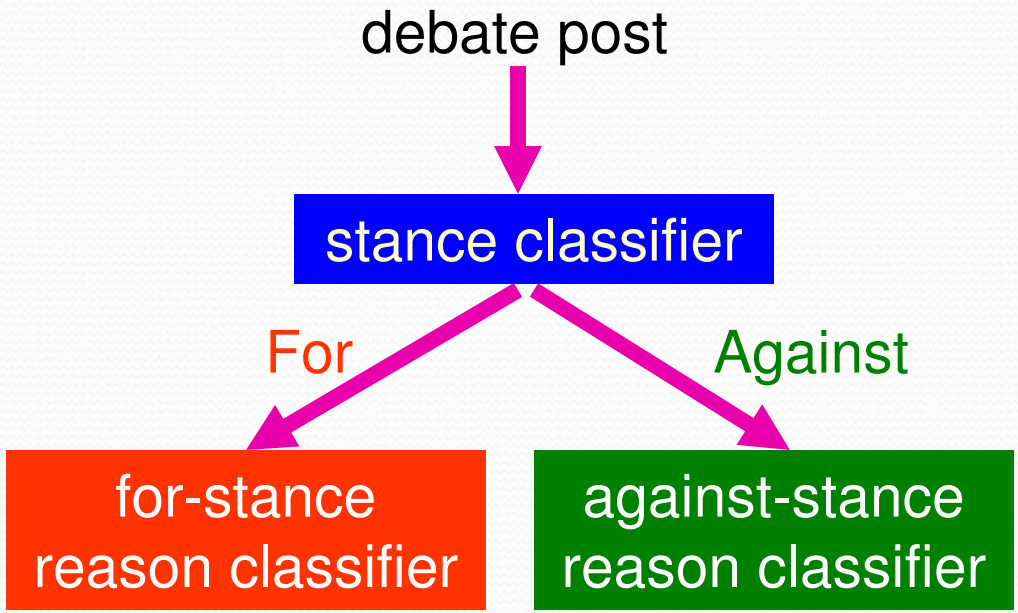

How to train the stance classifier?

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- Binary classifier that assigns a stance label (for/against) to each debate post p independently of other posts

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  - Each training instance corresponds to a debate post
  - **Features**: as those used for reason classification
  - **Learning algorithm**: maximum entropy
    - estimates $P(s \mid p)$

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- Same as Method 1, except we recast stance classification (SC) as a sequence learning problem
  - Input: a post sequence $P_S = (p_1, p_2, ..., p_n)$
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- To train sequence models, we employ MEMM

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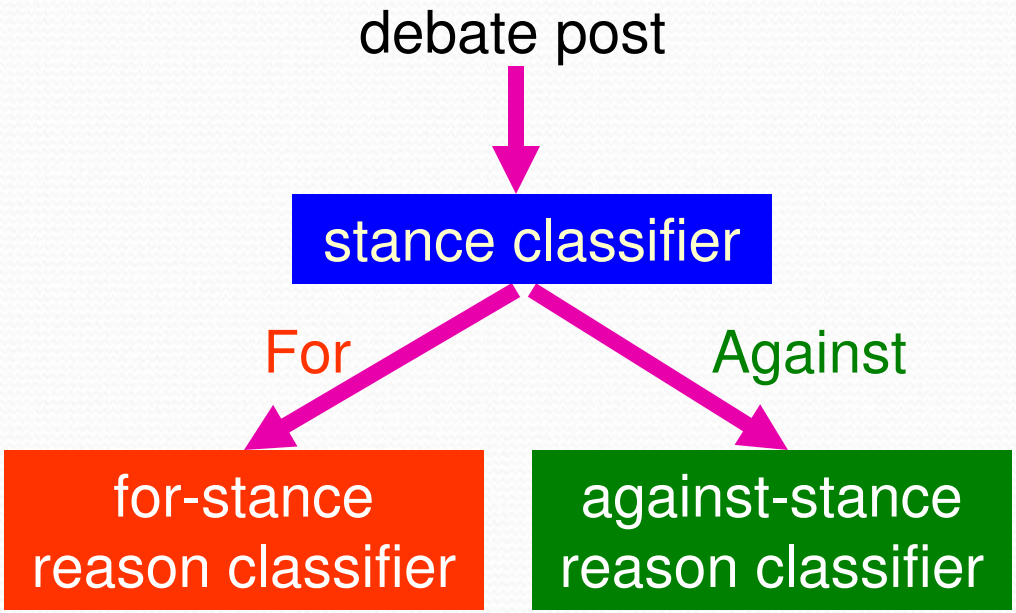

