

Computational Argumentation Seminar

# A Brief Introduction to Computational Argumentation

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October 18, 2017

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# Outline

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- **Argumentation**

Goals, definitions, genres, and participants



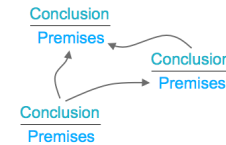
- **Computational argumentation**

Definitions, applications, tasks, and perspectives



- **Models**

Argument units, types, relations, and beyond



- **Computational methods**

Mining, assessment, generation, and more

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

- **Resources**

Corpora, portals, visualizations, and tools



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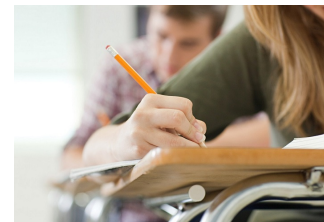
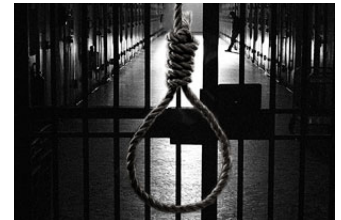
# Argumentation

# 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

# 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

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## ▪ **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

# Argumentation quality

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

Logic

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

van Eemeren (2015)

Dialectic

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

$$\frac{B \rightarrow C}{C}$$



*"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

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



*"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)

# 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.”*



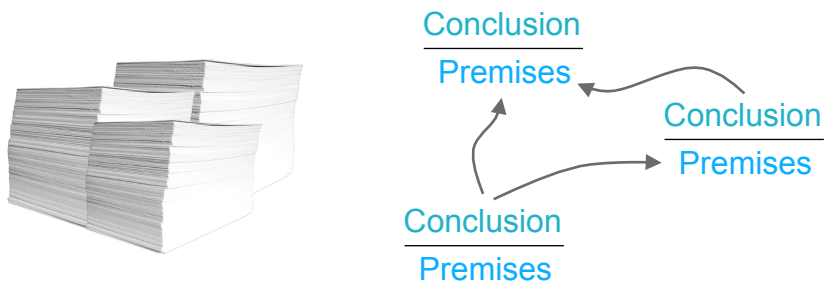
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# Computational argumentation

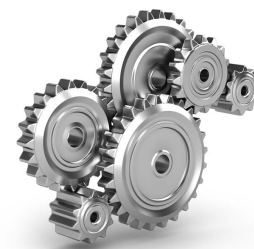
# What is computational argumentation?

- **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

# Applications

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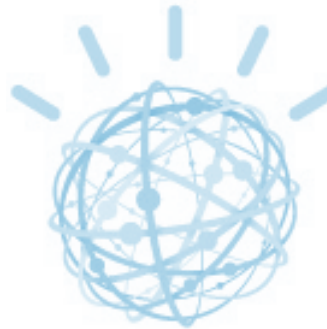
## Argument search

(Wachsmuth et al., 2017b)



