

Tutorial slides <https://cs.upb.de/css/teaching/tutorials/argumentation-analysis-and-retrieval-asirf-2018>

ASIRF 2018, Schloss Dagstuhl

Argumentation Retrieval and Analysis

Henning Wachsmuth

cs.upb.de/css

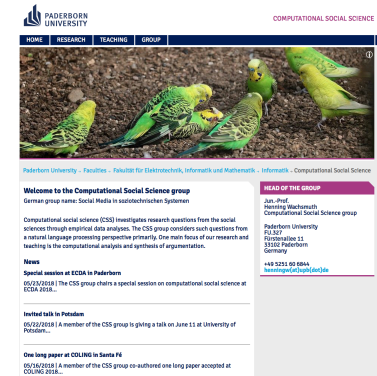
September 20, 2018



The people behind

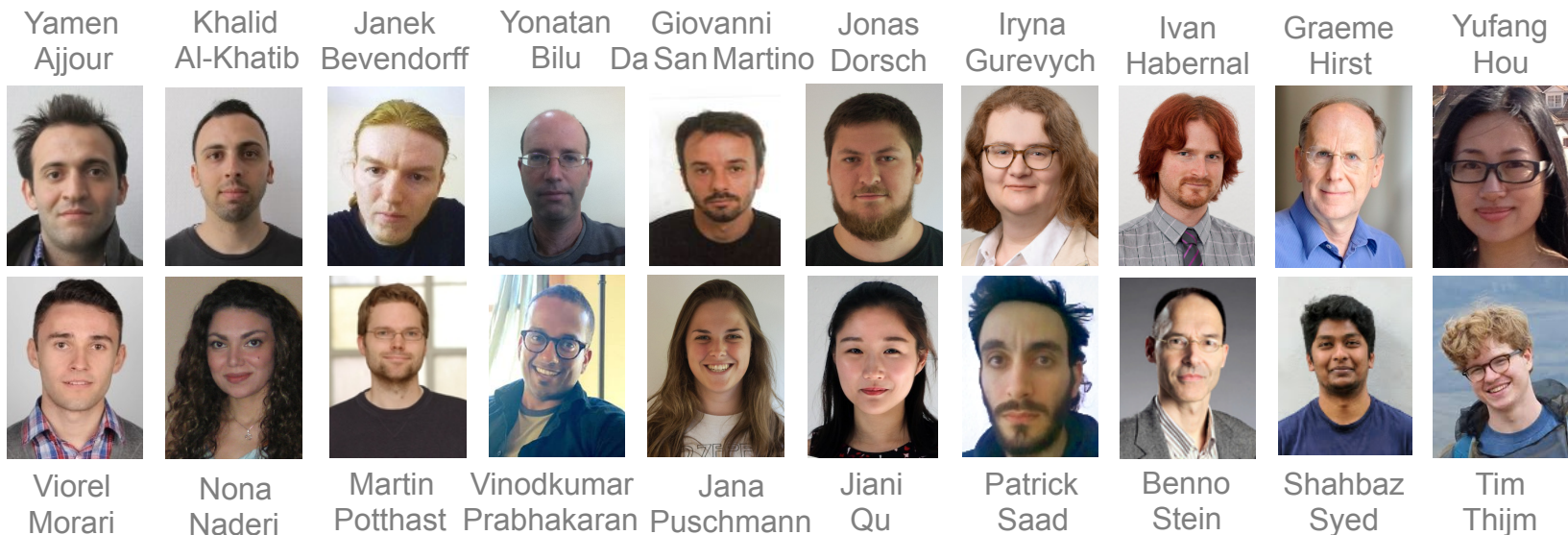
Who you see

- 2009 – 2015: PhD student at Paderborn University
Natural language processing and information retrieval
- 2015 – 2018: PostDoc at Bauhaus-Universität Weimar
Computational argumentation
- As of April 1: Junior professor at Paderborn University
Computational social science



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Who you don't see



This tutorial

▪ **Goals**

- Get to know research on computational argumentation
- Learn the basics of considering it in your work



▪ **Focus**

- Analysis of arguments in natural language text
- Retrieval of arguments within web search



▪ **Elements**

- Overview and in-detail presentations
- Demos, hands-on's, and discussions



Outline

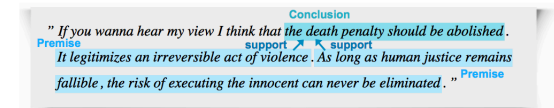
1. Introduction

Argumentation, computational argumentation, applications



2. Argument analysis

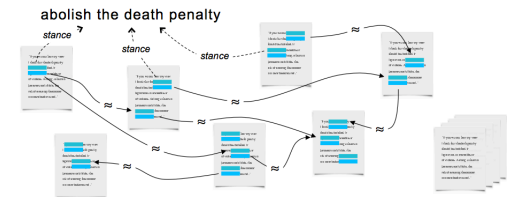
Mining, quality assessment, stance classification



— coffee break —

3. Argument retrieval

Argument search, relevance, counterarguments



4. Outlook and conclusion

Beyond retrieval and analysis, resources, summary



1. Introduction

Argument annotation

Hands-on: Manual argument annotation

■ Annotation

- Adding meta-information to a text or text span
Usually in terms of labels; sometimes also terms, numbers, ...
- **Annotation levels.** Words, phrases, sentences, paragraphs, entire text, ...

■ Your task (in groups of 1–4)

- Given an opinionated news editorial
- Read once through it
- **Annotate manually what you consider most relevant in terms of argumentation**

■ Notice

- **15 minutes for reading and annotating**
- **Follow your intuition!**

Tutorial hands-on task – Argument annotation

An education was my path to financial security. Then I got my student loan bill.

Anthonia Akitunde

I have a very distinct memory from my first day of college: My family's minivan slowly pulling into my dormitory's parking lot, through a crowd of first-year students flanked by helicopter parents and, in retrospect, probably hungover orientation week advisers. I remember thinking "Hurry up! I'm ready to start my real life." I had no idea what I was really rushing towards.

As the only daughter of Nigerian immigrants with a tenuous-at-best foothold on the middle class, college was billed as the only path to financial security. "No one can ever take away your education," my father would say repeatedly. While that may be true, two degrees later someone could take away my access to decent housing because of my shit credit, thanks to the nearly \$60,000 in student loans I've essentially defaulted on since graduating from the University of Chicago and Northwestern University.

It seems a college education is part of the American dream that's easy to buy (or borrow) into, but hard to pay off. With tuition soaring, and the middle class shrinking along with their incomes, many students and their families are left holding incredibly expensive bags. In 2013, 69% of graduating seniors at public and private nonprofit colleges took out student loans to pay for college, and "about one-fifth of new graduates' debt was in private loans," according to the Project on Student Debt. Even public schools – long considered a more affordable option – are less accessible: public colleges increasingly rely on tuition dollars as state funding continues to fall (25% and 23%, respectively, in 2012, compared to 17% and 23% in 2003). The country's cumulative student loan debt (\$1.1tn) has surpassed car loans (\$873bn) and credit card debt (\$659bn). Though college graduates make more than their peers who only graduated from high school, for many, monthly student loans leech into that extra \$17,500 in salary.

Yet the party line that college education is the middle class' only hope for upward mobility persists – it will even be the message of President Obama's last stop on his "SOTU Spoiler" tour in Knoxville, Tennessee.

"In today's economy," Dan Pfeiffer, the president's senior advisor, wrote on Medium, "access to a college education is the surest ticket to the middle class – and the President's proposals will help more young people punch that ticket."

One of those proposals is to make student loans affordable and assign values to colleges based on their affordability, access and "outcomes" – such as whether or not people graduate and enter high-paying jobs or go on to get graduate degrees. These changes will perhaps make starry-eyed students less easily swayed than I was by the promise of reading Plato on the quad. Another is making the first two years of community college free for "anybody who's willing to work for it," as the President announced in a preview video on Thursday. A step in the right direction, but one that needs backing from a Republican Congress to happen. Without it, we're back at square one: Graduates and incoming students signing up for the decades-long financial burden taking out student loans to fund your education all but ensures. (President Obama should know – he and the First Lady didn't pay off their student loans until they were in their 40s.)

As someone who punched that ticket twice, I'm still waiting for my express bus to the middle class. The modest income I make as an entrepreneur with a day job is whittled away each month thanks to loan payments (plus interest) to various financial institutions that feel more like bounty hunters than supporters of middle-class aspirants.

With that \$60,000 in student loans hanging over me, I'm still waiting to start the "real" life I'd always imagined for myself. It's just that now I want one with its possibilities a little less hampered by student debt.

1. Introduction

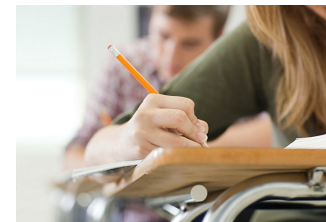
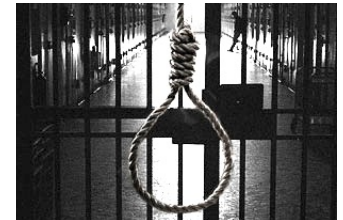
Introduction to computational argumentation

Why do people argue?

■ Reasons for argumentation

(Freeley and Steinberg, 2009)

- No (clearly) correct answer or solution
- A (possible) conflict of ideas, interests, positions, ...
- In other words: **Controversy**



■ Goals of argumentation

(Tindale, 2007)

- **Persuasion**
- Agreement, dispute resolution
- Deliberation
- Justification, explanation
- Decision making
- Recommendation

... and similar



Arguments and argumentation

▪ Argument

- A conclusion (claim) supported by premises (reasons) (Walton et al., 2008)
- Conveys a stance on a controversial topic (Freeley and Steinberg, 2009)

Conclusion
Premises

Conclusion *The death penalty should be abolished.*

Premise 1 *It legitimizes an irreversible act of violence.*

Premise 2 *As long as human justice remains fallible, the risk of executing the innocent can never be eliminated.*

- Often some argument units implicit (Toulmin, 1958)
- Most natural language arguments are defeasible (Walton, 2006)
- Arguments follow some inference scheme (Walton et al., 2008)

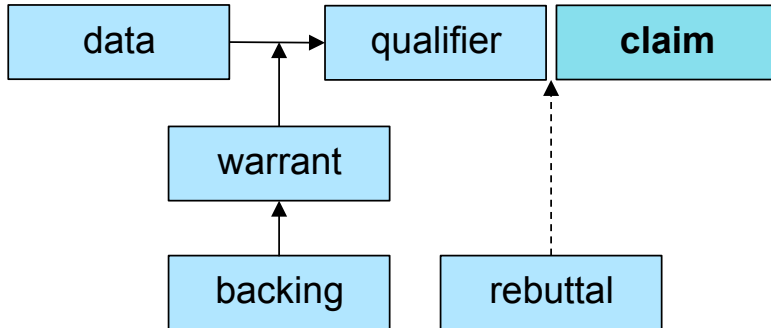
▪ Argumentation

- Usage of arguments to achieve persuasion, agreement, ...
- Includes rhetorical and dialectical aspects