- 2 pipeline systems
  - **P1**: classifies the stance of each post independently
  - **P2**: uses sequence learning for stance classification

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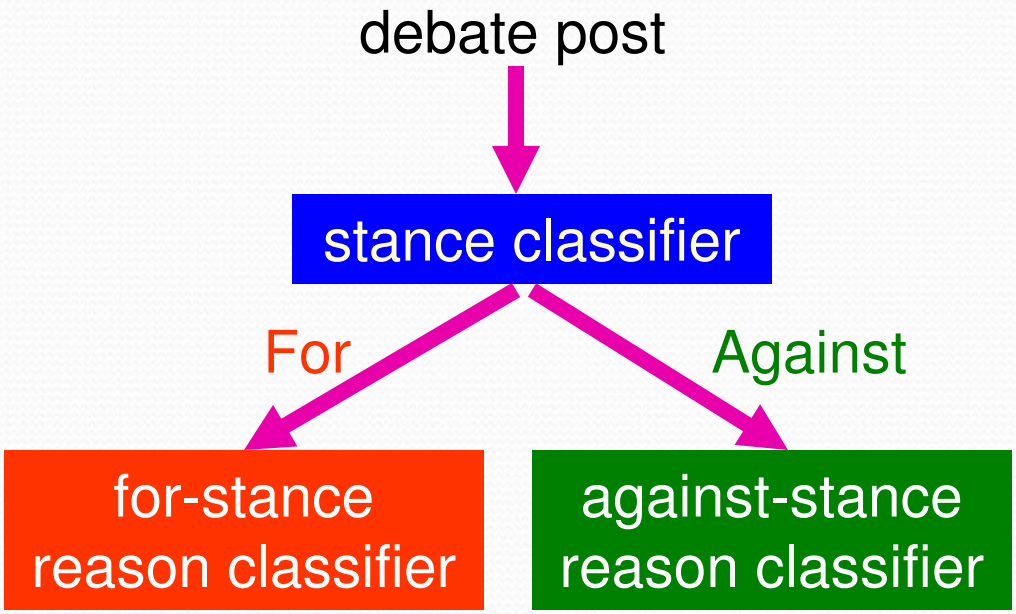
- ILP constraints
  - If a post contains a For reason, its stance label should be For
  - A post stance-labeled as For should contain a For reason
  - Similar constraints are defined for the Against label

Joint Maximization

- Another way to address the error propagation problem inherent in the pipeline systems



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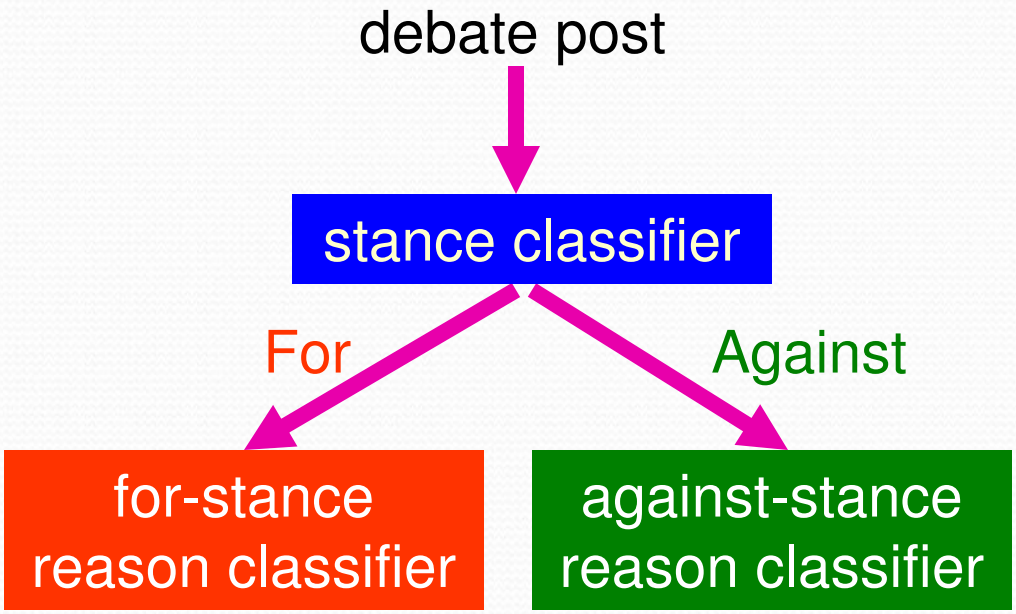