## 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)



# 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...)

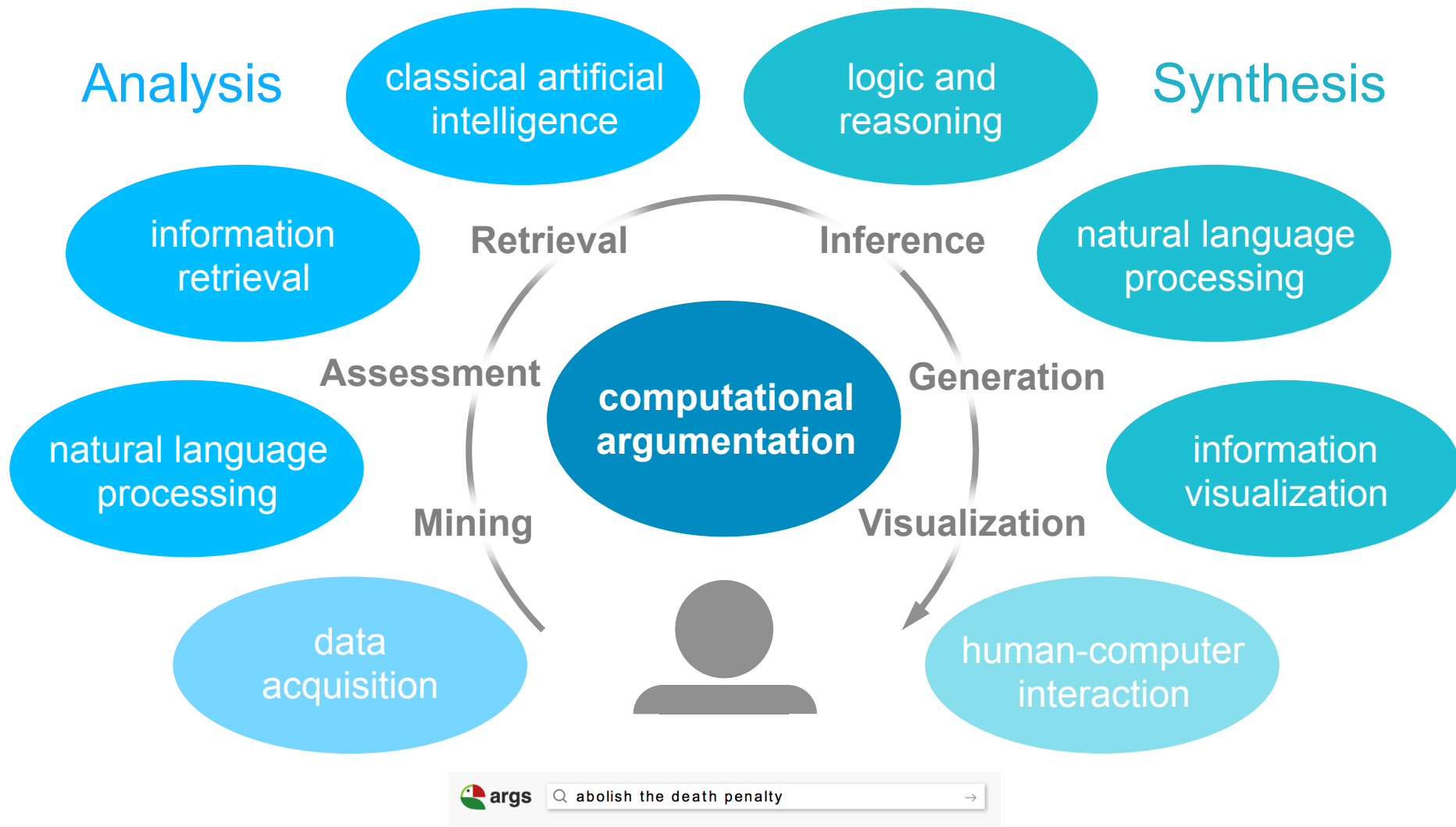
By executing convicted murderers, would-be murderers are deterred from killing people.

### #3 Prevention of re-offending

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

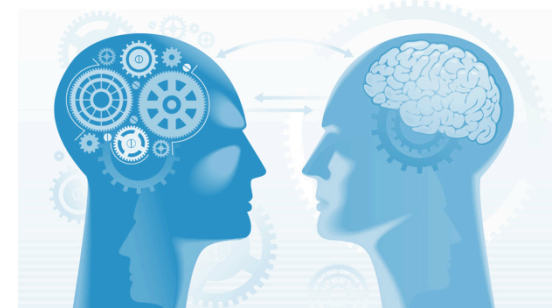
Those executed cannot commit further crimes. Imprisonment does not protect sufficiently.

# Analysis and synthesis tasks

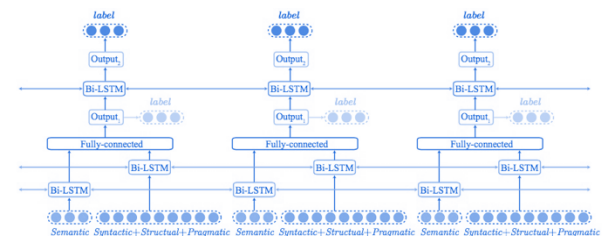


# A natural language processing perspective

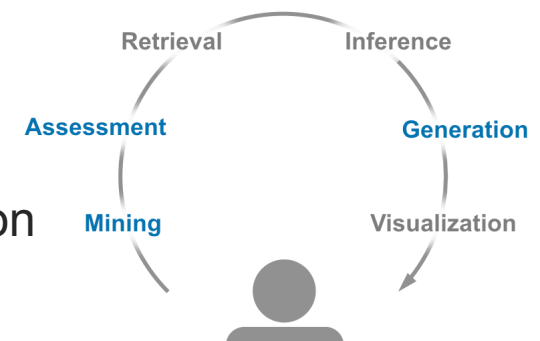
- **Computational linguistics** (see <http://www.aclweb.org>)
  - Intersection of computer science and linguistics
  - **Models** to explain linguistic phenomena, either knowledge-based or statistical (machine-learned)
  - **Technologies** for processing natural language



