

Computational Argumentation – Part I

Introduction to Computational Argumentation

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Outline

I. Introduction to computational argumentation

- II. Basics of natural language processing
- III. Basics of argumentation
- IV. Applications of computational argumentation
- V. Resources for computational argumentation
- VI. Mining of argumentative units
- VII. Mining of supporting and objecting units
- VIII. Mining of argumentative structure
- IX. Assessment of the structure of argumentation
- X. Assessment of the reasoning of argumentation
- XI. Assessment of the quality of argumentation
- XII. Generation of argumentation
- XIII. Development of an argument search engine
- XIV. Conclusion

- Introduction
- Argumentation
- Computational argumentation
- Tasks in computational argumentation
- Conclusion

Learning goals

▪ Concepts

- Understand the need for processing argumentation.
- Get to know some general aspects of argumentation.
- Learn about benefits and challenges of computational argumentation.



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▪ Methods

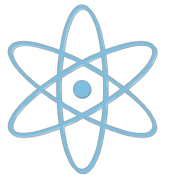
- Get a first idea of the analysis and synthesis of argumentation.



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▪ Associated research fields

- Argumentation theory
- Computational linguistics



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▪ Within this course

- A first overview of the topics covered in this course.



Introduction

Welcome to the post-factual age!

Remember January 22, 2017

<https://www.youtube.com/watch?v=VSrEEDQgFc8> (1:36 – 2:05)



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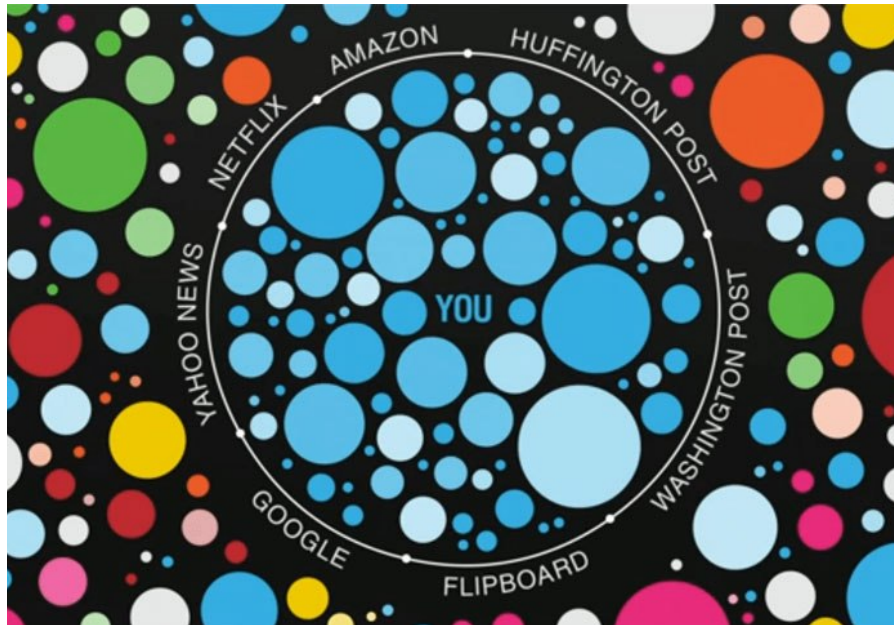
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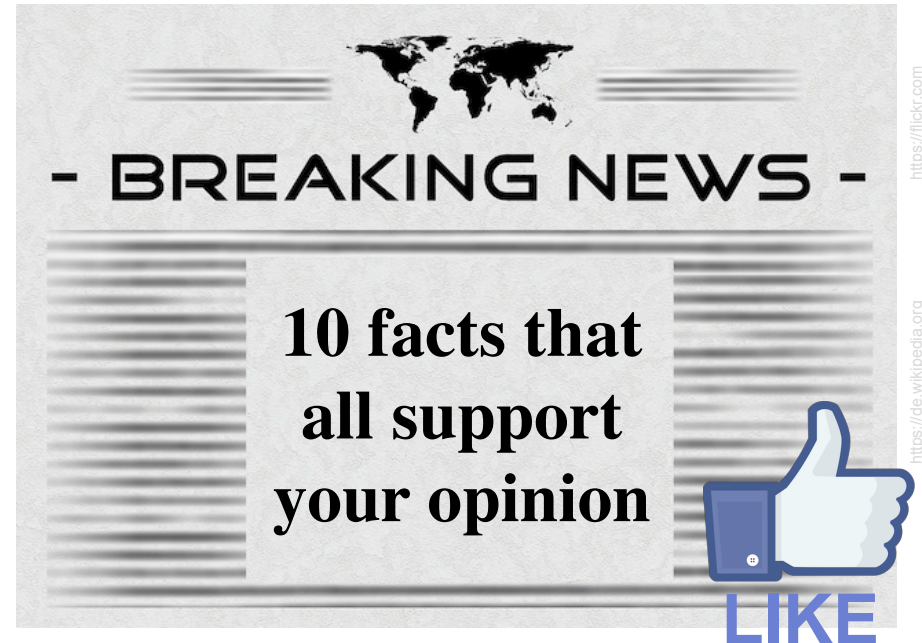
How could we end up there?