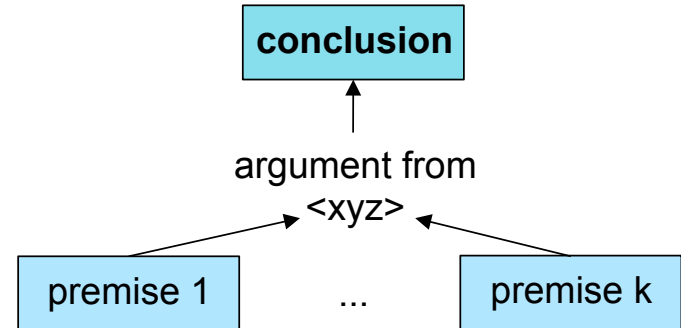
Conclusion
Premises

Diverse argument models

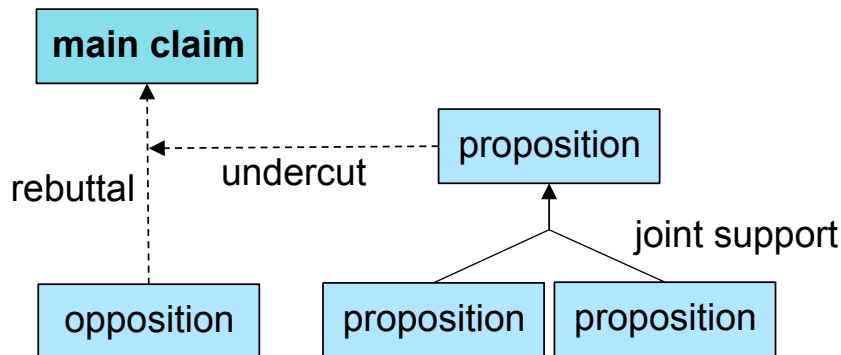
- Capture fine-grained unit roles
(Toulmin, 1958)



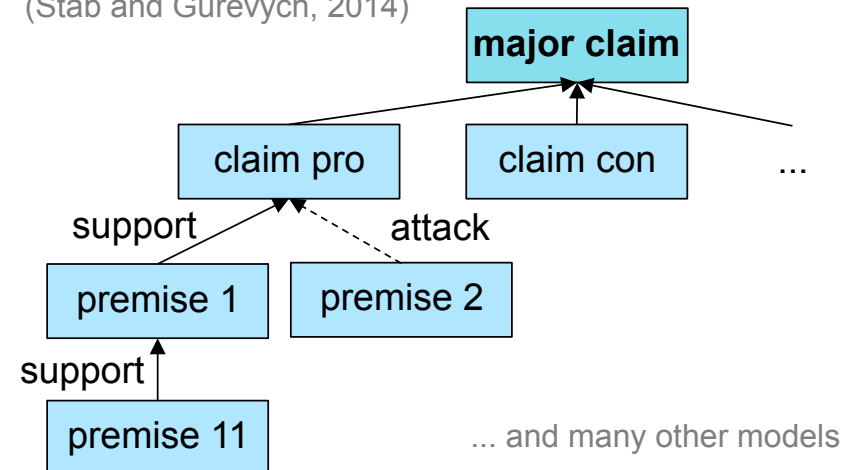
- Capture the inference scheme
(Walton et al., 2008)



- Capture dialectical exchange
(Freeman, 2011)



- Capture argumentative hierarchy
(Stab and Gurevych, 2014)



Monological vs. dialogical argumentation



Monological argumentation

I would not say that university degrees are useless; of course, they have their value but I think that the university courses are rather theoretical. [...]

In my opinion most of the courses taken by first and second year students aim at acquiring general knowledge, instead of specialized which the students will need in their later study and work. General knowledge is not a bad thing in principle but sometimes it turns into a mere waste of time. [...]



Dialogical argumentation

Alice: *I think a university degree is important. Employers always look at what degree you have first.*

Bob: *LOL ... everyone knows that practical experience is what does the trick.*

Alice: *Good point! Anyway, in doubt I would always prefer to have one!*

Argumentative genres



▪ **Written monolog**

- Persuasive essays
 - News editorials / opinionated articles
 - Argumentative blog posts
 - Customer/scientific reviews
 - Scientific articles
 - Law texts
- ... among others

▪ **Spoken monolog** (possibly transcribed)

- Political speeches
 - Law pleadings
- ... among others



▪ **Written dialog**

- Comments to news articles
 - Forum discussions
 - eMail threads
 - Online debates
- ... among others

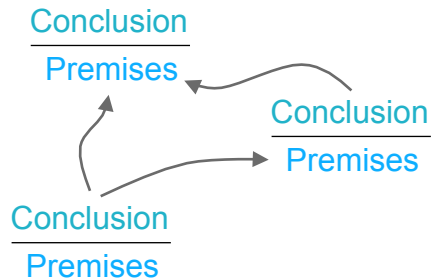
▪ **Spoken dialog** (possibly transcribed)

- Classical debates
 - Panel discussions
- ... among others

What is computational argumentation?

- **Computational argumentation**

- Computational analysis and synthesis of natural language argumentation
- Usually data-driven



$$(1 - \alpha) \cdot \frac{p(d) \cdot |D|}{|A|} + \alpha \cdot \sum_i \frac{\hat{p}(c_i)}{|P_i|}$$



- **Research on computational argumentation**

- **Models** of arguments and argumentation
- **Computational methods** for analysis and synthesis
- **Resources** for development and evaluation
- **Applications** built upon the models and methods

1. Introduction

Applications of computational argumentation

Selected envisioned applications

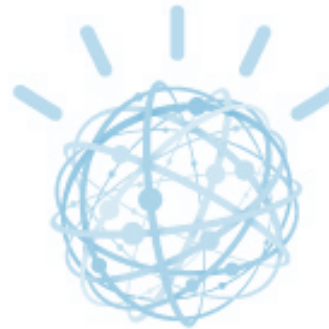
Argument search

(Wachsmuth et al., 2017e)



Intelligent personal assistants

(Rinott et al., 2015)



Fact checking

(Samadi et al., 2016)



Automated decision making

(Bench-Capon et al., 2009)



Argument summarization

(Wang and Ling, 2016)



Writing support

(Stab and Gurevych, 2014)



IBM Debater



https://youtu.be/UeF_N1r91RQ

Argument search – args.me



Q abolish the death penalty →

Page 1 of 639 arguments, 326 pro, 313 con (retrieved in 0.4s)

Pro

#1 No execution of the innocent

<http://www.bbc.co.uk> (81 other sources...)

As long as human justice remains fallible, the risk of executing the innocent can never be eliminated.

#2 Everyone has a right to live

<http://www.amnesty.org> (102 other sources...)

Everyone has an inalienable human right to live, even those who commit murder.

#3 Death penalty fails to deter

<http://www.procon.org> (24 other sources...)

There is no scientific proof that executions have a greater deterrent effect than life imprisonment.

Con

#1 Retribution

<http://www.bbc.co.uk> (36 other sources...)

Real justice requires people to suffer for their wrongdoing in a way adequate for the crime.

#2 Death penalty deters

<http://www.debate.org> (15 other sources...)

By executing convicted murderers, would-be murderers are deterred from killing people.

#3 Prevention of re-offending

<http://www.bbc.co.uk> (25 other sources...)

Those executed cannot commit further crimes. Imprisonment does not protect sufficiently.

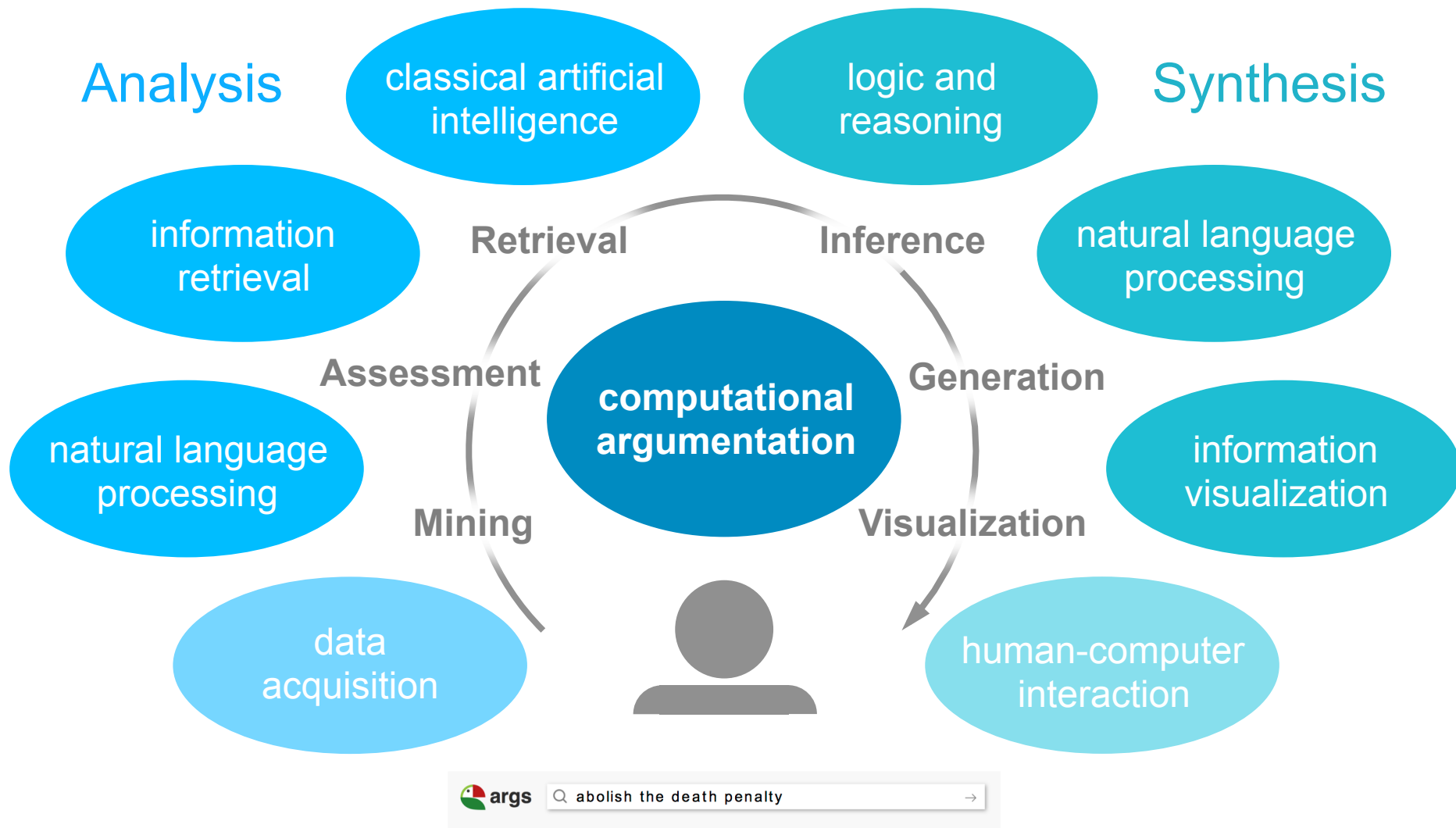
Demo: args.me



Q Enter a topic **demo** →

<http://args.me>

Analysis and synthesis tasks



2. Argument Analysis

Argument mining

Argument mining

- **Argument mining**

- Automatic identification of arguments in natural language text
- Core task in computational argumentation
- Based on any of the argument models



Conclusion

” If you wanna hear my view I think that *the death penalty should be abolished.*

Premise

support

support

It legitimizes an irreversible act of violence. *As long as human justice remains*

Premise

fallible, the risk of executing the innocent can never be eliminated. ”

- **Three main argument mining steps**

- Segmenting a text into argument units and other (Ajjour et al., 2017)
- Classifying the type of each unit (Stab and Gurevych, 2014)
- Identifying and classify relations between units (Peldszus and Stede, 2015)

Argument mining: Unit segmentation

- **Argument units** (aka argumentative discourse units)
 - Premises and conclusions of arguments
Broader: Text segments with an argumentative function
- **Unit segmentation**
 - **Task.** Given a text, segment it into argument units and other parts
 - **Method.** Usually, token-level sequence labeling

” If you wanna hear my view I think that the death penalty should be abolished .

