

Computational Argumentation — Part VIII

# Applications of Computational Argumentation

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# Learning goals

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## ▪ Concepts

- Overview of applications of computational argumentation
- Details on argument search, debating technology, and writing support



<https://commons.wikimedia.org>

## ▪ Methods

- Processes based on computational argumentation algorithms
- What works well in practice so far and what not
- "Tricks" that can be used in practice



<https://pixabay.com>

## ▪ Associated research fields

- Natural language processing
- Information retrieval



<https://pixabay.com>

## ▪ Within this course


- Understand what can be done with computational argumentation and what the status quo is



# Outline

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- I. Introduction to computational argumentation
- II. Basics of natural language processing
- III. Basics of argumentation
- IV. Argument acquisition
- V. Argument mining
- VI. Argument assessment
- VII. Argument generation
- VIII. Applications of computational argumentation**
- IX. Conclusion

- 
- a) Introduction**
  - b) Argument search
  - c) Debating technology
  - d) Argumentative writing support
  - e) Conclusion

# What are applications of computational argumentation?

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## ▪ Applications

- The term *application* is used in multiple ways in natural language processing:
- **Approaches.** Developed approaches process new data
- **Downstream tasks.** General NLP techniques are used for specific tasks  
For instance, computational argumentation itself is an application of techniques such as text classification.
- **Technologies.** Developed approaches are deployed in software.  
This is what is meant here.

## ▪ Application in technologies

- Software applications that use computational argumentation to solve real-world tasks
- Examples follow on the next slide.



<https://de.wikipedia.org>

## ▪ Argumentation in these applications

- Argumentative utterances (text or speech) may be given as input.
- Argumentative utterances may be provided as output.
- Other output may be computed from argumentative utterances.

# Overview of applications

## Argument search

(Wachsmuth et al., 2017e)



## Debating technology

(Slonim et al., 2021)



<https://commons.wikimedia.org>

## Writing support

(Stab, 2017)



<https://www.publicdomainpictures.net>

## Deliberative democracy

(Plüss et al., 2018)



<https://www.uni-konstanz.de>

## Automated decision making

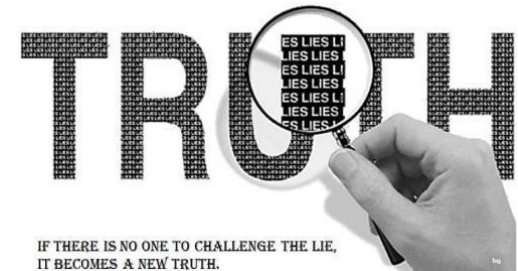
(Bench-Capon et al., 2009)



<https://pixabay.com>

## Fact checking

(Samadi et al., 2016)



IF THERE IS NO ONE TO CHALLENGE THE LIE,  
IT BECOMES A NEW TRUTH.

<https://commons.wikimedia.org>

# Computational argumentation in the media



Sign in The...  
SingularityHub

ITUNews  
VB

AI

## IBM is bringing Project Debater to Watson

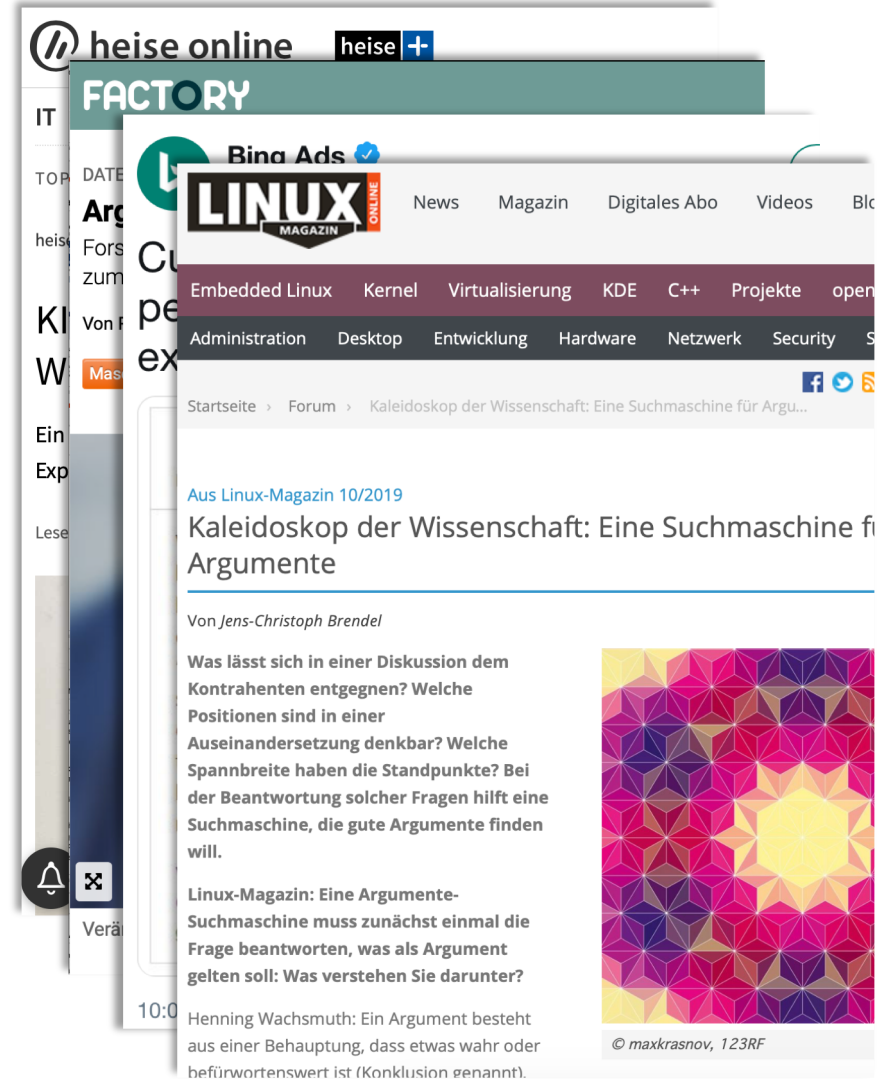
KHARI JOHNSON @KHARIJOHNSON MARCH 10, 2020 9:01 PM



Project Debater Dan Zafrir

Dan Zafrir and Project Debater compete at IBM offices in San Francisco in June  
Image Credit: IBM Research

IBM today announced plans to integrate Project Debater into Watson products like Watson NLP, Watson Knowledge Studio, and Watson Dis



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FACTORY

Bina Ads

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Startseite > Forum > Kaleidoskop der Wissenschaft: Eine Suchmaschine für Argu...

Aus Linux-Magazin 10/2019

## Kaleidoskop der Wissenschaft: Eine Suchmaschine für Argumente

Von Jens-Christoph Brendel

Was lässt sich in einer Diskussion dem Kontrahenten entgegenen? Welche Positionen sind in einer Auseinandersetzung denkbar? Welche Spannweite haben die Standpunkte? Bei der Beantwortung solcher Fragen hilft eine Suchmaschine, die gute Argumente finden will.