Filter bubbles



We get what fits our past behavior

Echo chambers



We like to get what fits our world view

So what does that mean?

Forming opinions in a self-determined manner
is one of the great problems of our time

Where truth is unclear, we need to compare *arguments*

Argumentation

Why do people argue?

■ Reasons for argumentation

(Freeley and Steinberg, 2009)

- No (clearly) correct answer or solution
- A (possible) conflict of interests or positions
- So: **Controversy**

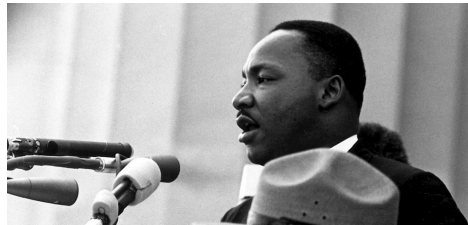


■ Goals of argumentation

(Tindale, 2007)

- **Persuasion**
- Agreement
- Justification
- Recommendation
- Deliberation

... and similar



What is argumentation?

▪ Argument

- A claim (conclusion) supported by reasons (premises). (Walton et al., 2008)
- Conveys a stance on a controversial issue. (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 are implicit. (Toulmin, 1958)
- Most natural language arguments are defeasible. (Walton, 2006)

▪ Argumentation

- The usage of arguments to persuade, agree, deliberate, or similar.
- Also includes rhetorical and dialectical aspects.

Conclusion
Premises

Monological vs. dialogical argumentation

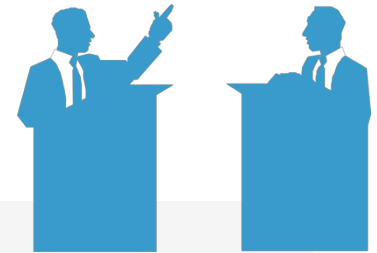


Monological argumentation

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

▪ **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

▪ **Notice**

- The focus in this course is on *written* argumentation, i.e., argumentative texts.

▪ **Written dialog**

- Comments to news articles
- Social media posts
- Online forum discussions
- eMail threads
- Online debates

... among others

▪ **Spoken dialog** (possibly transcribed)