- **Natural language processing (NLP)** (Tsuji, 2011)
  - Algorithms for understanding and generating speech and human-readable text
  - From natural language to structured information, and vice versa



- **Main NLP tasks in computational argumentation**
  - **Mining** arguments and related information from text
  - **Assessing** properties of arguments and argumentation
  - **Generating** arguments and argumentative text

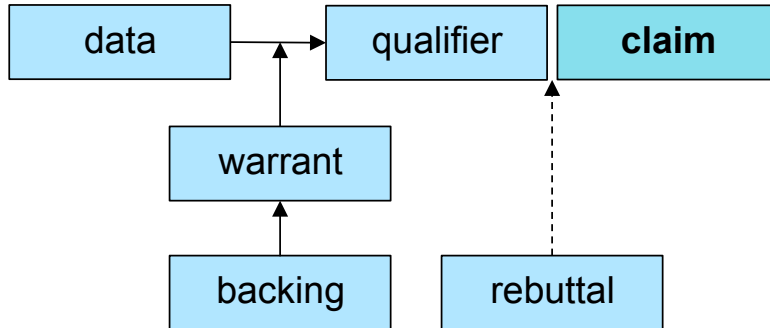


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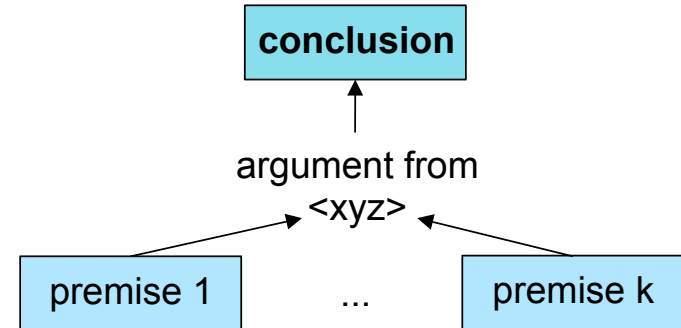
# Models

# Argument models

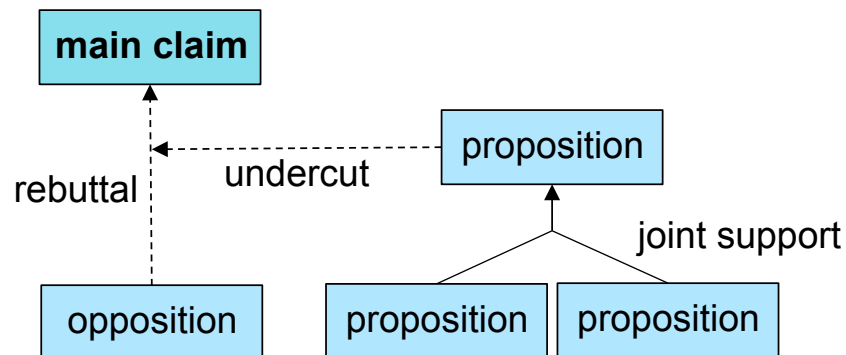
- Capture fine-grained unit roles  
(Toulmin, 1958)



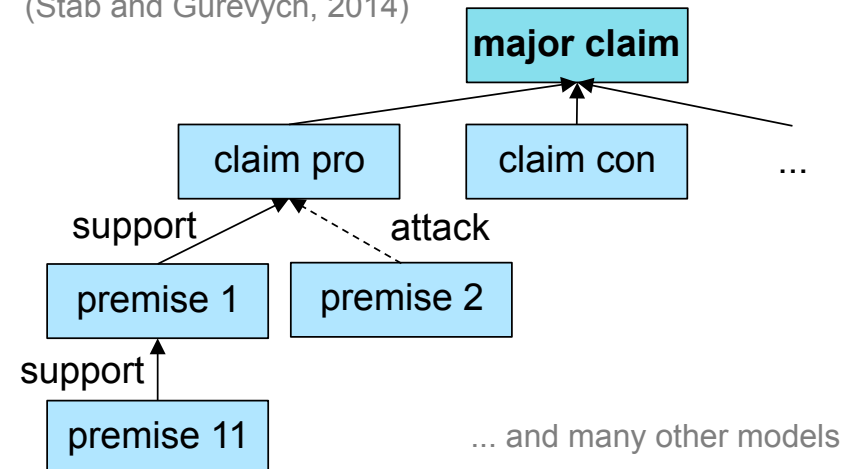
- Capture the inference scheme  
(Walton et al., 2008)