Linux-Magazin: Eine Argumente-Suchmaschine muss zunächst einmal die Frage beantworten, was als Argument gelten soll: Was verstehen Sie darunter?

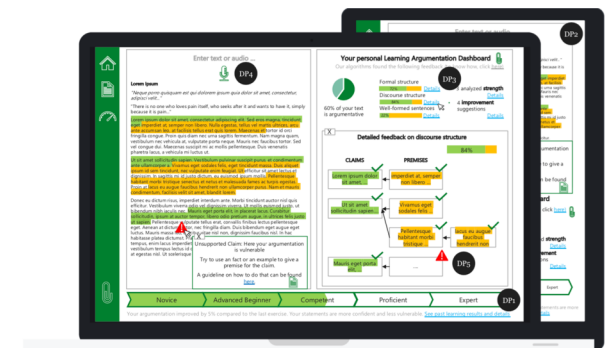
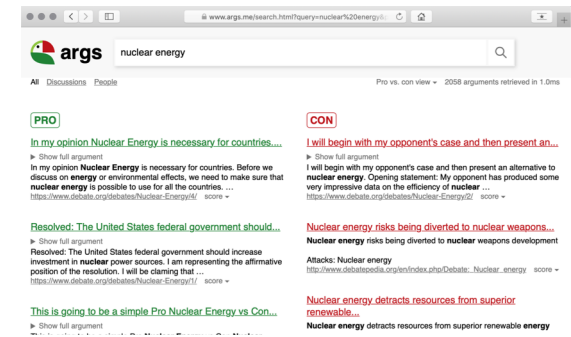


© maxkrasnov, 123RF

Henning Wachsmuth: Ein Argument besteht aus einer Behauptung, dass etwas wahr oder befürwortenswert ist (Konklusion genannt).

# Applications in the focus here (recap)

- **Argument search** (Wachsmuth et al., 2017e)
  - **What.** Find arguments on controversial issues and oppose best pro's and con's
  - **Why.** Support self-determined opinion formation
- **Debating technology** (Slonim et al., 2021)
  - **What.** Present arguments for controversial issue and argue for a stance towards the issue
  - **Why.** Support decision making
- **Argumentative writing support** (Stab, 2017)
  - **What.** Assess quality of argumentative text and provide feedback to text
  - **Why.** Support learning of argumentative writing



# Next section: Argument search

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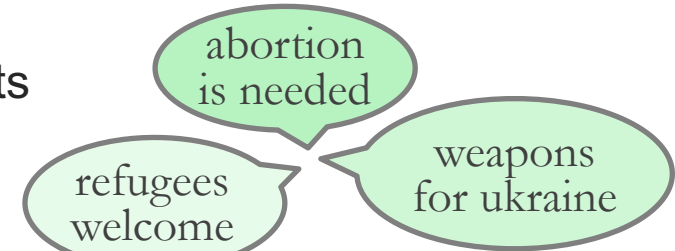
- a) Introduction
- b) Argument search**
- c) Debating technology
- d) Argumentative writing support
- e) Conclusion



# What is argument search?

## ■ Argument search

- A technology that finds and opposes arguments in response to queries on controversial issues



## ■ Scenario of argument search

- Help people form opinions on controversial issues.
- Make it easy to find relevant arguments.
- Avoid being biased towards either stance.

## ■ Goals of argument search

- Rank the *best* arguments highest.
- Cover diverse aspects.
- Cover reliable and heterogeneous sources.
- Cover the most recent arguments.
- Present arguments concisely.

... and much more

The screenshot shows the 'args' website interface. At the top, there is a search bar with the word 'abortion' entered. Below the search bar, the page is divided into two main columns of search results. The left column is labeled 'PRO' and contains several arguments, such as 'Abortion is the ending of pregnancy by the removal or...' and 'Great, another forfeiter. As someone who has debated abortion before...'. The right column is labeled 'CON' and contains arguments like 'In 2011 there were about 730,322 abortions reported to...' and 'The greatest destroyer of peace is abortion because if a...'. Each argument entry includes a title, a brief description, and a link to the full argument. The page also displays the number of arguments retrieved (5238) and the version (1.0 ms).

# Overview of argument search

## ▪ Characteristics of argument search

- All existing systems oppose pro and con arguments for an issue.
- Main differences lie in the sources, processing paradigms, and interfaces.

## ▪ Available argument search engines

- [args.me](#). Indexes debate portal arguments; retrieves relevant arguments in response to queries
- [ArgumenText](#). Indexes diverse web pages; mines relevant arguments in response to queries
- [PerspectroScope](#). Similar to ArgumenText for debate portals and Wikipedia texts
- [Bing Multi-Perspective Answers](#). 1 pro and 1 con point on selected issues, integrated in web search

So far, included in US version only



<https://seas.upenn.edu>



<https://de.wikipedia.org>

## ▪ Notice

- IBM's Project Debater is not covered here but under *debating technology*. Its main tasks resemble argument search, but the intended use case differs.

# Example: [args.me](https://args.me)



nuclear energy



All [Discussions](#) [News](#) [People](#)

Pro vs. con view ▾ 2018 arguments retrieved in 489.0 ms

PRO

[We're dependent on thermal power and fuels so nuclear...](#)

► Show full argument

We're dependent on thermal power and fuels so **nuclear energy** will be a useful hand of help. ... 1:<http://www.forbes.com...> 2:[http://www.cand...gov...](http://www.cand...)  
<https://www.debate.org/debates/Nuclear-Energy/4/> score ▾

[The most up-to-date study, conducted at the Forsmark...](#)

► Show full argument

The most up-to-date study, conducted at the Forsmark **nuclear** power facility in Sweden during 2005, shows that the plant was producing only 3.10 grams of CO2 per kilowatt per hour [1]. ... Sources: [1] ...  
<https://www.debate.org/debates/Nuclear-Energy/1/> score ▾

[Thermal energy causes the global warming which is the...](#)

► Show full argument

Thermal **energy** causes the global warming which is the most important world discussion and the most dangerous natural disaster of our generation. ... I wish my best lucks to my opponent 1.<http://www.fi.edu...> ...  
<https://www.debate.org/debates/Nuclear-Energy/4/> score ▾

[So If we are arguing about countries, and we are, we need...](#)

CON

[There are high protocol, likely classified, to protect...](#)

► Show full argument

There are high protocol, likely classified, to protect the integrity of **nuclear** facilities in developed nations. ... Thank you!  
<https://www.debate.org/debates/Nuclear-Energy/2/> score ▾

[nuclear energy risks being diverted to nuclear weapons...](#)

► Show full argument

**Nuclear energy** risks being diverted to **nuclear** weapons development  
[http://www.debatepedia.org/en/index.php/Debate:\\_Nuclear\\_energy](http://www.debatepedia.org/en/index.php/Debate:_Nuclear_energy) score ▾

[Nuclear energy detracts resources from superior renewable...](#)

► Show full argument

**Nuclear energy** detracts resources from superior renewable **energy**  
[http://www.debatepedia.org/en/index.php/Debate:\\_Nuclear\\_energy](http://www.debatepedia.org/en/index.php/Debate:_Nuclear_energy) score ▾