- Classical debates
- Everyday discussions

... among others

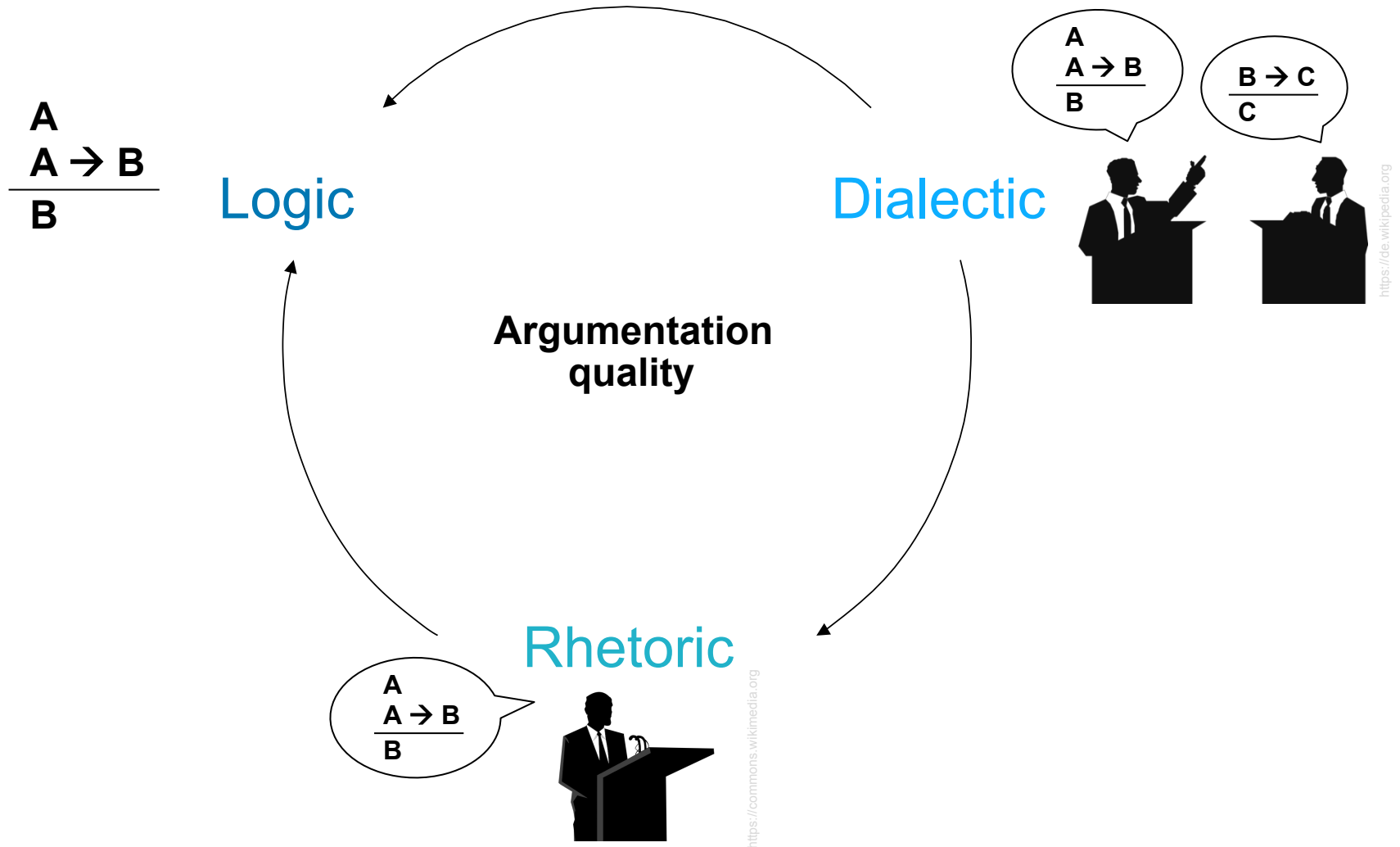


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What is *good* argumentation?



Participants in argumentation

- **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 readers.

”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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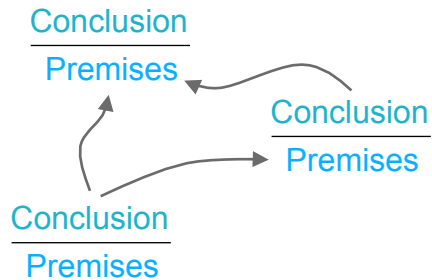
Computational argumentation

What is computational argumentation?

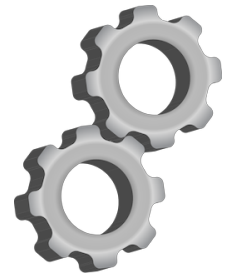
■ Computational argumentation

- The computational analysis and synthesis of natural language argumentation.
- Usually, processes are data-driven.

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



<https://de.wikipedia.org>

■ Main research aspects

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

Applications of computational argumentation

Argument search

(Wachsmuth et al., 2017e)



Intelligent personal assistants

(Rinott et al., 2015)



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Fact checking

(Samadi et al., 2016)



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Argument summarization

(Wang and Ling, 2016)



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Automated decision making

(Bench-Capon et al., 2009)



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Writing support

(Stab, 2017)