- Capture dialectical exchange  
(Freeman, 2011)



- Capture argumentative hierarchy  
(Stab and Gurevych, 2014)



... and many other models

# Beyond arguments

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## ■ Monological argumentation

- Not only argument units and relations
- Other units often serve rhetorical or dialectical functions
- Hierarchical structure induced by relations
- Sequential structure of a text or speech



## ■ Modeling monological argumentation

- **Argumentative zones** serving different discourse functions (Teufel, 1999)
- **Frames** capturing different aspects of an issue (Naderi and Hirst, 2015)
- **Overall argumentation** of entire texts (Wachsmuth et al., 2017c)
- **Argumentation strategies** pursued by authors (Al-Khatib et al., 2017)

... among other concepts

## ■ Dialogical argumentation

- Differences: process-oriented, fragmented, not plannable, ...
- Models still largely missing



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# Computational methods

# Argument mining

## ■ Argument mining

- Core task in computational argumentation
- Automatic identification of arguments in natural language text
- Based on either 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  
fallible , the risk of executing the innocent can never be eliminated . ” Premise*

## ■ Three main argument mining steps

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

# 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 fragment
- Pro vs. con, sometimes also none, not relevant, ...
- Not perspective classification, such as “republicans vs. democrats“

# 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., 2017a)
- **Examples:** Premise acceptability, linguistic clarity, relevance, ...



*" 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 . "* **premise  
acceptability:**  
3 out of 3

**more acceptable than**

## ■ Argumentation quality assessment

- Identification of fallacies
- Absolute ratings of quality dimensions
- Relative comparison of arguments

(Habernal and Gurevych, 2016)

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

# Selected other analysis and synthesis tasks

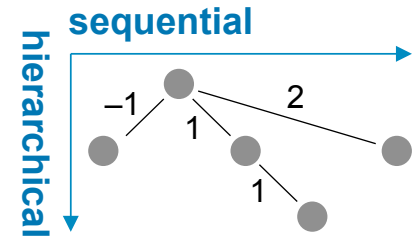
- **Argumentative zoning** (Teufel, 1999)
  - Classifying discourse functions of text segments

background aim  
contrast own other

- **Framing** (Naderi and Hirst, 2015)
  - Identifying the aspects discussed in arguments

fiscal discrimination  
benefits gay marriage world  
man and woman religions

- **Overall argumentation analysis** (Wachsmuth et al., 2017c)
  - Modeling sequential or hierarchical overall structure
  - Assessing argumentation properties on this basis



- **Claim and argument generation** (Bilu and Slonim, 2016)
  - Creating arguments from topics and predicates

"Democratization contributes to stability."  
"Nuclear weapons cause lung cancer."

- **Strategy analysis and synthesis** (Al-Khatib et al., 2017)
  - Finding patterns of argumentation strategies
  - Using the patterns to create argumentative texts

<b>content</b>	<b>structure</b>	<b>style</b>
career	frame	personal
education	thesis	impersonal
finance	evidence	personal

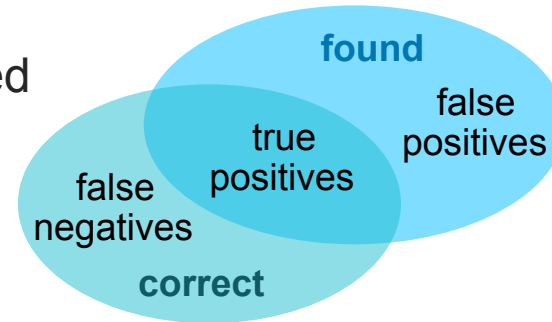
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# Resources

# Text corpora

## ▪ Data-driven research

- Models and methods developed/learned on training texts
- Most methods not fully "correct"
- Effectiveness evaluated on test texts



**Precision =**  
 $TP / (TP + FP)$

**Recall =**  
 $TP / (TP + FN)$

**F<sub>1</sub>-score =**  
 $2 * P * R / (P + R)$

## ▪ Text corpus

- A collection of texts compiled for a specific task or similar
- Usually has manual annotations of meta-information