[Likewise, there is no doubt that there ae inherent...](#)

► Show full argument

Likewise, there is no doubt that there ae inherent dangers associated with **nuclear**, and we have yet to discover a feasible way to dispose of the toxic

demo

# Computational tasks in argument search

**args** feminism

All Discussions News People **relevance assessment** Topic space view ▾ 1031 arguments retrieved in 1.0 ms

**PRO** Instead of measuring themselves against men, women should...  
► Show full argument  
Instead of measuring themselves against men, women should make their own activities more visible and valued. ... Want to do away with the dehumanization of women in pornography You say that **feminism** has "gone too far," but before ...  
<https://www.debate.org/debates/feminism/29/> score ▾

**PRO** Feminism is the ACT of Advocating (though perhaps...  
► Show full argument  
**Feminism** is the ACT of Advocating (though perhaps passively in some circumstances) against Woman Abuse, and EVERYTHING which leads to women being slandered - Including False propaganda of **Feminism** by SLuts who enable ...  
<https://www.debate.org/debates/Feminism./1/> score ▾

**PRO** If Con cannot, then this debate must concede that...  
► Show full argument  
If Con cannot, then this debate must concede that **Feminism** is about equality between men and women by definition. ... Therefore, like me, Con is for **Feminism** as defined in the dictionaries. ...  
<https://www.debate.org/debates/Feminism/21/> score ▾

**quality assessment**

**stance classification**

**snippet generation**

**argument mining**

**frame identification**

**... and more**

# Argument search process: Concept

Determine arguments relevant to a query

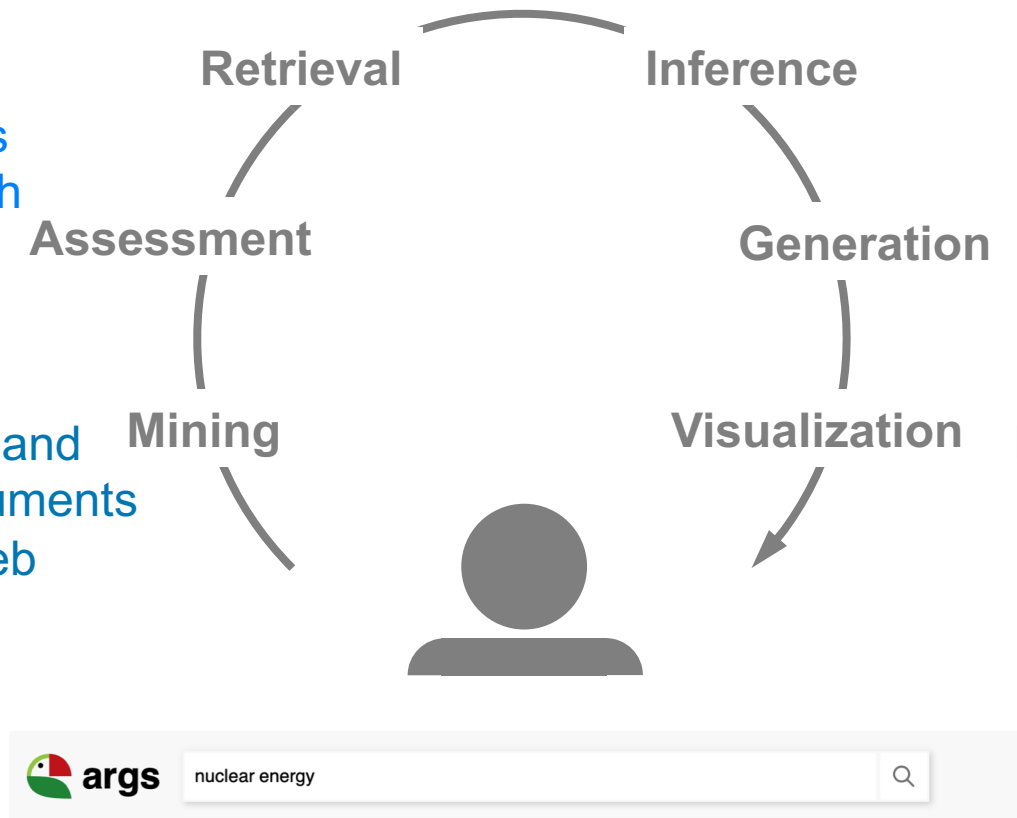
Derive further information related to arguments

Assess properties of arguments, such as quality

Create results in response to query

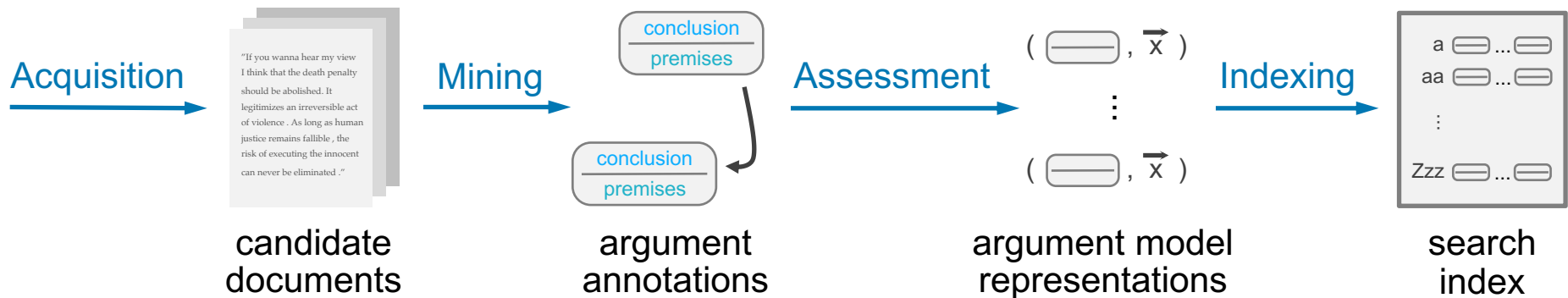
Mine content and structure of arguments from the web