<https://www.publicdomainpictures.net>

Argument search — args.me



Q feminism →

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

pro **Feminism Has NO gender. I am a Man And I am A...**

<http://www.debate.org/debates/Feminism/1/>

Feminism Has NO gender. I am a Man And I am A Feminist. **Feminism** by definition stands up for all my perspectives, ambitions, desires and behaviours. **Feminism** is the ACT of ... ▼ [score](#)

pro **Feminism is definitely something that there needs...**

<http://www.debate.org/debates/Feminism/12/>

Feminism is definitely something that there needs to be more of in the world. Feminists just want ... not like **feminism**. **Feminism** is about equality, nothing else. ... ▼ [score](#)

con **Do American women still need feminism? A...**

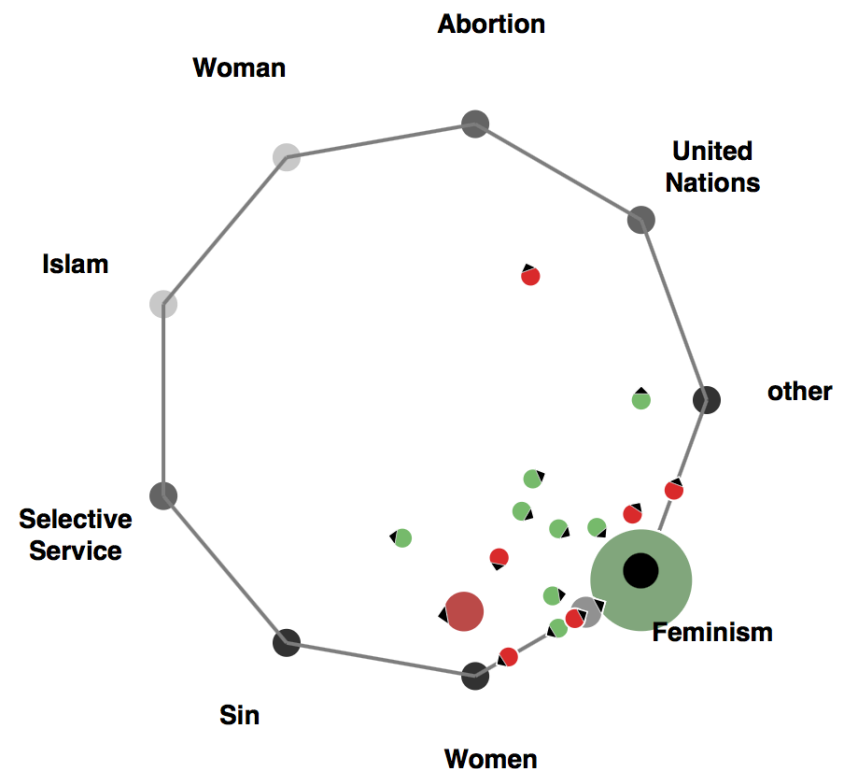
<http://www.debate.org/debates/Feminism/12/>

Do American women still need **feminism**? A controversial social media movement called Women Against **Feminism** features women explaining " mostly in "selfies" with handwritten signs " why ... ▼ [score](#)