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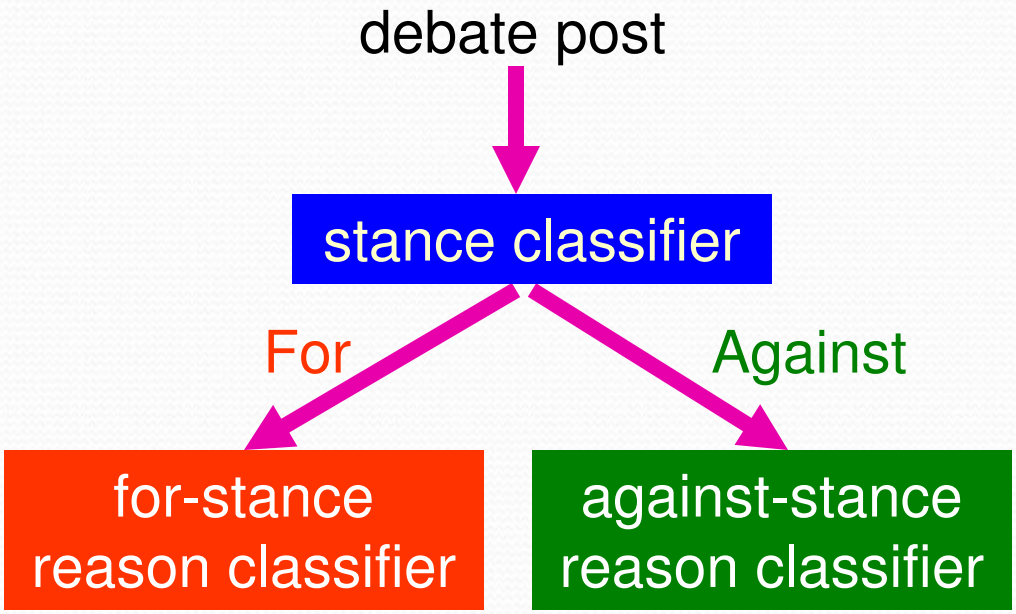

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- **Goal**: Determine the stance label using not only the stance classifier but also the stance-dependent reason classifiers
  - Let the reason classifiers influence the choice of the stance

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  - R_i is the list of reasons assigned to the sentences in post *i*
- The R and S that jointly maximize $P(R, S \mid P_s)$ can be found efficiently using dynamic programming

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- **Joint maximization model J3**
  - Build on top of J2: augment the feature set of the stance-dependent reason classifiers with a set of reason features
    - One binary feature for each reason class indicating presence/absence

Recap: 7 Stance-supported RC systems

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- 2 pipeline systems (SC followed by RC)
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  - **P2**: sequence labeling for SC

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  - **P1**: stance label of each post determined independently
  - **P2**: sequence labeling for SC
- joint inference using ILP

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- 2 pipeline systems (SC followed by RC)
  - **P1**: stance label of each post determined independently
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- joint inference using ILP
- 3 joint maximization systems
  - **J1**: joint version of P1
  - **J2**: joint version of P2
  - **J3**: J2 where the features for training the reason classifiers are augmented with the reason labels predicted for previous post

Plan for the Talk

- Corpus and annotation
- Baseline RC system
- Stance-supported RC systems
- Evaluation

Evaluation: Goal

- Evaluate the stance-supported RC systems

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Will RC performance improve as we employ more sophisticated methods for modeling stances and reasons?