Present results and allow for interaction

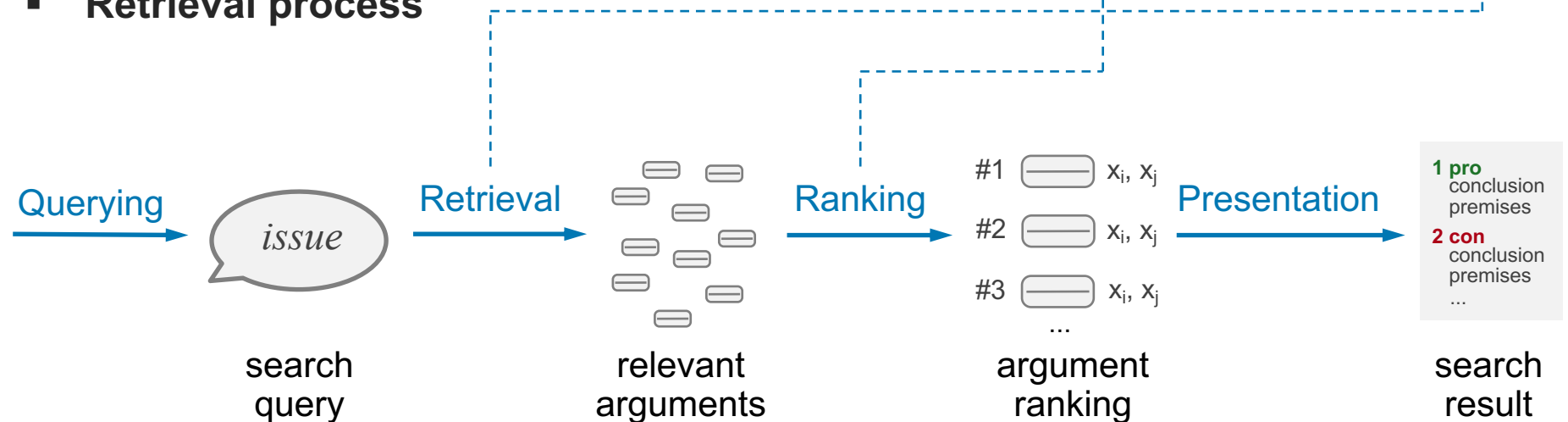


# Argument search process in args.me (Wachsmuth et al., 2017e)

## Indexing process



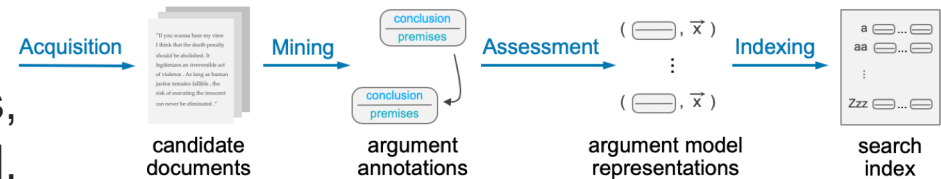
## Retrieval process



# Argument search process in args.me: Steps

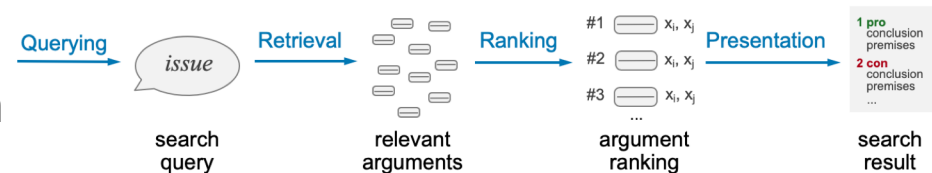
## Indexing process

- **Acquisition.** Crawl candidate texts, in which arguments may be found.
- **Mining.** Mine arguments from the candidate texts.
- **Assessment.** Assess properties of the mined arguments, such as quality.
- **Indexing.** Store arguments in search index.



## Retrieval process

- **Querying.** A user enters a query on a controversial issue or claim.
- **Retrieval.** Determine indexed pro and con arguments relevant to the query.
- **Ranking.** Sort arguments by relevance, quality, recency, or similar.
- **Presentation.** Present arguments, such that the user can interact with them.



## Argument search framework

- The decomposition into eight steps defines a framework that allows stepwise working towards the goals of argument search.

# Indexing process in args.me (status quo)

## Argument model in args.me

- A conclusion and  $k$  premises with a stance towards the conclusion

Along with different meta-information, such as the URL

conclusion  
pro/con premises

- Basically applicable to all arguments
- Allows treating all arguments equally

## Indexing process

- "Mining". Distant supervision on four debate portals  
[idebate.org](http://idebate.org), [debatepedia.org](http://debatepedia.org), [debatewise.org](http://debatewise.org), [debate.org](http://debate.org)
- Assessment. Only general filtering so far

## Result

- Index. 387,606 nearly balanced arguments

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



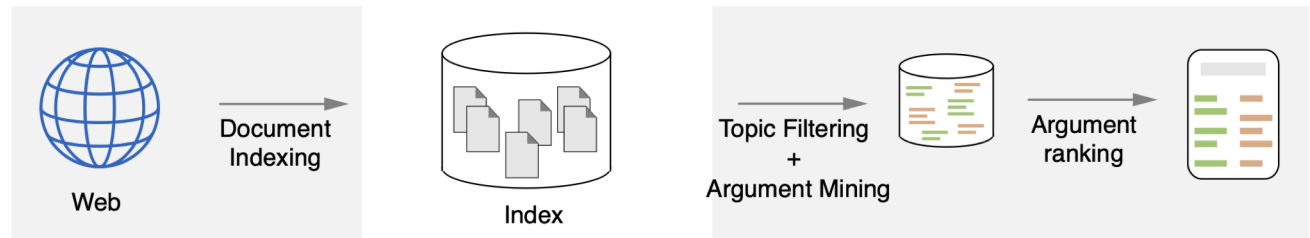
# Indexing process: Acquisition paradigms (Ajjour et al., 2019)

## Argument acquisition paradigm

- A choice of data sources, along with a method to obtain arguments

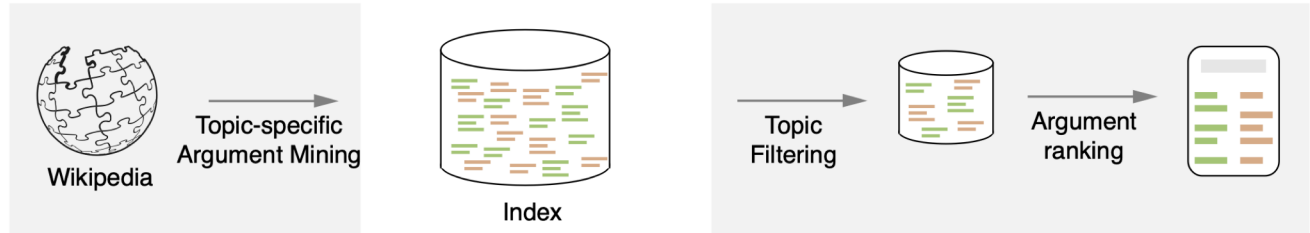
## ArgumentText

- Lower precision
- Higher recall
- Slower



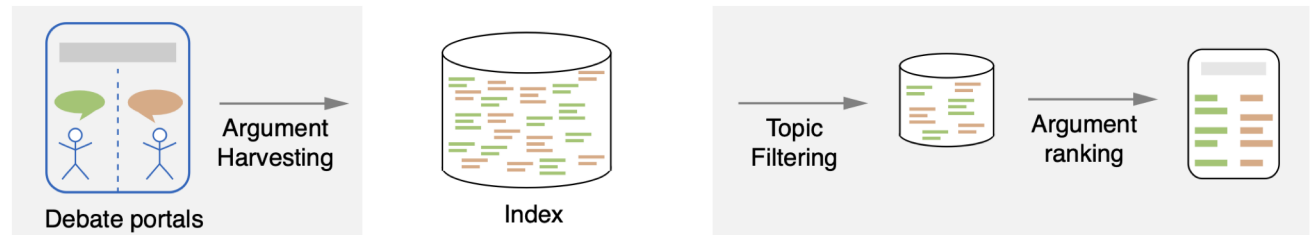
## Project Debater

- Higher precision
- Lower recall
- Faster



## args.me

- High precision
- Low recall
- Faster



**Offline** (indexing time)

**Online** (querying time)

# Retrieval process in args.me (status quo)

## ■ Querying

- Free text *phrase* and *and* queries possible
- No argument-specific interpretation so far

## ■ Retrieval

- For precision, only the conclusion is matched with the query terms.
- Stance is simply taken from premises so far.