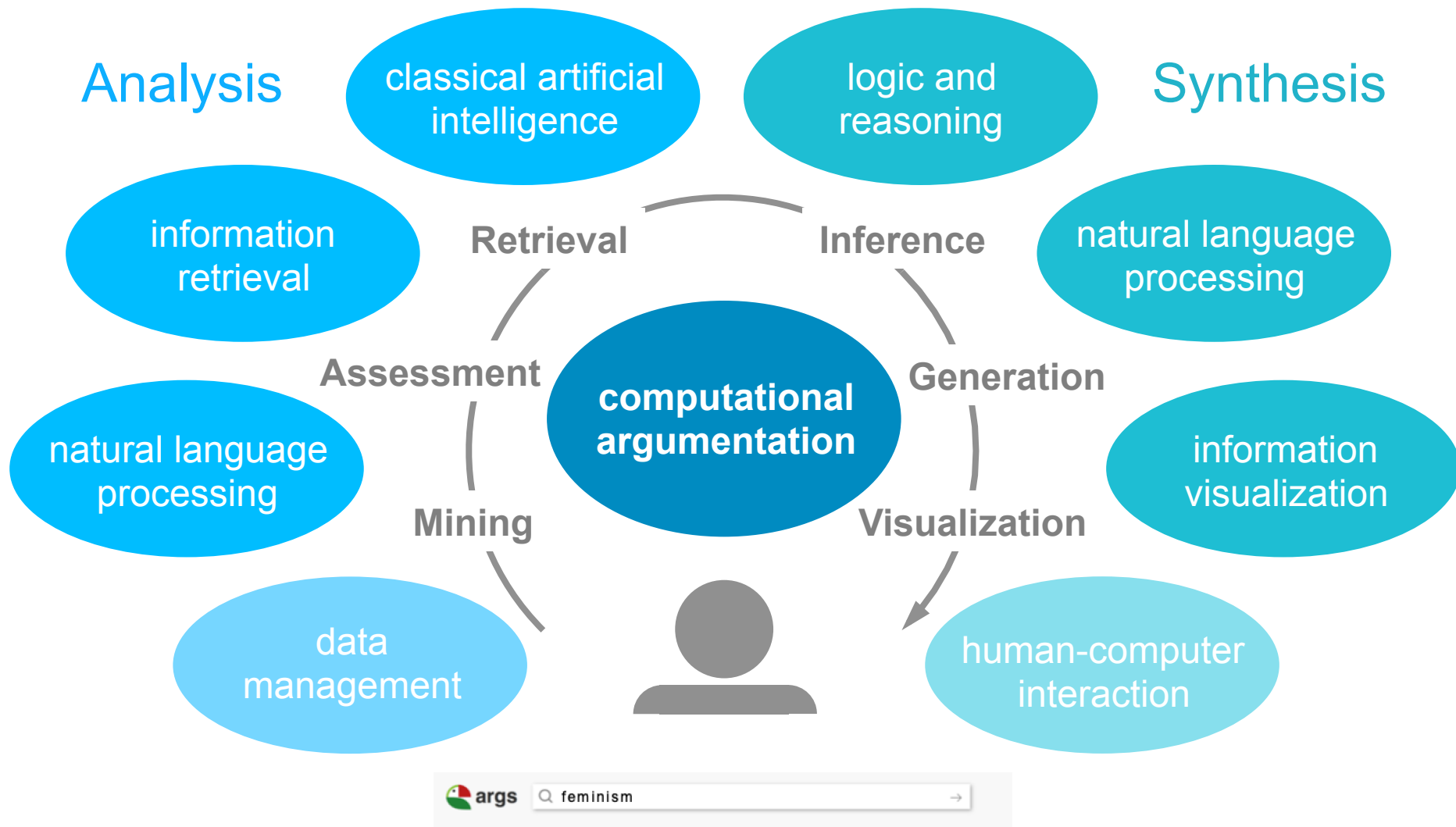
con **Feminism says they want the equality but the...**

<http://www.debate.org/debates/Feminism/12/>

Feminism says they want the equality but the definition of the **Feminism**



Analysis and synthesis tasks

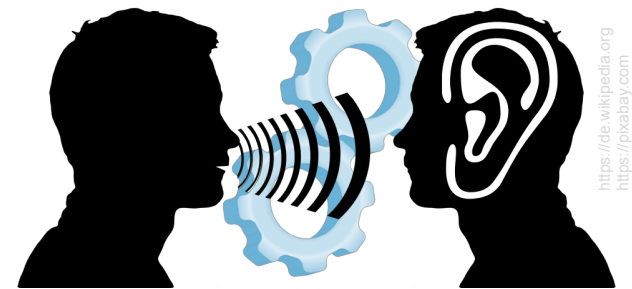


A natural language processing perspective

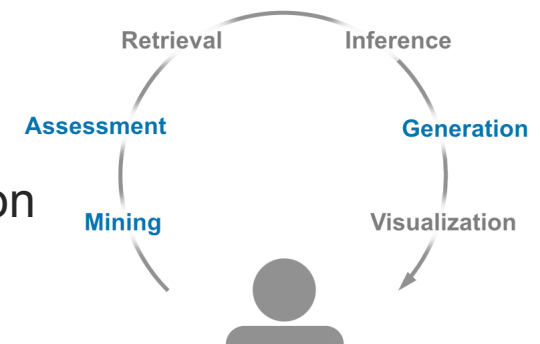
- **Natural language processing (NLP)** (Tsuji, 2011)
 - Algorithms for understanding and generating speech and human-readable text
 - From natural language to structured information, and vice versa

Analysis
Synthesis

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



- **Main NLP stages in computational argumentation**
 - **Mining** arguments and their relations from text
 - **Assessing** properties of arguments and argumentation
 - **Generating** arguments and argumentative text



(Our) Research on computational argumentation

How to model argument relevance?
(Wachsmuth et al., 2017a)