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Can SC performance improve when SC is jointly modeled with RC?

Evaluation: Setup

- 5-fold cross validation for each debate topic

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- Evaluation metrics
  - SC: accuracy
  - RC: F-score micro-averaged over all reason classes except the NONE class
    - **Sentence-level RC** scores computed over sentences
    - **Post-level** RC scores computed over posts

Evaluation: Setup

- 5-fold cross validation for each debate topic
  - **No** cross-domain training/testing

- Evaluation metrics
  - SC: accuracy
  - RC: F-score micro-averaged over all reason classes except the NONE class
    - **Sentence-level RC** scores computed over sentences
    - **Post-level** RC scores computed over posts
      - Post-level reason labels are derived from the sentence-level reason labels

Evaluation: RC F-scores

System	Abortion		Gay Rights		Obama		Marijuana	
	Sent.	Post	Sent.	Post	Sent.	Post	Sent.	Post
Baseline	32.7	45.0	23.3	40.5	19.5	31.5	28.7	44.2

Evaluation: RC F-scores

System	Abortion		Gay Rights		Obama		Marijuana	
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	Sent.	Post	Sent.	Post	Sent.	Post	Sent.	Post
Baseline	32.7	45.0	23.3	40.5	19.5	31.5	28.7	44.2

Evaluation: Baseline

System	Abortion		Gay Rights		Obama		Marijuana	
	Sent.	Post	Sent.	Post	Sent.	Post	Sent.	Post
Baseline	32.7	45.0	23.3	40.5	19.5	31.5	28.7	44.2

- Sentence-level RC scores are lower than post-level RC scores

Evaluation: Pipeline Systems

System	Abortion		Gay Rights		Obama		Marijuana	
	Sent.	Post	Sent.	Post	Sent.	Post	Sent.	Post
Baseline	32.7	45.0	23.3	40.5	19.5	31.5	28.7	44.2
P1	34.5	46.3	24.5	43.2	20.3	33.5	30.5	47.3
P2	36.1	47.7	26.6	45.5	21.1	34.4	32.9	48.8

Evaluation: Pipeline Systems

System	Abortion		Gay Rights		Obama		Marijuana	
	Sent.	Post	Sent.	Post	Sent.	Post	Sent.	Post
Baseline	32.7	45.0	23.3	40.5	19.5	31.5	28.7	44.2
P1	34.5	46.3	24.5	43.2	20.3	33.5	30.5	47.3
P2	36.1	47.7	26.6	45.5	21.1	34.4	32.9	48.8

- P1 and P2 significantly outperform Baseline
  - RC can be improved even when stance information is incorporated in a simple manner

Evaluation: Pipeline Systems

System	Abortion		Gay Rights		Obama		Marijuana	
	Sent.	Post	Sent.	Post	Sent.	Post	Sent.	Post
Baseline	32.7	45.0	23.3	40.5	19.5	31.5	28.7	44.2
P1	34.5	46.3	24.5	43.2	20.3	33.5	30.5	47.3
P2	36.1	47.7	26.6	45.5	21.1	34.4	32.9	48.8

- P2 outperforms P1
  - Better SC leads to better RC

Evaluation: Joint Inference via ILP

System	Abortion		Gay Rights		Obama		Marijuana	
	Sent.	Post	Sent.	Post	Sent.	Post	Sent.	Post
Baseline	32.7	45.0	23.3	40.5	19.5	31.5	28.7	44.2
P1	34.5	46.3	24.5	43.2	20.3	33.5	30.5	47.3
P2	36.1	47.7	26.6	45.5	21.1	34.4	32.9	48.8
ILP	36.5	48.4	28.0	46.7	22.8	35.0	33.1	48.9

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P2	36.1	47.7	26.6	45.5	21.1	34.4	32.9	48.8
ILP	36.5	48.4	28.0	46.7	22.8	35.0	33.1	48.9