## ■ Ranking

- Arguments are scored with weighted BM25F.  
BM25F is a variant of TF-IDF (Robertson and Zaragoza, 2009).
- No quality assessment so far

## ■ Presentation

- Different views (pro vs. con, topic space)
- Snippets based on extractive summarization  
(Alshomary et al., 2020b)



nuclear energy|



[Nuclear radiation is clearly hazardous but the practices...](#)

▼ Show full argument

**Nuclear** radiation is clearly hazardous but the practices at Fukushima were less than safe. Fukushima was not a Chernobyl but it was a horrible occurrence. The reason it made international news is because that because of the hazard of **nuclear energy**, there are many safety practices. I'd like to share a New York Times headline: No Survivors Found After West Virginia Mine Disaster. Twenty nine people are dead. Certainly the alternative can be just as harmful as **nuclear energy**. Thank you for letting me debate this with you.

Attacks: Nuclear energy should not be used.

<https://www.debate.org/debates/Nuclear-energy-should-not-be-used./1/> score ▼

BM25 score: 34.05

nuclear: 17.45

conclusion: 8.76 (boost 1.50, idf 5.26, tfNorm 1.11)

premises: 7.57 (idf 4.12, tfNorm 1.83)

sourceText: 1.12 (boost 0.20, idf 2.66, tfNorm 2.11)

energy: 16.60

conclusion: 9.52 (boost 1.50, idf 5.72, tfNorm 1.11)

premises: 6.20 (idf 3.66, tfNorm 1.69)

sourceText: 0.89 (boost 0.20, idf 2.10, tfNorm 2.11)

[PRO Greetings! Thank you for this debate. this should be fun!...](#)

► Show full argument

Greetings! Thank you for this debate, this should be fun! In accepting this debate I do not pretend to stand for all of **feminism** seeing as there are many different sects of the movement. ...  
<https://www.debate.org/debates/Feminism/29/> score ▼

[PRO Feminism Has NO gender. I am a Man And I am A Feminist...](#)

► Show full argument

**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 Advocating (though ...  
<https://www.debate.org/debates/Feminism/1/> score ▼

[PRO Feminism is definitely something that there needs to be...](#)

► Show full argument

**Feminism** is definitely something that there needs to be more of in the world. Feminists just want to have equal rights, not overpower men. People who say they are feminists but say women ...  
<https://www.debate.org/debates/Feminism/12/> score ▼



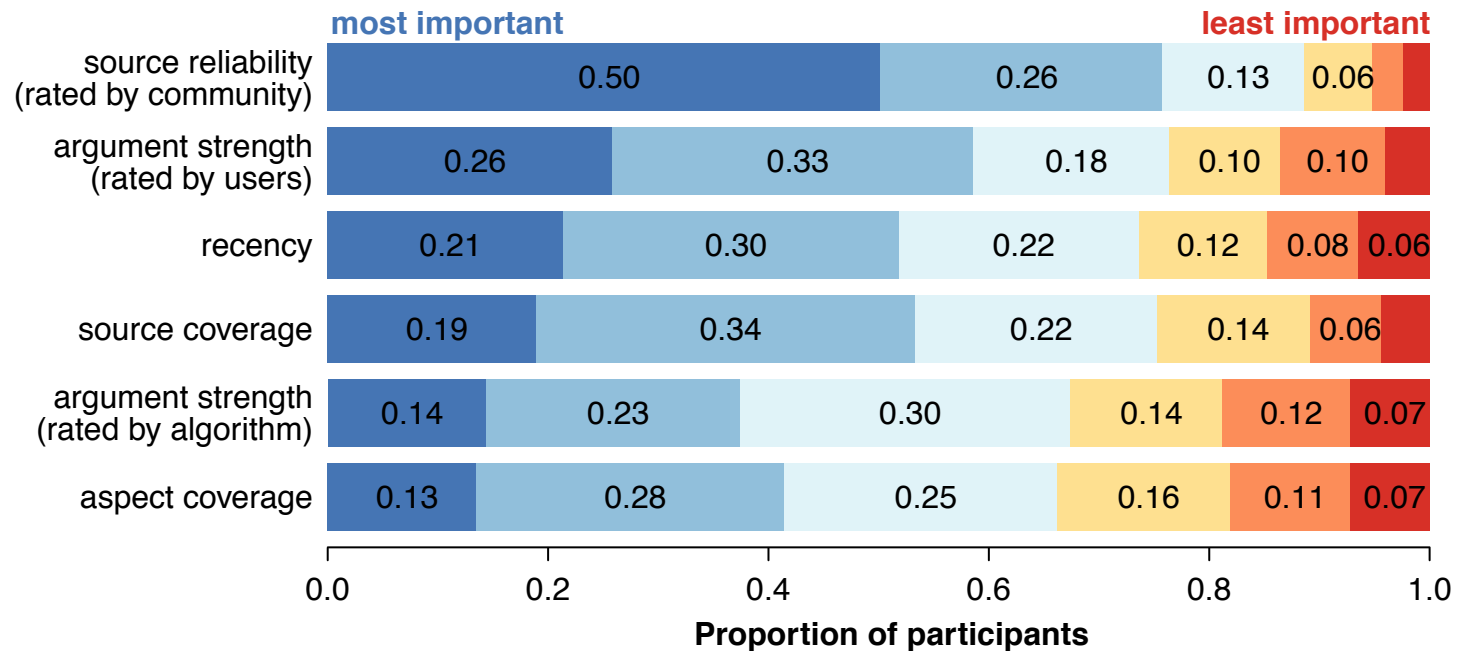
# Retrieval process: How to rank search results? (Kiesel et al., 2020)