How to retrieve the best counterargument?
(Wachsmuth et al., 2018a)

How to reconstruct implicit argument parts?
(Habernal et al., 2018a)

How to assess argumentation quality?
e.g. (El Baff et al., 2018)

Retrieval
Assessment

Inference
Generation

How to change the stance of a text?
(Chen et al., 2018)

How to model overall argumentation?
e.g. (Wachsmuth et al., 2017f)

Mining

How to build an argument search engine?
(Wachsmuth et al., 2017e)

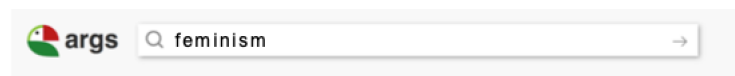
Visualization

How to generate text following a strategy?
(Wachsmuth et al., 2018b)

How to mine arguments across domains?
(Al-Khatib et al., 2016)



How to visualize the topic space of arguments?
(Ajjour et al., 2018)



Tasks in computational argumentation

Overview of computational argumentation tasks

- **Argument(ation) mining**

1. The identification and segmentation of argumentative units.
2. The identification and classification of supporting and objecting units.
3. The identification and classification of argumentative structure.

- **Argument(ation) assessment**

4. The analysis of properties of the structure of argumentation.
5. The analysis of the reasoning behind argumentation.
6. The analysis of dimensions of the quality of argumentation.

- **Argument(ation) generation**

7. The synthesis of argumentative units, arguments, and argumentation.

A decomposition would be possible, but research on generation is still limited.

- **Notice**

- In most applications, not all stages/tasks are needed.
- **The exact decomposition into tasks varies in literature.**

Task 1: Mining argumentative units

▪ Mining of argumentative units

- The identification of texts of argumentative text portions (where needed).
- The segmentation of a text into units with an argumentative function (claims) and their non-argumentative counterparts.

non-argumentative

argumentative

” *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 .* ”

▪ How to do unit segmentation?

- **Approach.** Usually, each token is classified sequentially in the context of the others using supervised learning.
- **Results.** Segmentation works rather reliable on narrow genres (F_1 0.72–0.82), but remains unsolved across genres. (Ajjour et al., 2017)

Task 2: Mining supporting and objecting units

▪ Stance

- The overall position of a person towards a target, such as a topic or claim.

▪ Mining of supporting and objecting units

- The identification of units that have a pro or con stance towards some target.

” *If you wanna hear my view I think that **Con** towards death penalty the death penalty should be abolished.*
Pro towards claim above
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 claim above

▪ How to do stance classification?

- **Approach.** Usually supervised classification based on various text features, partly exploiting dialogue structure, knowledge bases for target matching, ...
- **Results.** Topic-specific approaches with F_1 around 0.70–0.75. (Hasan and Ng, 2013)
Open-topic worse (0.65), but works for confident cases (0.84). (Bar-Haim et al., 2017)

Task 3: Mining argumentative structure

▪ Mining of argumentative structure

- The identification of the roles of argument units (premise, conclusion, ...).
- The classification of relations between units (or arguments) and their types, such as support and attack.

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

▪ How to do identification and classification?

- **Approach.** Usually with supervised learning.
- **Results.** Role identification works rather reliable within genres (F_1 0.77–0.87). Relation identification semi-reliable for explicit argumentation (0.73), but unsolved for “hidden“ argumentation. (Stab, 2017; Al-Khatib et al., 2017)

Task 4: Assessing the structure of argumentation

The death penalty is a legal means that as such is not practicable in Germany.