○ ○ ○ ○ ○ ○ ○ ○ ○ ○ **B** **I** **I** **I** **I** **I** ○

- **Challenges**
 - Unit granularity differs: Anything between clauses and paragraphs
 - Usually the first mining step: Unclear what are the arguments
- **State of the art** (Ajjour et al., 2017)
 - Rather reliable on narrow genres (F_1 0.72–0.82), unsolved across genres

Argument mining: Unit type classification

- **Unit types** (aka argument components)

- Roles within argumentation

(Stab and Gurevych, 2014; Habernal and Gurevych 2015)

- Claim and evidence types

(Rinott et al., 2015; Al-Khatib et al., 2016b)

- Often corpus-specific

claim premise none
major claim

assumption statistics other
anecdote common ground testimony

- **Unit type classification**

- **Task.** Given an argument unit, assign one type from a set of types

- **Method.** Usually, supervised text classification (more on this below)

Conclusion
" If you wanna hear my view I think that the death penalty should be abolished.
Premise
It legitimizes an irreversible act of violence. As long as human justice remains
fallible, the risk of executing the innocent can never be eliminated. " Premise

- **State of the art**

- Reliable on "explicit" argumentation, such as in essays (F_1 0.87) (Stab, 2017)
- Still rather reliable on news editorials (F_1 0.77) (Al-Khatib et al., 2017)
- Minority classes may be problematic, though

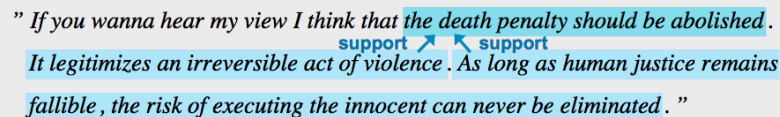
Argument mining: Relation identification & classification

▪ Argumentative relation

- **Within arguments.** From premise to conclusion
- **Across arguments.** From argument to argument
- Support or attack, partly with more fine-grained subtypes (Peldszus and Stede, 2015)

▪ Relation identification classification

- **Task.** Given two units or arguments, what type of relation holds between them, if any
- **Method.** Usually, supervised text classification (more on this below)



" If you wanna hear my view I think that **the death penalty should be abolished.**
It legitimizes an irreversible act of violence. **As long as human justice remains fallible, the risk of executing the innocent can never be eliminated.** "

The diagram shows two sentences. The first sentence is "If you wanna hear my view I think that the death penalty should be abolished." and the second sentence is "It legitimizes an irreversible act of violence. As long as human justice remains fallible, the risk of executing the innocent can never be eliminated." Both sentences have blue highlights under the phrases "the death penalty should be abolished." and "As long as human justice remains fallible, the risk of executing the innocent can never be eliminated." respectively. Two blue arrows labeled "support" point from the highlighted phrase in the second sentence to the highlighted phrase in the first sentence.

▪ State of the art

- Rather reliable on narrow genres, such as essays (F_1 0.73) (Stab, 2017)
- Identification works better than classification
- Relations hard to agree on in "hidden" argumentation, such as editorials

2. Argument Analysis

Argument assessment

Classification of schemes and fallacies

▪ Argumentation scheme

- Form of inference from premises to conclusion (Walton et al., 2008)
- Several deductive, inductive, and abductive schemes
- **Examples.** Cause to effect, expert opinion, analogy, ...



” If you wanna hear my view I think that *the death penalty should be abolished* .

It legitimizes an irreversible act of violence . As long as human justice remains fallible , the risk of executing the innocent can never be eliminated . ”

argument
from
consequences

- Classification based on given premises and conclusions (Feng and Hirst, 2011)

▪ Fallacies

- Failed or deceptive scheme instances (Tindale, 2007)
- **Examples.** Ad-hominem, red herring, ...



Argumentation quality assessment

Argumentation quality

- "Strength" of argumentation, arguments, or units
- Logical, rhetorical, and dialectical dimensions (Wachsmuth et al., 2017b)
- Some highly subjective



cogent?

effective?

reasonable?

"If you wanna hear my view I think that *the death penalty should be abolished.*

It legitimizes an irreversible act of violence. As long as human justice remains

fallible, the risk of executing the innocent can never be eliminated." **acceptability:**
3 out of 3

acceptable?

clear?

relevant?

more acceptable than

"Human beings never act freely and thus should not be punished for even the most horrific crimes."

Quality assessment

- Absolute or relative?
- How *should* we argue vs. how *do* we argue?

Three main quality aspects

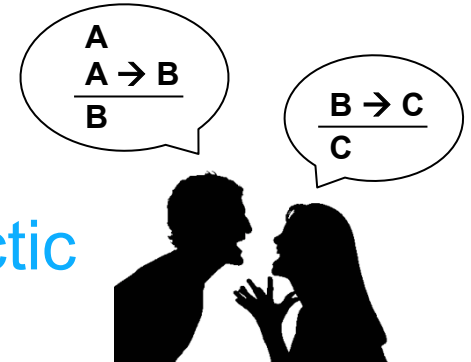
$$\frac{A}{A \rightarrow B} \\ B$$

Logic

"A dialectical discussion derives its reasonableness from a dual criterion: problem validity and intersubjective validity."

van Eemeren (2015)

Dialectic

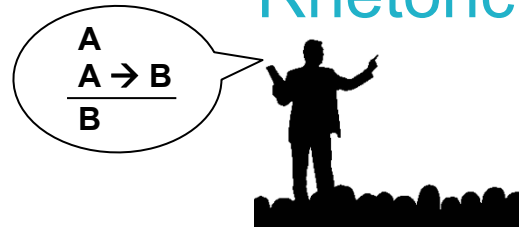


"An argument is cogent if its premises are relevant to its conclusion, individually acceptable, and together sufficient to draw the conclusion."

Blair (2012)

Argumentation
quality

Rhetoric



"In making a speech, one must study three points: the means of producing persuasion, the style or language to be used, and the proper arrangement of the various parts."

Aristotle (2007)

Stance classification

▪ Stance

- Overall position of a person towards an issue or statement
(Somasundaran and Wiebe, 2010)
- Depends on what the person argues to be true



Con towards death penalty

” If you wanna hear my view I think that *the death penalty should be abolished* .

Pro towards conclusion

It legitimizes an irreversible act of violence . As long as human justice remains

*fallible , the risk of executing the innocent can never be eliminated . ” **Pro** towards conclusion*

▪ Stance classification

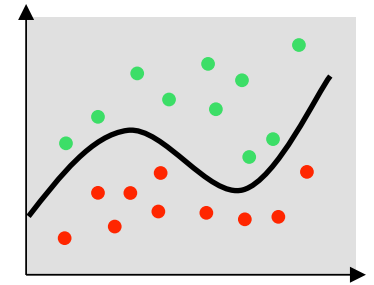
- Determination of the stance encoded in a text or text span
- Pro vs. con, sometimes also: none, not relevant, ...
- Not perspective classification, such as ”republicans vs. democrats“