## ▪ User study on argument ranking

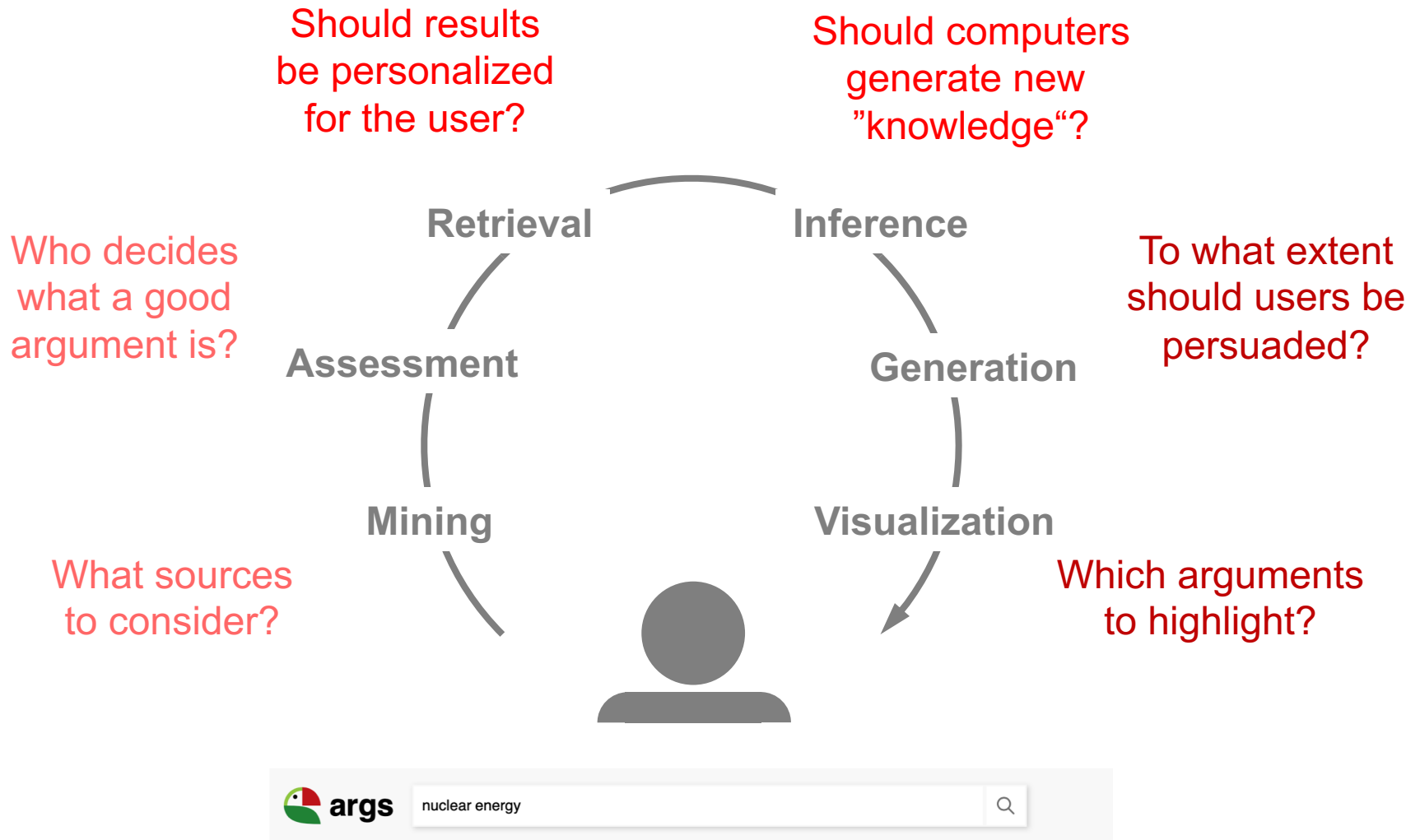
- Crowdsourcing study on MTurk with 500 participants from 11 countries
- The participants assessed the importance of six argument ranking criteria

## ▪ Results

- Reliability of sources is clearly seen as most important.
- Other criteria are rather close to each other.



# Ethical questions in argument search



# Discussion of argument search

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## ▪ **Need for argument search?**

- Self-determined opinion formation is getting harder in our times.
- Argument search shows a way of how to leave your echo chamber.
- So far, web search engines support argument search insufficiently.

## ▪ **Computational tasks in argument search**

- Mining and stance classification are required to provide arguments as results, even though the realization may be simple (as for args.me).
- Quality assessment is likely to enhance the ranking of search results.
- Argument generation is so far used for snippet generation only.


## ▪ **Status quo of argument search**

- Prototypical search engines, such as args.me and ArgumenText exist.
- The general concept seems to work and is well-received.
- Still, challenges at several ends prevent it from being industry-ready yet, from large-scale up-to-date acquisition to convincing rankings.

# Next section: Debating technology

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# What is decision assistance?

## ■ What is debating technology?

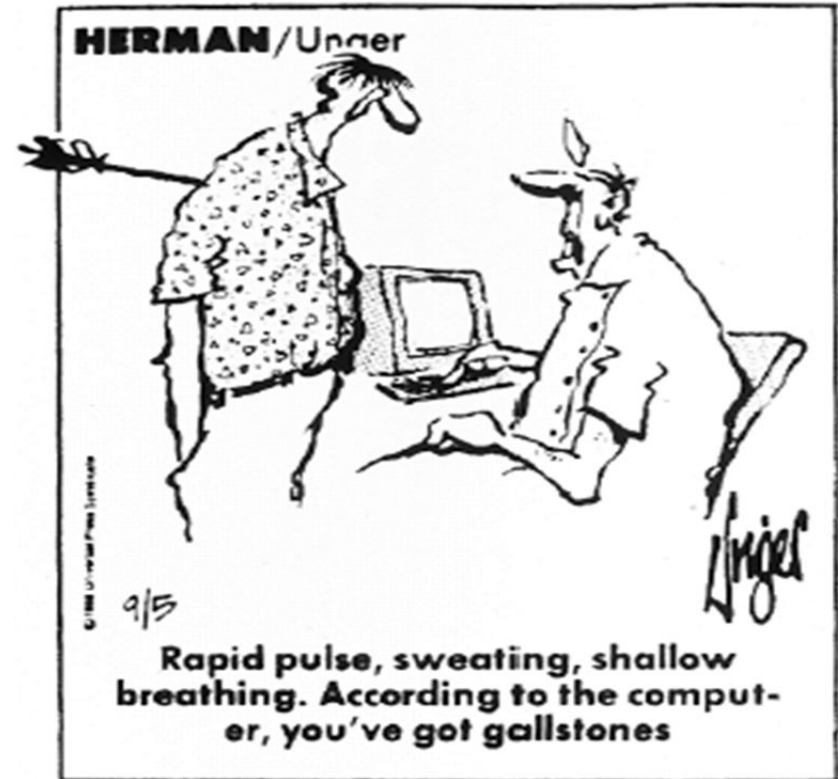
- Technology that debate humans on controversial issues
- The most widely-known such system is IBM's *Project Debater*.
- The underlying idea is to showcase algorithms for *decision assistance*.

## ■ Decision assistance (aka decision support)

- Analysis of data to help people make decisions about problems

## ■ Scenarios of decision assistance

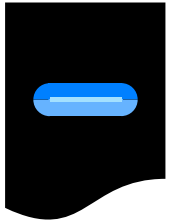
- Professional scenarios include medical diagnosis and market trading.
- Also, personal assistants such as Siri and Alexa directly entail applications.
- In controversial contexts, weighing pros and cons may support more informed and self-determined decisions.