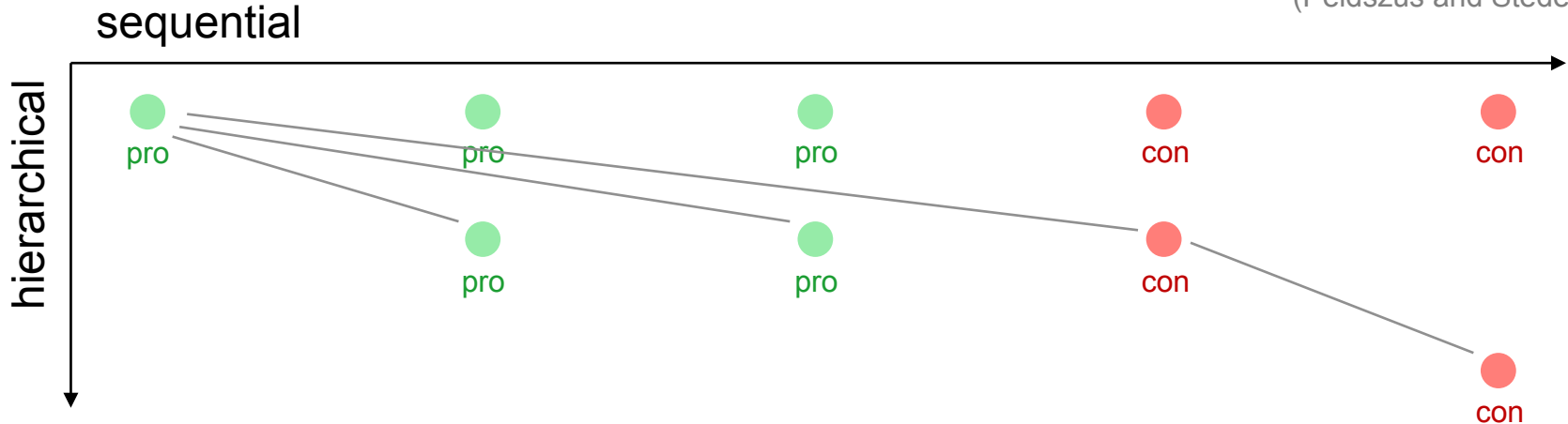
For one thing, inviolable human dignity is anchored in our constitution,

and further no one may have the right to adjudicate upon the death of another human being.

Even if many people think that a murderer has already decided on the life or death of another person,

this is precisely the crime that we should not repay with the same.

(Peldszus and Stede, 2016)



▪ What properties to assess based on structure?

- Organization, stance, myside bias, ... (Wachsmuth and Stein, 2017; Wachsmuth et al., 2017f)

Task 5: Assessing the reasoning of argumentation

▪ Assessment of the reasoning

- Reconstruction of the units of arguments left implicit (called *enthymemes*).
- Classification of the inference scheme from premises to conclusion.

Several schemes exist, such as argument from cause to effect, expert opinion, analogy, ... (Walton et al., 2008)

” 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

▪ How to do scheme classification?

- **Approach.** Usually supervised one-against-others, based on given premises and conclusion (so far, only done for most frequent schemes).
- **Results.** Some schemes easy, e.g., *argument from example* (accuracy 90.6). Others hard, e.g., *argument from consequences* (62.9). (Feng and Hirst, 2011)

Task 6: Assessing the quality of argumentation

▪ Assessment of the quality

- Absolute rating or relative comparison of several logical, rhetorical, and dialectical quality of arguments or argumentation.
- Partly, a highly subjective task.

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. “

▪ How to assess quality?

- **Approach.** Diverse techniques from supervised regression and classification to graph-based analyses.

Task 7: Synthesizing argumentation

- **Synthesis of argumentation**

- The generation of argument units, arguments, and argumentation.
- Either text is created from a knowledge base, or text is rewritten into new text.

- **How to generate arguments?**

- **Approach.** Recycle topics and predicates from existing claims in new claims, combining parsing and supervised classification. (Bilu and Slonim, 2016)

Nuclear weapons contribute to stability.



Democratization contributes to stability.

Nuclear weapons cause lung cancer.

- **Approach.** Change the stance of units while keeping the content using neural sequence-to-sequence models. (Chen et al., 2018)