- ILP beats P2 on ABO and GAY and achieves the same level of performance as P2 on OBA and MAR
  - Joint inference is no worse (and sometimes better) than pipeline learning when exploiting stance information for RC

Evaluation: Joint Maximization Systems

System	Abortion		Gay Rights		Obama		Marijuana	
	Sent.	Post	Sent.	Post	Sent.	Post	Sent.	Post
Baseline	32.7	45.0	23.3	40.5	19.5	31.5	28.7	44.2
P1	34.5	46.3	24.5	43.2	20.3	33.5	30.5	47.3
P2	36.1	47.7	26.6	45.5	21.1	34.4	32.9	48.8
ILP	36.5	48.4	28.0	46.7	22.8	35.0	33.1	48.9
J1	36.0	47.6	26.7	45.6	23.1	35.7	33.3	49.2
J2	37.9	50.6	29.6	48.5	24.5	37.1	34.5	50.5

Evaluation: Joint Maximization Systems

System	Abortion		Gay Rights		Obama		Marijuana	
	Sent.	Post	Sent.	Post	Sent.	Post	Sent.	Post
Baseline	32.7	45.0	23.3	40.5	19.5	31.5	28.7	44.2
P1	34.5	46.3	24.5	43.2	20.3	33.5	30.5	47.3
P2	36.1	47.7	26.6	45.5	21.1	34.4	32.9	48.8
ILP	36.5	48.4	28.0	46.7	22.8	35.0	33.1	48.9
J1	36.0	47.6	26.7	45.6	23.1	35.7	33.3	49.2
J2	37.9	50.6	29.6	48.5	24.5	37.1	34.5	50.5

- J2 outperforms J1
  - Better SC leads to better RC

Evaluation: Joint Maximization Systems

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ILP	36.5	48.4	28.0	46.7	22.8	35.0	33.1	48.9
J1	36.0	47.6	26.7	45.6	23.1	35.7	33.3	49.2
J2	37.9	50.6	29.6	48.5	24.5	37.1	34.5	50.5

- J1 and J2 outperform their pipeline counterparts, P1 and P2
  - Joint learning is a better way to incorporate stance information for RC than pipeline learning

Evaluation: Joint Maximization Systems

System	Abortion		Gay Rights		Obama		Marijuana	
	Sent.	Post	Sent.	Post	Sent.	Post	Sent.	Post
Baseline	32.7	45.0	23.3	40.5	19.5	31.5	28.7	44.2
P1	34.5	46.3	24.5	43.2	20.3	33.5	30.5	47.3
P2	36.1	47.7	26.6	45.5	21.1	34.4	32.9	48.8
ILP	36.5	48.4	28.0	46.7	22.8	35.0	33.1	48.9
J1	36.0	47.6	26.7	45.6	23.1	35.7	33.3	49.2
J2	37.9	50.6	29.6	48.5	24.5	37.1	34.5	50.5
J3	**39.5**	**52.3**	**31.4**	**49.8**	**25.1**	**38.0**	**35.1**	**51.1**

Evaluation: Joint Maximization Systems

System	Abortion		Gay Rights		Obama		Marijuana	
	Sent.	Post	Sent.	Post	Sent.	Post	Sent.	Post
Baseline	32.7	45.0	23.3	40.5	19.5	31.5	28.7	44.2
P1	34.5	46.3	24.5	43.2	20.3	33.5	30.5	47.3
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J1	36.0	47.6	26.7	45.6	23.1	35.7	33.3	49.2
J2	37.9	50.6	29.6	48.5	24.5	37.1	34.5	50.5
J3	**39.5**	**52.3**	**31.4**	**49.8**	**25.1**	**38.0**	**35.1**	**51.1**