2. Argument Analysis

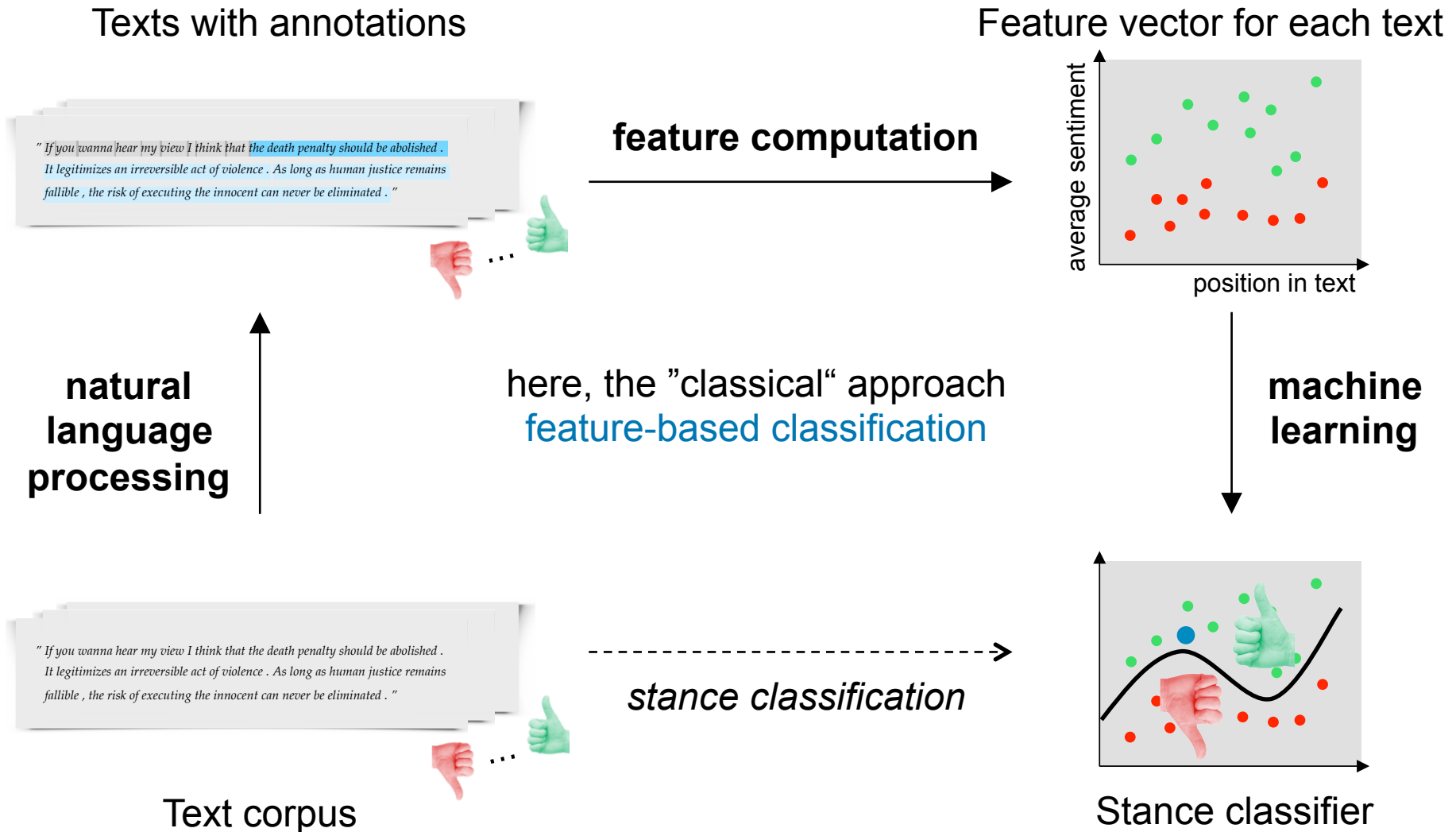
Stance classification: How to

Text classification with supervised learning

- **Text classification** (aka document categorization or similar)
 - **Task.** Given a text, assign it one class from a set of classes
Stance classification is a text classification problem
 - Usually done with supervised machine learning
- **Feature-based classification**
 - Map text to feature vector, map feature vector to class label
Features engineered manually or semi-automatically
 - **Models.** Support vector machines, random forest, ...
- **Neural classification / deep learning** (usually works better, when given enough data)
 - Features (weights in neural networks) learned automatically
 - **Models.** Convolutional neural networks, bi-directional LSTMs, ...
- **Sequence labeling** (applicable, when a sequence of texts is classified)
 - Like other methods, but considering previous classifications
 - **Models.** Conditional random fields, recurrent neural networks, ...



How to develop a stance classification algorithm



Modeling stance

▪ **Candidate features of the text** (Somasundaran and Wiebe, 2010, Hasan and Ng, 2013)

- **Bag-of-words.** Distribution of words or word n-grams
- **Core vocab.** Terms from arguing or subjectivity lexica
- **POS.** Distribution of part-of-speech tags
- **Discourse.** Connectives and relations between units
- **Sentiment.** Aspect-based or topic-directed polarity

... and many more...

→ accuracy up to 0.70 in experiments

▪ **Candidate features of the context**

- Exploit author knowledge in dialog → up to 0.74
(Ranade et al., 2013)
- Exploit opposing views in dialog → up to 0.75
(Hasan and Ng, 2013)
- Connections between claim topics and target topics
(Bar-Haim et al., 2017)

→ 0.84 for most confident 10%, 0.65 overall (3 classes)

Alice: I think a **university degree** is important. Employers always look at what degree you have first.

↓ stance tend to be the same

Alice: Good point! Anyway, in doubt I would always prefer to have one!

↓ stance tend to be opposite

Bob: LOL ... everyone knows that **practical experience** is what does the trick.



— *coffee break* —

Outline (revisited)

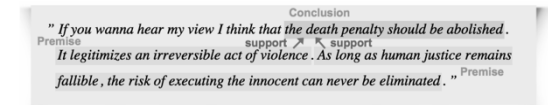
- **Introduction**

Argumentation, computational argumentation, applications



- **Argument analysis**

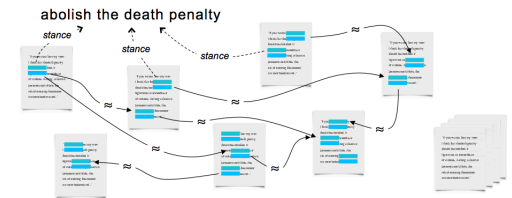
Mining, quality assessment, stance classification



— coffee break —

- **Argument retrieval**

Argument search, relevance, counterarguments



- **Outlook and conclusion**

Beyond retrieval and analysis, resources, summary



3. Argument retrieval

Argumentation in information retrieval

Hands-on: Plenary brainstorming and discussion

What **retrieval research questions** arise
in the context of **computational argumentation**?

3. Argument retrieval

Argument search

(Wachsmuth et al., 2017e)

Vision of argument search

Arguments in future web search

- Support forming opinions on controversial issues
- Make it easy to find relevant arguments

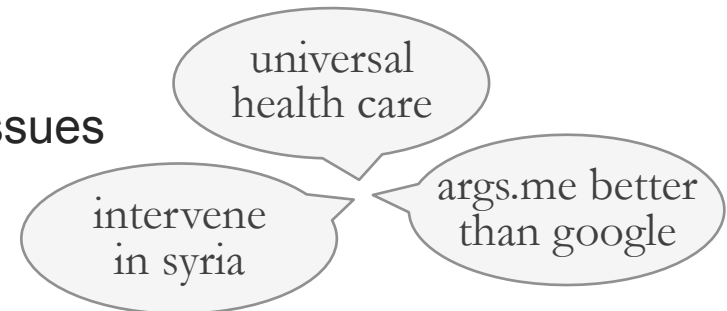
Search results should...

- Rank the *best* arguments highest
- Cover diverse aspects
- Cover reliable and heterogeneous sources
- Be up-to-the-minute
- Be concise but detailed enough
- Be traceable and evaluable

... and much more

Our argument search engine...

- Is improvable on all these criteria
- Defines a framework to work towards the vision



Pro

With universal health care, people are able to...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-people-able-to-see-preventive-treatment.html](#)
With universal health care, people are able to see preventive treatment. This means having tests a...
...>

Moving to a system of universal health care would...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-would-reduce-burden-on-human-resources-personal.html](#)
Moving to a system of universal health care would reduce the burden on human resources personal...
...>

I thank my opponent for posting this debate and...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-Health-care.html](#)
I thank my opponent for posting this debate and...
I am not ready to give victory though. Since my opponent does not define Universal Health Care, I will do so now. Universal Health Care refers to a...
...>

No universal health care causes 'job lock'...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-causes-job-lock.html](#)
No universal health care causes 'job lock'...
...>

The well insured also face risks without universal...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-well-insured.html](#)
The well insured also face risks without universal health care...
...>

A payroll tax could help fund universal health...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-payroll-tax.html](#)
A payroll tax could help fund universal health care...
...>

Universal health care creates a universal standard...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-universal-standard.html](#)
Universal health care creates a universal standard of care...
...>

The government funds fire stations, why not...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-government.html](#)
The government funds fire stations, why not universal health care?...
...>

Free universal health care motivates people to...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-free.html](#)
Free universal health care motivates people to seek preventive care...
...>

Universal health care grounds doctors in...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-grounded.html](#)
Universal health care grounds doctors in professionalism, not commercialism...
...>

Con

Well here is what I believe is wrong with universal...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-wrong.html](#)
Well here is what I believe is wrong with universal health care that I will pay a amount in taxes...
...>

I will post first in the second round I am not...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-second-round.html](#)
I will post first in the second round I am not finally against universal health care but I find it often...
...>

Universal health care risks monopoly...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-monopoly.html](#)
Universal health care risks monopoly...
...>

Hi guys, I'm new to debating, and this is my...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-debate.html](#)
Hi guys, I'm new to debating, and this is my first debate ever. It is fighting against universal health...
care in the US while pro will fighting for it just accept in the first...
...>

Aging countries cannot afford universal health...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-afford.html](#)
Aging countries cannot afford universal health care...
...>

Universal health care creates dependencies on...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-dependencies.html](#)
Universal health care creates dependencies on government...
...>

Universal health care leads to rationing...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-rationing.html](#)
Universal health care leads to rationing...
...>

Government-funded universal health care would...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-government-funded.html](#)
Government-funded universal health care would violate patient privacy...
...>

Universal health care creates a big, inefficient...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-inefficient.html](#)
Universal health care creates a big, inefficient bureaucracy...
...>

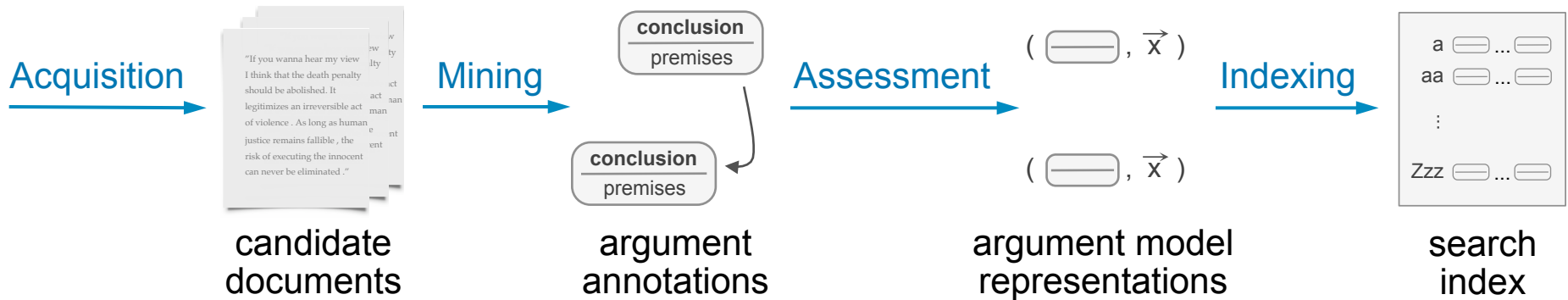
Government-funded universal health care is no...
[http://www.dailymail.co.uk/US/Health/Health-care/Universal-Health-Care-government-funded.html](#)
Government-funded universal health care is a right...
...>



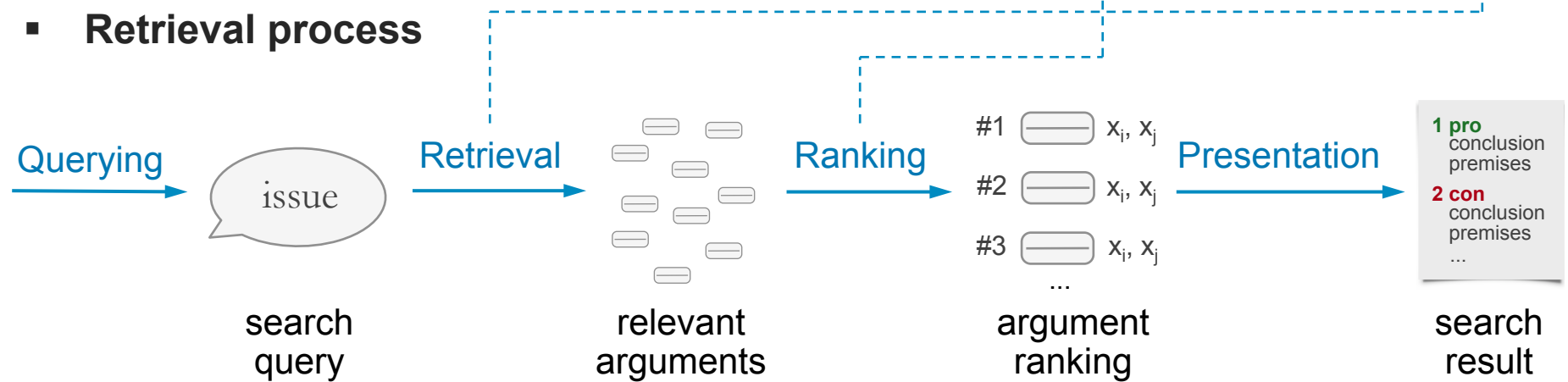
args.me

Argument search framework: Processes

Indexing process



Retrieval process



Argument search index

- **Crawling of 5 debate portals**
 - idebate.org, debatepedia.org, and debatewise.org
 - debate.org and forandagainst.com
- **”Mining“ with distant supervision**
 - Portal-specific mappings to model
 - Conclusion + 1 premise with stance in all cases
 - 376,129 arguments initially
 - 291,440 after cleaning
- **Coverage of phrase queries**
 - 1082 Wikipedia controversial issues
 - 78% match with ≥ 1 argument
 - 42% match with ≥ 1 conclusion