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

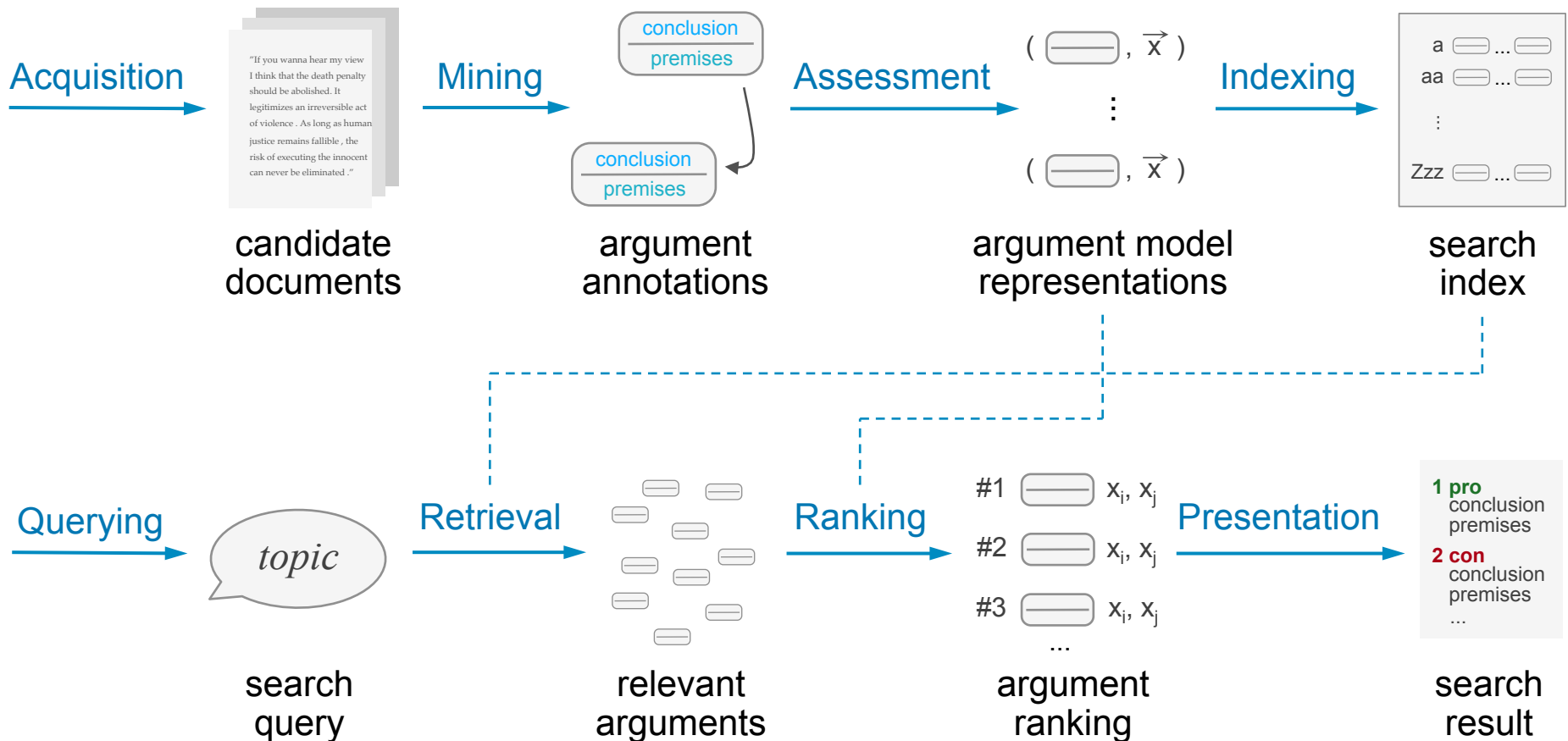


Obama blasted re-election, saying it a "very difficult" to go down.

- **Results.** Often, of limited effectiveness so far (across approaches).

Application: Developing an argument search engine

- Development of an argument search engine
 - Design and realization of the main search processes for arguments



Conclusion

Conclusion

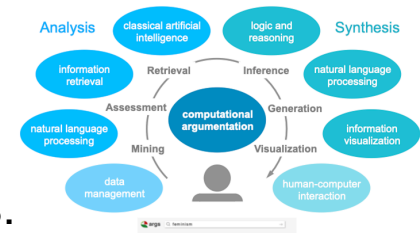
■ Argumentation

- Of ever increasing importance in the "post-factual age".
- Combines arguments with rhetorical and dialectical aspects.
- Used to persuade or agree with others on controversies.



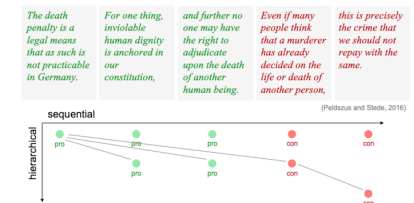
■ Computational argumentation

- The computational analysis and synthesis of arguments.
- Important applications, such as argument search.
- So far (and here), natural language processing in the focus.



■ Main tasks in computational argumentation

- Mining of argument units, their stance, roles, and relations.
- Assessment of structure, reasoning, quality, and similar.
- Generation of units, arguments, and argumentation.



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