# Example: Project Debater

## ▪ Project Debater

- A system that can debate humans on (potentially) arbitrary issues
- In 2019, showcased on *intelligence*<sup>2</sup> against a top human debater



## ▪ Intelligence<sup>2</sup> debates

- US TV show where two parties debate against each other.
- **Stages.** Opening (4 minutes each), rebuttal (4 each), closing (2 each)
- **Goal.** Change stance of audience (who votes before and afterwards)  
Additional question in the given debate: "Who better enriched your knowledge?"
- **Winner.** The side who has more votes after the debate than before

*intelligence*<sup>2</sup>  
THE WORLD OF DEBATE

<https://en.wikipedia.org>

## ▪ Showcase <https://research.ibm.com/interactive/project-debater/live/>

- **Issue.** "We should subsidize preschool"  
The issue was chosen from curated list, but not trained on.
- **Stances.** Project Debater is **pro**, Harish Natarajan is **con**
- **Background.** Parties given 15 minutes for preparation



<https://flickr.com>

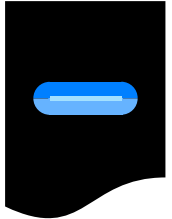


# Project Debater showcase: Opening

## ▪ Opening Project Debater

- Video: Minutes 11:25 – 15:03 (intro starts at 10:50)
- Observations?

Discussed orally



## ▪ What is done (during preparation)

- **Input.** ~10B preprocessed, indexed sentences from 400M news articles
- Retrieve a few hundred relevant text segments, remove redundancy.
- Select the strongest segments classified as pro/con claims and evidence.
- Arrange them by clustered themes to create a narrative.
- Phrase a full text and convert it to speech.
- **Output.** A four-minutes speech

## ▪ Opening Harish Natarajan

- Video: Minutes 15:42 – 19:50 (intro starts at 15:28)
- Observations?

Discussed orally

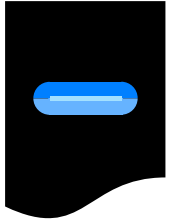


# Project Debater showcase: Rebuttal

## ▪ Rebuttal Project Debater

- Video: Minutes 24:36 – 28:40 (intro starts at 24:22)
- Observations?

Discussed orally



## ▪ What is done (during break)

- **Input.** Opening speech of Harish Natarajan (and own speech)
- Recognize spoken language and transcribe it to text.
- Preprocess text in several standard NLP analyses.
- Mine claims and key concepts from text.
- Construct rebuttal (similar to opening steps).
- **Output.** A four-minutes speech

## ▪ Rebuttal Harish Natarajan

- Video: Minutes 28:58 – 33:14 (intro starts at 28:48).
- Observations?

Discussed orally

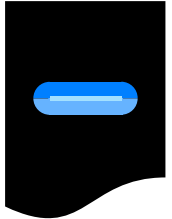


# Project Debater showcase: Closing and results

## ▪ Closing Project Debater

- Video: Minutes 37:44 – 39:35 (intro starts at 37:29)
- Observations?

Discussed orally



## ▪ Closing Harish Natarajan

- Video: Minutes 39:52 – 42:17 (intro starts at 39:43)
- Observations?

Discussed orally



## ▪ Results

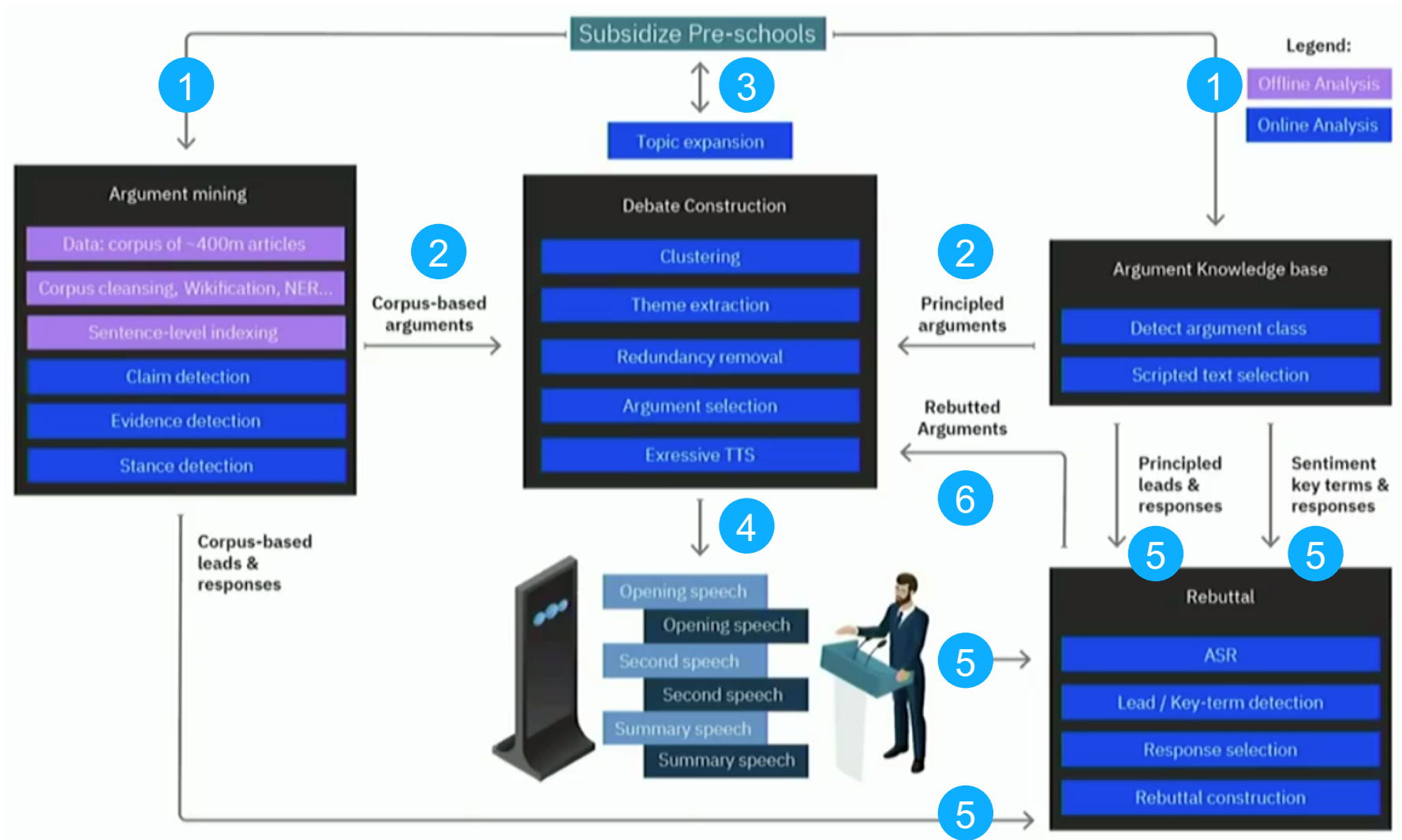
- Video: Minutes 52:48 – 54:36
- **Before the debate.** 79% pro, 13% con, 8% undecided
- **After the debate.** 62% pro, 30% con, 8% undecided

Knowledge enrichment: 55% Project Debater, 22% Harish Natarajan, 23% undecided

## ▪ Conclusion

- Human debater won, but Project Debater competed well.