Debate title. *This house believes that the united nations has failed*

Point against. *The UN has performed a valuable service in preventing wars and in peacekeeping.*

Point. *It is clearly unrealistic to imagine that the United Nations could prevent all wars, but nonetheless it has been successful at negotiating peaceful resolutions to international disputes. It has also authorised military force [...]*

Debate title
Point against

Point against
Point

Argument search engine v1

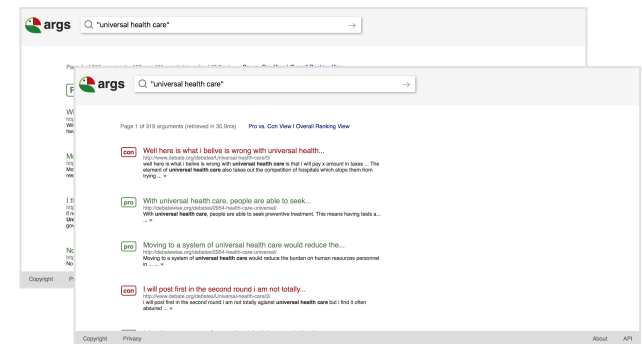
■ args.me

- Based on framework and index
- Content-based argument search



■ Capabilities in version 1

- **Querying.** Free text *phrase* and *and* queries
- **Retrieval.** Exact matching with conclusion
- **Ranking.** BM25F on conclusion, premise, and context (Robertson and Zaragoza, 2009)
- **Presentation.** *Pro vs. con* and *overall ranking*



■ Limitations in version 1

- **Querying.** No argument-specific interpretation
- **Retrieval.** Stance taken from premises
- **Ranking.** Quality not considered
- **Presentation.** Snippets only premise excerpts

capitalism
over socialism

against
abortion

Ongoing evolution of args.me

Recent developments

- **Topic space view.** Interactive visualization of aspects of returned arguments (Ajjour et al., 2018)
- **User study.** Source reliability and aspect coverage seen as most important

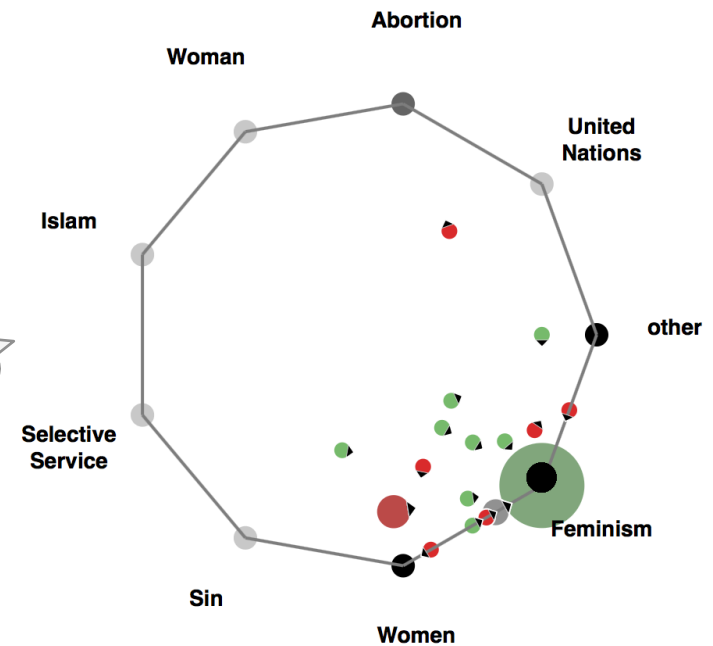
Ongoing developments

- Argument-specific query interpretation
- Query-dependent stance classification

Planned developments

- Extension of index and periodic re-crawling
- "Static" quality assessment

feminism



3. Argument retrieval

Argument Relevance Assessment

(Wachsmuth et al., 2017a)

Mining of relevant arguments

▪ Argument relevance

- Contribution to conclusion on an issue (Walton, 2006)
- Often perceived subjectively

” The death penalty legitimizes an irreversible act of violence. As long as human justice remains fallible, the risk of executing the innocent can never be eliminated.”

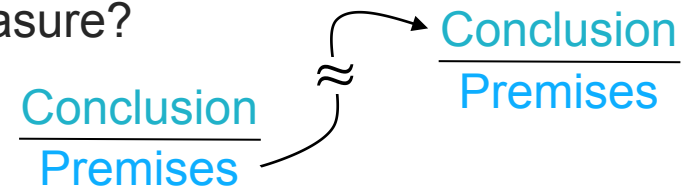
” The death penalty doesn’t deter people from committing serious violent crimes. The thing that deters is the likelihood of being caught and punished.”

▪ Research question

- Can we develop an “objective” relevance measure?

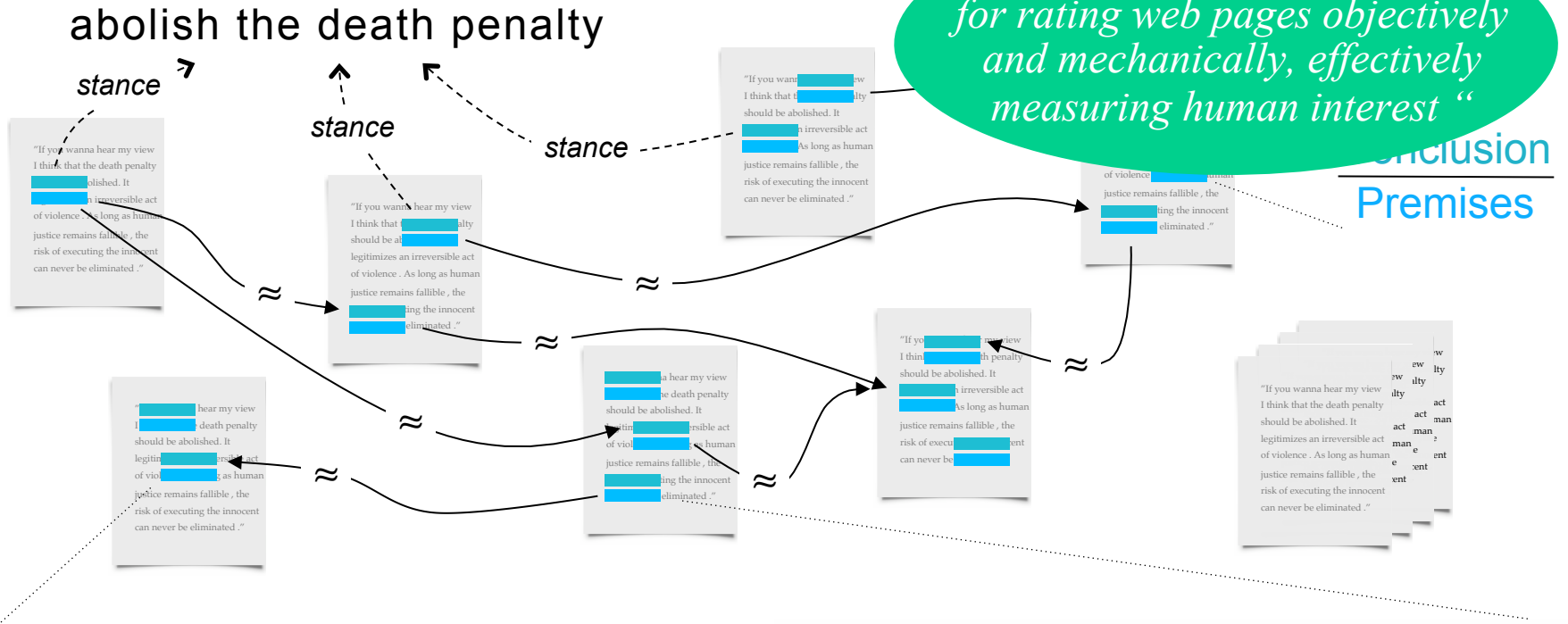
▪ Approach

- Decide relevance structurally only
- **Hypothesis.** Relevance of a conclusion depends on what other arguments across the web use it as a premise



Build an argument graph for the web

"PageRank, a method for rating web pages objectively and mechanically, effectively measuring human interest"



The death penalty doesn't deter people from committing serious violent crimes.

A survey of the UN on the relation between the death penalty and homicide rates gave no support to the deterrent hypothesis.

The death penalty should be abolished.