- J3 exploits reason labels predicted for the previous post

Evaluation: Joint Maximization Systems

System	Abortion		Gay Rights		Obama		Marijuana	
	Sent.	Post	Sent.	Post	Sent.	Post	Sent.	Post
Baseline	32.7	45.0	23.3	40.5	19.5	31.5	28.7	44.2
P1	34.5	46.3	24.5	43.2	20.3	33.5	30.5	47.3
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J1	36.0	47.6	26.7	45.6	23.1	35.7	33.3	49.2
J2	37.9	50.6	29.6	48.5	24.5	37.1	34.5	50.5
J3	**39.5**	**52.3**	**31.4**	**49.8**	**25.1**	**38.0**	**35.1**	**51.1**

- J3 significantly beats J2 for ABO and GAY, and yields small, statistically insignificant gains for OBA and MAR
  - Reasons predicted for the previous post provide useful info

Evaluation: Joint Maximization Systems

System	Abortion		Gay Rights		Obama		Marijuana	
	Sent.	**Post**	**Sent.**	**Post**	**Sent.**	**Post**	**Sent.**	**Post**
Baseline	32.7	45.0	23.3	40.5	19.5	31.5	28.7	44.2
P1	34.5	46.3	24.5	43.2	20.3	33.5	30.5	47.3
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J1	36.0	47.6	26.7	45.6	23.1	35.7	33.3	49.2
J2	37.9	50.6	29.6	48.5	24.5	37.1	34.5	50.5
J3	**39.5**	**52.3**	**31.4**	**49.8**	**25.1**	**38.0**	**35.1**	**51.1**

- J3 significantly beats Baseline by an average of 6.7 and 7.5 points at the sentence and post levels respectively

Evaluation: Joint Maximization Systems

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	Sent.	Post	Sent.	Post	Sent.	Post	Sent.	Post
Baseline	32.7	45.0	23.3	40.5	19.5	31.5	28.7	44.2
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J1	36.0	47.6	26.7	45.6	23.1	35.7	33.3	49.2
J2	37.9	50.6	29.6	48.5	24.5	37.1	34.5	50.5
J3	**39.5**	**52.3**	**31.4**	**49.8**	**25.1**	**38.0**	**35.1**	**51.1**

- Results suggest that the usefulness of automatically computed stance information depends in part on the way it is exploited

Evaluation: Goal

- Evaluate the stance-supported RC systems

Will RC performance improve as we employ more sophisticated methods for modeling stances and reasons?

Can SC performance improve when SC is jointly modeled with RC?

Evaluation: SC accuracies

System	Abortion	Gay Rights	Obama	Marijuana
Baseline	--	--	--	--
P1	62.8	63.4	61.0	67.2
P2	65.1	64.2	63.8	68.5
ILP	65.2	64.6	63.6	68.8
J1	62.5	64.0	61.2	67.8
J2	65.9	65.3	63.5	68.7
J3	**66.3**	**65.7**	**64.0**	**69.0**

Evaluation: SC accuracies

System	Abortion	Gay Rights	Obama	Marijuana
Baseline	--	--	--	--
P1	62.8	63.4	61.0	67.2
P2	65.1	64.2	63.8	68.5
ILP	65.2	64.6	63.6	68.8
J1	62.5	64.0	61.2	67.8
J2	65.9	65.3	63.5	68.7
J3	**66.3**	**65.7**	**64.0**	**69.0**

- J3 achieved the best SC accuracies for all four datasets

Evaluation: SC accuracies

System	Abortion	Gay Rights	Obama	Marijuana
Baseline	--	--	--	--
P1	62.8	63.4	61.0	67.2
P2	65.1	64.2	63.8	68.5
ILP	65.2	64.6	63.6	68.8
J1	62.5	64.0	61.2	67.8
J2	65.9	65.3	63.5	68.7
J3	**66.3**	**65.7**	**64.0**	**69.0**

- Comparing J3 (best joint model) and P2 (best pipeline model),
  - J3 is better, sometimes significantly so, than P2 on all datasets
  - Joint modeling of SC and RC has a positive impact on SC

Summary

- Examined the task of reason classification in ideological debates
- Demonstrated on our reason-annotated corpus that sophisticated models of stances and reasons can indeed yield more accurate reason and stance classification results than their simpler counterparts
- Reason classification remains a challenging task
  - Best post-level F-scores are in the low 50s.