## ▪ Text corpora for computational argumentation

- [AAE-v2](#). Persuasive essays with argument structure (Stab and Gurevych, 2014)
- [Ideological debates](#). Online discussions with stance (Hasan and Ng, 2013)
- [Araucaria](#). Mixed argumentative texts with schemes (Reed and Rowe, 2004)
- [ArgQuality](#). Debate portal arguments with 15 quality scores (Wachsmuth et al., 2017a)

... and many more

# Debate portals and community platforms

## ■ 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



## ■ Community platforms

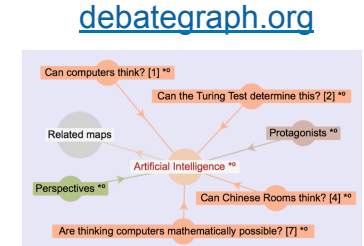
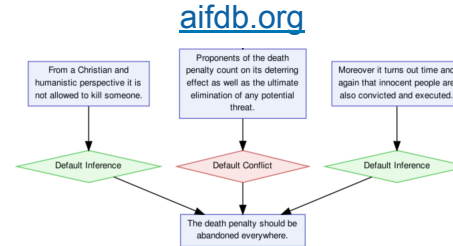
- Tools to create and interact with argument data
- Visualizations of arguments
- Browsers, corpus repositories, editors, forums, blogs, ...



# Argumentation visualization

## ■ Single argumentative texts

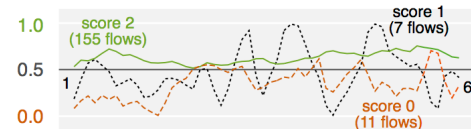
- Majority of existing visualizations
- Mostly in form of directed graphs
- **Goal:** Create or explore structure of arguments



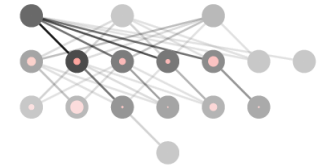
## ■ Multiple argumentative texts

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

Wachsmuth et al. (2014)



Wachsmuth et al. (2017c)



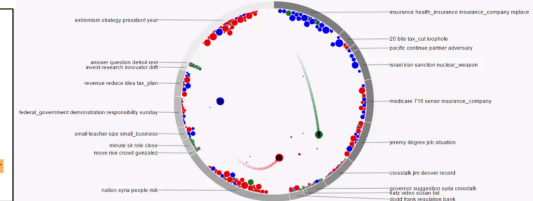
## ■ Dialogical discussions

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

Gold et al. (2015)



[visargue.inf.uni-konstanz.de](http://visargue.inf.uni-konstanz.de)



■ ... and more

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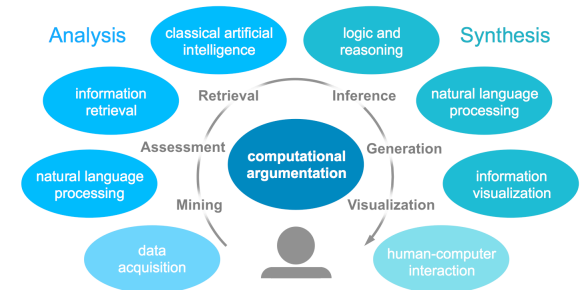
# Conclusion

# Take aways

## ■ Computational argumentation

- Analysis and synthesis of argumentation
- Impact on the future of intelligent technologies
- So far, focus on natural language processing

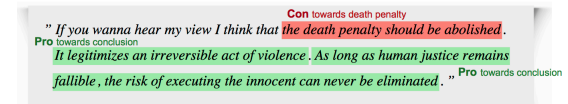
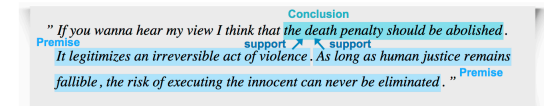
... but many other fields involved



## ■ Analysis and synthesis tasks

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

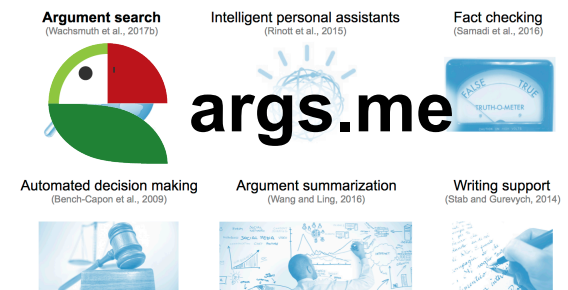
... and many more



## ■ Envisioned applications

- Argument search
- Intelligent personal assistants
- Argumentative writing support

... and many more



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