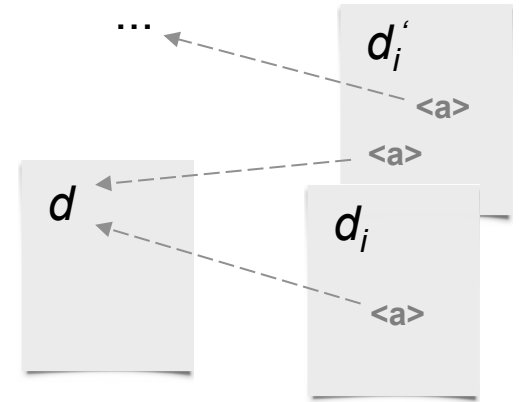
It does not deter people from committing serious violent crimes. *Even if it did, is it acceptable to pay for predicted future crimes of others?*

Adapt PageRank for argument relevance

- Original PageRank score of a web page d (Page et al., 1999)

same score for each page

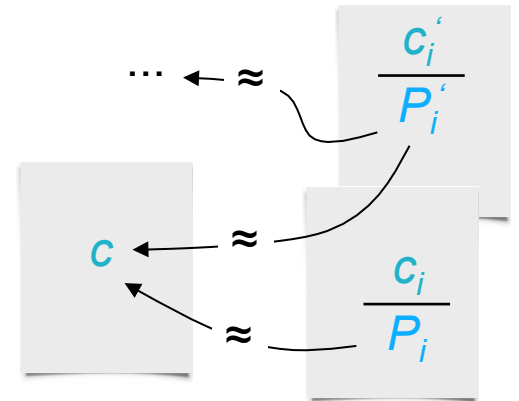
$$p(d) = (1 - \alpha) \cdot \underbrace{\frac{1}{|D|}}_{\text{ground relevance}} + \alpha \cdot \underbrace{\sum_i \frac{p(d_i)}{|D_i|}}_{\text{recursive relevance}} \quad \begin{array}{l} \text{page } d_i \text{ links to } d \\ \text{\# pages } d_i \text{ links to } \end{array}$$



- Adapted PageRank score of an argument unit c

PageRank of page d containing c

$$\hat{p}(c) = (1 - \alpha) \cdot \underbrace{\frac{p(d) \cdot |D|}{|A|}}_{\text{ground relevance}} + \alpha \cdot \underbrace{\sum_i \frac{\hat{p}(c_i)}{|P_i|}}_{\text{recursive relevance}} \quad \begin{array}{l} \text{conclusion } c_i \\ \text{uses } c \text{ as premise} \\ \text{\# premises of } c_i \end{array}$$



- Argument relevance is aggregation of premise scores
 - Minimum, average, maximum, or sum

Ranking arguments by relevance

- **Evaluation of unsupervised ranking approaches**

PageRank
of premises

\hat{p}

Frequency
of premises

Σ

Similarity
of units

$c \sim P$

Sentiment
of premises



Number
of premises

$|P|$

Random
ranking



each for minimum, average, maximum, and sum aggregation

- **Experiment on graph with 18k arguments**

- Rank with each approach
- Correlate with benchmark rankings

- **Results**

- PageRank best (with sum aggregation)
- Notable correlation despite ignorance of content and inference

best results for each ranking approach

#	Approach	Kendall's tau
1	PageRank	0.28
2	Number	0.19
3	Sentiment	0.12
4	Frequency	0.10
5	Similarity	0.02
6	Random	0.00

3. Argument retrieval

Counterargument retrieval

(Wachsmuth et al., 2018a)

Countering an argument

▪ **Argument**

The Feminist Cause No Longer Appeals to Women. (conclusion)

Many women no longer identify themselves as feminists, associating feminism with man-hating, sex-hating humourlessness, and seeing it as a relic of the 1970s. Modern women are perfectly capable of competing with men on equal terms [...] (premise)

<https://idebate.org/debatabase/society-gender/house-believes-feminism-still-needed>

▪ **Counterargument**

Opponents of the feminist movement have always sought to stereotype feminists in order to reduce their support. That this enterprise is often successful is not an argument against feminism [...]

<https://idebate.org/debatabase/society-gender/house-believes-feminism-still-needed>

▪ **Disclaimer**

- Even the best counterargument will not convince everyone

Countering an argument — with no/less prior knowledge

▪ **Argument**

Neo-functionalism proposes a purpose to EU integration. (conclusion)

Neo-functionalism proposed building a community Europe, through the concept of spillover the theory proposes economic determinism. Spill-over will eventually lead to a completely integrated Europe with a strong central government [...] (premise)

<https://idebate.org/debatabase/economy-economic-policy-economy-general-international-europe-philosophy-political>

▪ **Counterargument**

Neo-functionalism believes in building a community Europe, but then the question is raised, what is the purpose of this new entity? There is no common outlook and getting the major powers of Europe to agree what this should be will be near impossible [...]

<https://idebate.org/debatabase/economy-economic-policy-economy-general-international-europe-philosophy-political>

▪ **Observation**

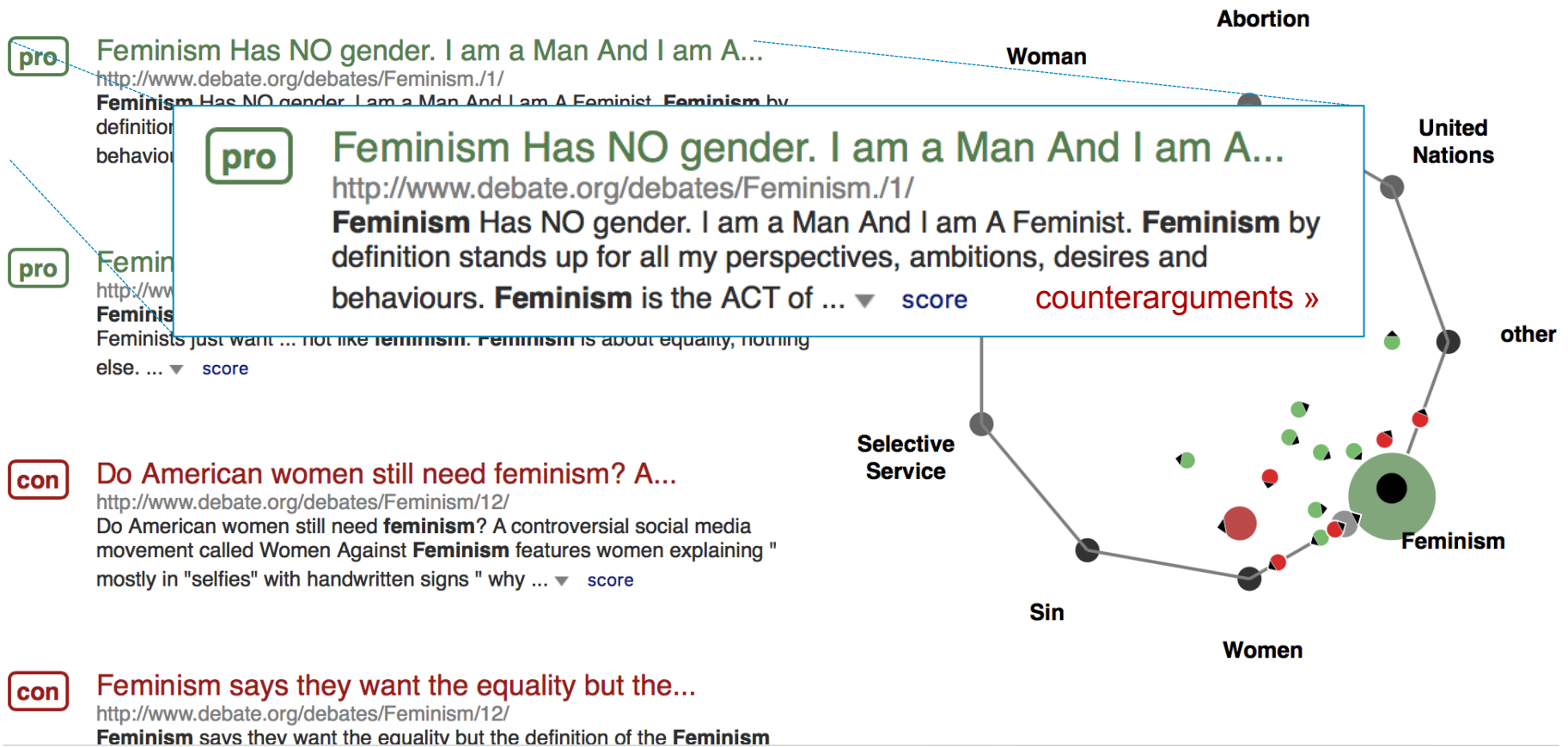
- Similar aspects but opposite stance

Motivation: Counterarguments on args.me



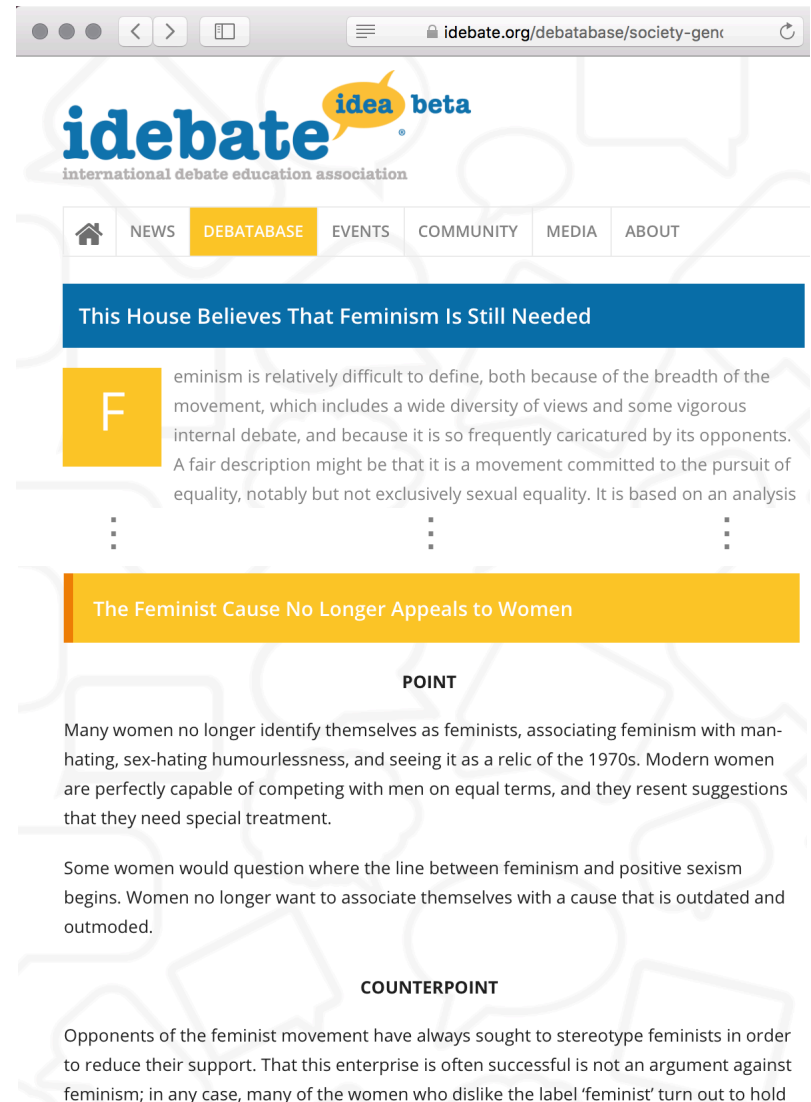
Q feminism →

Page 1 of 659 arguments (retrieved in 320.7ms) Pro vs. Con View | Topic Space View



A counterargument corpus

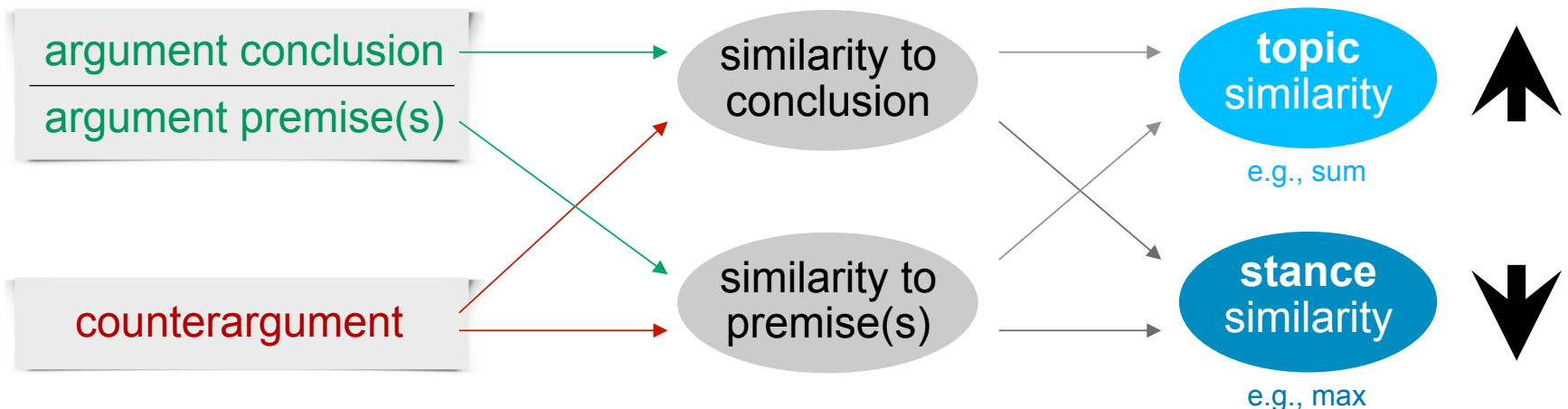
- **Web portal iDebate.org**
 - 1k+ debates on controversial topics
 - Pro and con points on each topic each with conclusion and premise
 - **Counterpoint to every point**
- **Corpus based on iDebate.org**
 - 6753 true point-counterpoint pairs **only** counterpoint seen as correct counterargument
 - 60% train, 20% validation, 20% test no debate in two datasets
- **Eight retrieval tasks, two in this talk**
 1. Candidates are all counters with opposite stance
true-to-false ratio 1:3
 8. Candidates are all arguments
true-to-false ratio 1:2800



The screenshot shows a web browser window with the URL `idebate.org/debatatabase/society-gen`. The page features the iDebate logo and navigation menu. A blue banner at the top reads "This House Believes That Feminism Is Still Needed". Below this, a yellow box contains the letter "F" and the start of a paragraph: "eminism is relatively difficult to define, both because of the breadth of the movement, which includes a wide diversity of views and some vigorous internal debate, and because it is so frequently caricatured by its opponents. A fair description might be that it is a movement committed to the pursuit of equality, notably but not exclusively sexual equality. It is based on an analysis". Three vertical ellipses follow. Below that, a yellow banner reads "The Feminist Cause No Longer Appeals to Women". Underneath, the word "POINT" is centered. The text of the point is: "Many women no longer identify themselves as feminists, associating feminism with man-hating, sex-hating humourlessness, and seeing it as a relic of the 1970s. Modern women are perfectly capable of competing with men on equal terms, and they resent suggestions that they need special treatment." Below this, another paragraph reads: "Some women would question where the line between feminism and positive sexism begins. Women no longer want to associate themselves with a cause that is outdated and outmoded." At the bottom, the word "COUNTERPOINT" is centered, followed by the text: "Opponents of the feminist movement have always sought to stereotype feminists in order to reduce their support. That this enterprise is often successful is not an argument against feminism; in any case, many of the women who dislike the label 'feminist' turn out to hold".

Retrieval approach: Concept

- **Approach**
 - Capture simultaneous topic similarity and stance *dissimilarity*
- **Background from theory** (Walton, 2009)
 - A counterargument attacks an argument's conclusion
 - ... or the argument's premise(s)
 - ... or the inference from premise(s) to conclusion
- **Infer both similarities from premise(s) and conclusion ... in different ways**



Retrieval approach: Realization

Ranking by simultaneous (dis)similarity

$$\alpha \cdot \text{topic similarity} - (1-\alpha) \cdot \text{stance similarity}$$
$$\left\{ \begin{array}{l} 1.0 \\ 0.9 \\ 0.8 \\ \dots \end{array} \right\} \cdot \left\{ \begin{array}{l} \text{min} \\ \text{max} \\ \text{prod}' \\ \text{sum} \end{array} \right\} \left(\begin{array}{l} \text{similarity to} \\ \text{conclusion} \\ \text{similarity to} \\ \text{premise(s)} \end{array} \right) - \left\{ \begin{array}{l} 0.0 \\ 0.1 \\ 0.2 \\ \dots \end{array} \right\} \cdot \left\{ \begin{array}{l} \text{min} \\ \text{max} \\ \text{prod}' \\ \text{sum} \end{array} \right\} \left(\begin{array}{l} \text{similarity to} \\ \text{conclusion} \\ \text{similarity to} \\ \text{premise(s)} \end{array} \right)$$

- Learn best α and best **topic-stance** similarity pair on validation set
- Apply best combinations on test set

Embedding + word similarity

- **Embeddings.** Word mover's distance on ConceptNet Numberbatch
outperformed average word embeddings and GoogleNews-vectors, wiki-news-300d-1M, and crawl-300d-2M
- **Words.** Manhattan distance on stem 1-grams
outperformed Jaccard, Euclidean, and Cosine distance on word, stem, and lemma 1-, 2-, and 3-grams

Accuracy of ranking the best counterarguments highest

- Selected baselines and approaches**

Argument-level similarities

Best conc'/prem' similarities

Best approaches

embedding
similarity

word
similarity

embedding
product

word
sum

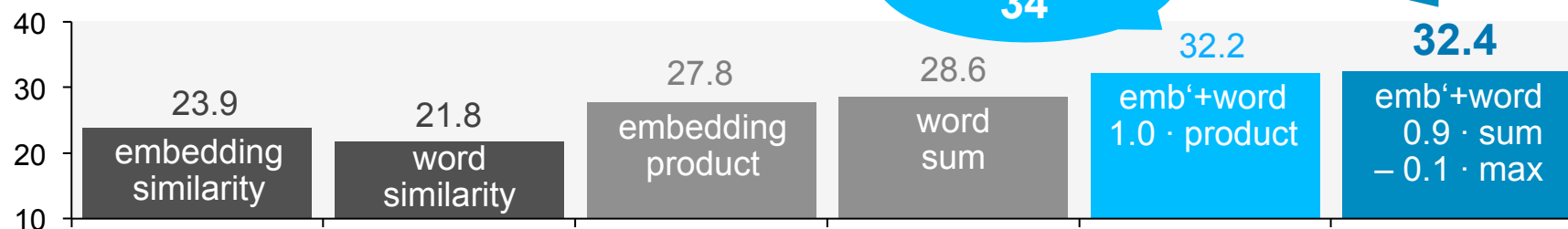
**emb'+word
1.0 · product**

**emb'+word
0.9 · sum
– 0.1 · max**

1. Candidates: All counters with opposite stance (true-to-false ratio 1:3)



8. Candidates: All arguments (true-to-false ratio 1:2800)



4. Outlook and Conclusion

Beyond argument retrieval and analysis

From arguments to argumentation

▪ Building blocks of monological argumentation

- **Argument units** only one part of argumentation
In some genres, only secondary
- **Other units** serve rhetorical and dialectical functions or give context information

▪ Overall structure of monological argumentation

- **Hierarchical** structure induced by relations
- **Sequential** structure of a text or speech
For models, see next slide

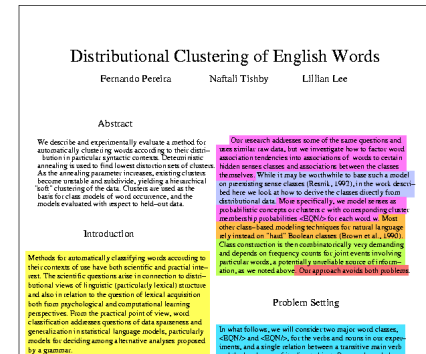
▪ Dialogical argumentation

- **Process-oriented.** Series of argumentative turns
- **Fragmented.** Arguments split into disconnected turns
- **Not plannable.** Need to react on opponents turns
Models still largely missing



Selected argumentation analysis tasks

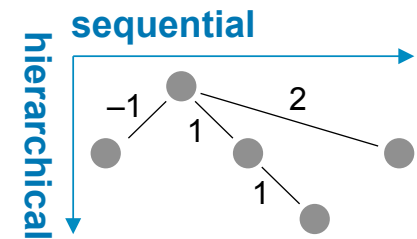
- **Argumentative zoning** (Teufel, 1999)
 - Argumentative zones capture discourse functions of text segments
 - **Examples.** Background, aim, contrast, own, other, ...
 - Well-studied for scientific articles



- **Identification of frames** (Naderi and Hirst, 2015)
 - A frame captures an aspect under which a topic may be considered
 - Studied, e.g., for parliamentary debates

fiscal benefits discrimination
gay marriage
man and woman world religions

- **Overall argumentation analysis** (Wachsmuth et al., 2017f)
 - Both sequential and hierarchical overall structure may be decisive
 - Studied, e.g., for stance classification



The role of the participants

- **Author (or speaker)**
 - Argumentation is connected to the person who argues
 - The same argument is perceived differently depending on the author
- **Reader (or audience)**
 - Argumentation often targets a particular audience
 - Different arguments and ways of arguing work for different persons

”University education must be free. That is the only way to achieve equal opportunities for everyone.“

”According to the study of XYZ found online, avoiding tuition fees is beneficial in the long run, both socially and economically.“



From analysis to synthesis

- **Argumentation synthesis**

- Generation of argument units, arguments, and argumentation
- Using an argument "knowledge base" or a (usually neural) language model

- **Selected synthesis approaches**

- Generating claims by recycling topics and predicates (Bilu and Slonim, 2016)

*Democratization **contributes to** stability.*

*Nuclear weapons **cause** lung cancer.*

- Select and arrange units following a rhetorical strategy (Wachsmuth et al., 2018b)

Emotion-oriented. Germany should by no means introduce capital punishment. Every human, even those who have committed a despicable crime, can bring themselves to regret...

- Change the stance/bias of a given sentence (Chen et al., 2018)

Obama accepts nomination, says his plan leads to a "better place"



Obama blasted re-election, saying it a "very difficult" to go down.

4. Outlook and Conclusion

Argumentation resources

Argument resources (1)

▪ Selected corpora on argumentative structure

- [AAE-v2](#). Persuasive essays, proprietary model (Stab and Gurevych, 2014)
- [Arg-microtexts](#). Short texts, Freeman model (Peldszus and Stede, 2015)
- [Araucaria](#). Mixed argumentative texts, Walton's schemes (Reed and Rowe, 2004)
- [AZ](#). Scientific articles, argumentative zones (Teufel, 1999)
- [IBM Debater](#). Wikipedia articles, claims and evidence (Rinott et al., 2015)
- [Web discourse](#). Mixed web arg's, Toulmin model (Habernal and Gurevych, 2015)
- [Webis-Debate-16](#). Debate portal arg's, argumentativeness (Al-Khatib et al., 2016a)
- [Webis-Editorials-16](#). News editorials with six unit types (Al-Khatib et al., 2016b)

▪ Selected corpora on argumentation quality

- [ArgQuality](#). Debate portal arg's, 15 quality scores (Wachsmuth et al., 2017b)
- [Cornell ChangeMyView](#). Discussion posts, effectiveness labels (Tan et al., 2016)
- [UKP-ConvArg](#). Debate portal arg's, convincingness pairs (Habernal et al., 2016)
- [Webis-ArgRank-17](#). Mixed arguments, relevance rankings (Wachsmuth et al., 2017a)
- [Webis-Editorials-18](#). News editorials, effectiveness ratings (El Baff et al., 2018)

Argument resources (2)

Selected corpora on stance and similar

- [ArguAna Counterargs](#). Debate portal counterargument pairs (Wachsmuth et al., 2018a)
- [ArguAna TripAdvisor](#). Hotel reviews with sentiment flows (Wachsmuth et al., 2014)
- [IBM Debater](#). Wikipedia articles, claim-related stance (Bar-Haim et al., 2017)
- [Ideological debates](#). Online discussions with stance (Hasan and Ng, 2013)
- [Internet arguments](#). Web discussions with topic and stance (Walker et al., 2012)

... and many others...

Online debate portals

- [Pro and con arguments](#) on controversial issues
- Some give comprehensive overviews, others let users debate
- Often sources given
- Some let users vote



Selected argumentation-related projects

- **Argument Web** www.argumentinterchange.org
 - Tools to create, analyze, and interact with arguments
- **ArguAna** www.arguana.com
 - Corpora, Java code, and tools for argumentation research
- **RATIO** www.spp-ratio.de
 - Priority program of the German research foundation with several projects
- **UKP Argumentation mining** <http://ukp.tu-darmstadt.de>
 - Corpora, Java code, tools, and another argument search engine
- **And much more...**

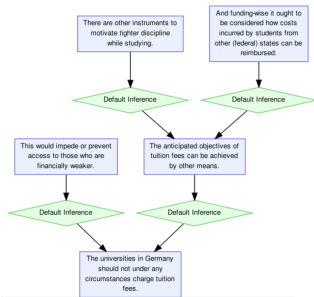
argument interchange
Home of the AIF: Infrastructure for the argument web

ArguAna



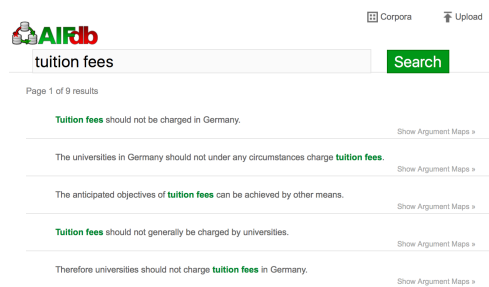

Example project: Argument Web

AIFdb Corpora



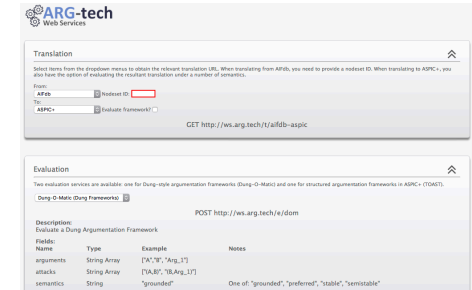
Structured argument data in uniform format

AIFdb Browser



Search interface for argument resources

ARG-tech API



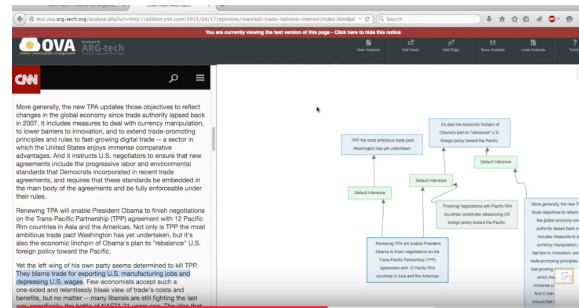
Several argument web services

Argublogging



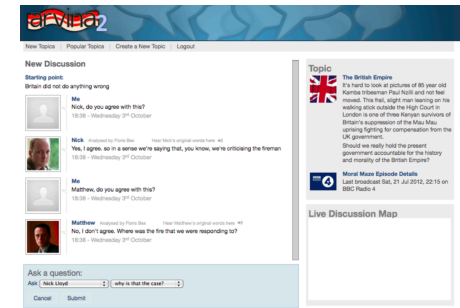
Widget for argument annotation in blogs

OVA



Online visualization and analysis of arguments

Arvina

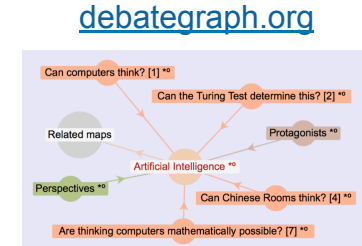
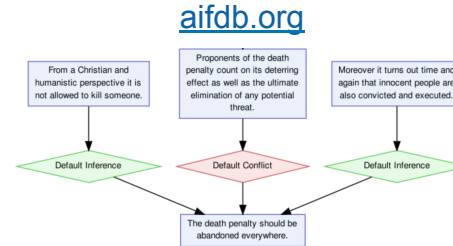


Dialog platform based on AIFdb

Argumentation visualizations

Single argumentative texts

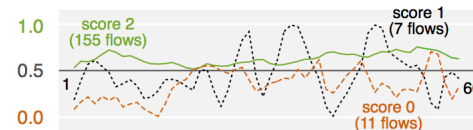
- Majority of existing visualizations
- Mostly in form of directed graphs
- **Goal:** Create or explore structure of arguments



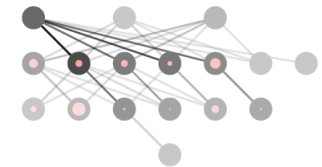
Multiple argumentative texts

- Sequential and/or hierarchical overall structures
- **Goal:** Find argumentation patterns

Wachsmuth et al. (2014b)



Wachsmuth et al. (2017f)



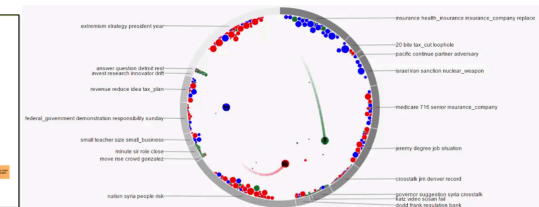
Dialogical discussions

- Process and content of debates
- **Goals:** Assess discourse quality, learn about interaction, ...

Gold et al. (2015)



visargue.inf.uni-konstanz.de



- ... and more

Argumentation-related research groups (1)

- **Disclaimer**

- Sorry to anyone that should be on this list but isn't — please mail me!

- **Groups with a focus on argumentation** (first half)

- Elena Cabrio, University of Nice Sophia Antipolis wimmics.inria.fr
- Claire Cardie, Cornell University nlp.cornell.edu
- Cristian Danescu-Niculescu-Mizil, Cornell University www.cs.cornell.edu/~cristian/
- Nancy L. Green, Uni. of North Carolina at Greensboro www.uncg.edu/cmp/faculty/nlgreen
- Iryna Gurevych, Technische Universität Darmstadt www.ukp.tu-darmstadt.de
- Graeme Hirst, University of Toronto www.cs.toronto.edu/compling
- Marco Lippi, Uni. of Modena and Reggio Emilia www.agentgroup.unimore.it/Lippi/index.html
- Diana Litman, University of Pittsburgh people.cs.pitt.edu/~litman/itspoke.html
- Marie-Francine Moens, Katholieke Universiteit Leuven liir.cs.kuleuven.be
- Smaranda Muresan, Columbia University www.cs.columbia.edu/~smara/index.html
- Vincent Ng, University of Texas at Dallas www.hlt.utdallas.edu

Argumentation-related research groups (2)

- **Disclaimer**

- Sorry to anyone that should be on this list but isn't — please mail me!

- **Groups with a focus on argumentation** (second half)

- Chris Reed, University of Dundee arg-tech.org
- Jodi Schneider, University of Illinois at Urbana-Champaign jodischneider.com/jodi.html
- Noam Slonim, IBM Debater researcher.watson.ibm.com/researcher/view_group.php?id=5443
- Jan Snajder, University of Zagreb takelab.fer.hr
- Manfred Stede, University of Potsdam angcl.ling.uni-potsdam.de/index.html
- Benno Stein, Bauhaus-Universität Weimar www.webis.de
- Francesca Toni, Imperial College London www.doc.ic.ac.uk/~ft/argumentation.html
- Henning Wachsmuth, Paderborn University cs.upb.de/css
- Marilyn Walker, University of California at Santa Cruz nlds.soe.ucsc.edu
- Lu Wang, Northeastern University homedirs.ccs.neu.edu/luwang/
- Adam Wyner, University of Aberdeen www.wyner.info/LanguageLogicLawSoftware/

Scientific events related to argumentation

▪ Conference series

- **Argumentation.** COMMA
- **NLP.** ACL, EMNLP, NAACL, EACL, COLING, CoNLL, IJCNLP, ...
- **Other.** SIGIR, ECIR, AAI, IJCAI, WebConf, WSDM, ...

▪ Workshop series

- **Natural language.** ArgMining, CMNA
- **Mixed.** ECA, CAF, SAFA, Computational Rhetoric, Argument Strength, ...

▪ Seminars

- **Natural language.** Dagstuhl 16161
- **Mixed.** Frontiers ARG-NLP, Dagstuhl 15512

▪ Tutorials and schools

- **Natural language.** NLP Approaches to Computational Argumentation (ACL 2016)
- **Mixed.** 3rd Summer School on Argumentation (and previous ones)

Shared tasks (aka dataset challenges or similar)

▪ **Argument reasoning comprehension**

SemEval-2018
International Workshop on Semantic Evaluation

- **Task.** Given a premise and conclusion, identify the correct warrant out of two options
- **Venue.** SemEval-2018 workshop competitions.codalab.org/competitions/17327

▪ **Ranking of argumentative tweets**

- **Task.** Given a topic, find and rank the most argumentative tweets on the topic
- **Venue.** CLEF 2018 conference mc2.talne.eu/spip/tasks-2018/2-mining-opinion-argumentation/



▪ **Same side classification (brand new info)**

- **Task.** Given to claims on a controversial topic, are they on the same side?
- **Venue.** Hackathon at CITEC, Bielefeld University <http://www.spp-ratio.de/de/hackathon> (taking place October 8–10, 2018)



4. Outlook and Conclusion

Argumentation in information retrieval revisited

Hands-on: Plenary discussion

Are the **presented methods sufficient**
for the collected research questions?

What is particularly important? **What is missing?**

4. Outlook and Conclusion

Summary and concluding remarks

Take aways

- **Computational argumentation**

- Argumentation is pervasive in natural language
- Computational analysis (and synthesis) important



- **Argument analysis**

- Mining of argument units, types, and relations
- Assessment of schemes, quality, and stance

... and much more



- **Argument retrieval**

- Assessment of argument relevance
- Identification of counterarguments

... and much more



- **Argumentation in your research**

- Argument search one main envisioned application
- Several resources available to start with



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