# Project Debater: The process behind



Screenshot from <https://www.facebook.com/events/492661778290843/> (March 27, 2020)

Learn more? See the Project Debater documentary: [www.theverge.com/ad/21244164/project-debater-film-artificial-intelligence](http://www.theverge.com/ad/21244164/project-debater-film-artificial-intelligence)

# Discussion of debating technology


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- **Need for debating technology and decision assistance**
  - Automated decision making is generally a main envisioned application of "intelligent" technologies.
  - The discussed technology extends this to controversial contexts.
- **Computational tasks in debating technology**
  - Systems such as Project Debater cover various analysis and synthesis tasks.
  - Argument mining and stance classification are core components.
  - Quality assessment is recently studied more, mainly for selecting arguments.
  - Argument generation seems to be largely composition-based.
- **Status quo of debating technology**
  - Project Debater appears to work rather convincingly in its given setting.
  - Core features are meanwhile integrated into IBM Watson, including multi-text summarization and advanced sentiment analysis.
  - How well it works in the "real" world, is still being observed.

# Next section: Argumentative writing support

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- I. Introduction to computational argumentation
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- 
- a) Introduction
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# What is argumentative writing support?

## ■ Argumentative writing support

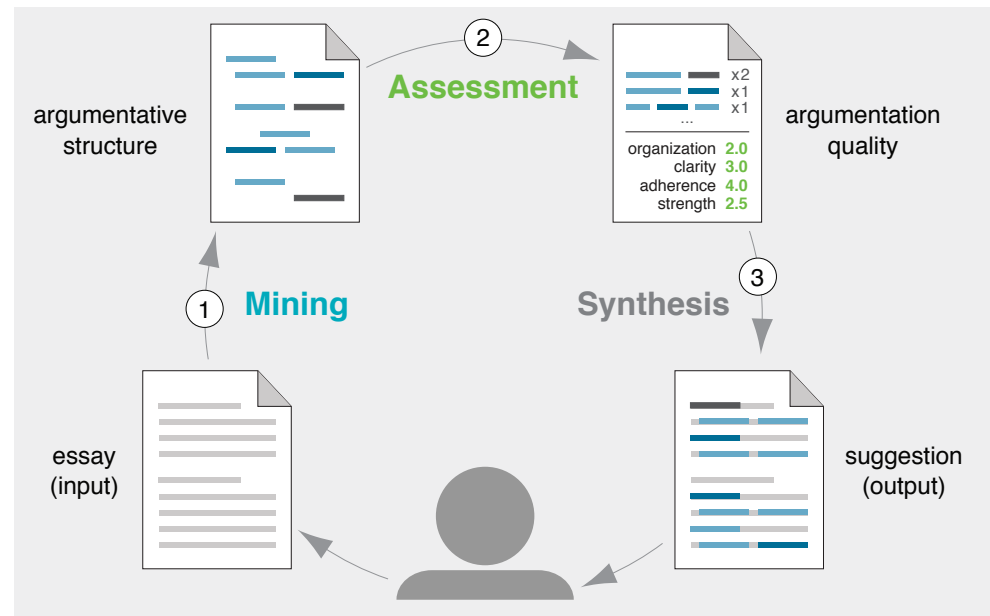
- A technology that automatically analyzes argumentative texts (e.g., essays), in order to provide feedback to the authors

## ■ Typical process

- The user enters a text draft into the system.
- The system analyzes the draft to synthesize feedback for the user.
- The user revises the draft and repeats the process.

## ■ Main computational steps

1. **Mining** of the argumentative structure of a written text draft
2. **Assessment** of specific quality dimensions based on the mined structure
3. **Synthesis** of feedback in terms of suggestions for improvements



# Overview of argumentative writing support

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## ■ Scenarios of argumentative writing support

- **Teaching** of argumentative writing
- **Optimization** of the persuasive effectiveness of texts
- **Increase** of writing speed

... and similar



<https://www.publicdomainpictures.net>

## ■ Selected applications of argumentative writing support

- Argumentation-related essay scoring (Wachsmuth et al., 2016)  
<https://demo.webis.de/essay-scoring>
- Argumentative writing support system for essays (Stab, 2017)
- Learning support system for arguing skills (Wambsganss et al., 2020)

## ■ Related applications

- **Build-in tools** for orthography and syntax checking (e.g., in Microsoft Word)
- **Professional writing tools** even analyze style, tone, etc. (e.g., Grammarly)
- **Augmented writing tools** actively complete text drafts (e.g., textio flow)

All these may be integrated with argumentative writing support.



# Argumentative writing support system for essays (Stab, 2017)

## ▪ System

- A tool that gives formative feedback to English persuasive student essays
- **Components.** Argument analysis, feedback generation

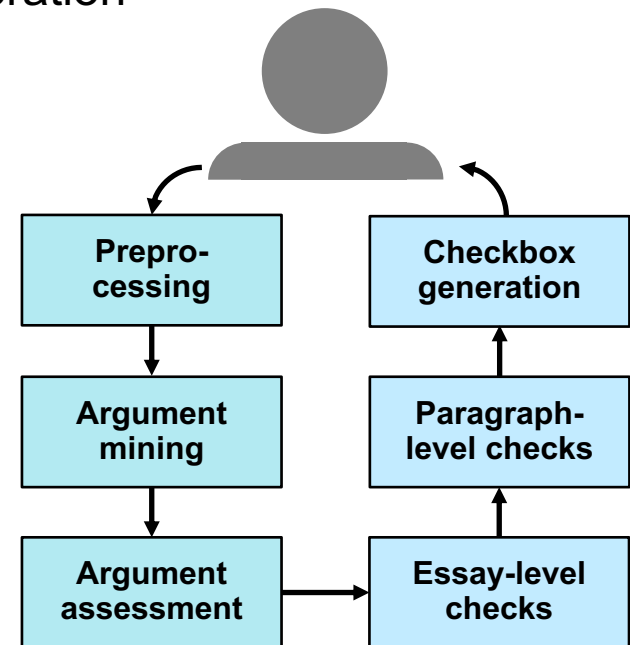
Fully implemented prototype, but not made publicly available

## ▪ Argument analysis

- **Preprocess** essay with several NLP analyses.
- **Mine** arguments using model of Stab (2017).
- **Assess** myside bias of the essay and local sufficiency of each paragraph.

## ▪ Feedback generation


- **Check** for three essay-level structural criteria.  
(1) Title present? (2) 4+ paragraphs? (3) Myside bias?
- **Check** for nine paragraph-level structural criteria.  
(1) Thesis present in first paragraph? (2) 2+ premises for each conclusion? (3) 1+ arguments in body? (4–9) ...
- **Generate** feedback in terms of whether each criterion is fulfilled or not.




# Argumentative writing support system for essays: Demo

(1) Essay & Argument Components

(2) Selection of Feedback Types



## Argumentative Writing Support



Essay Feedback | **Detailed Feedback** | Argumentation Structure

	Essay	Feedback	Details
Title	Using animals for the benefit of the human beings		
Paragraph1	With the rapid development of the standard of people's life, increasing numbers of animal experiments are done, new medicines and foods, for instance. Some opponents says that it is cruel to animals and nature, however, I believe that no sensible person will deny that it is a dramatically cruel activity to humanity if the latest foods or medicines are allowed to sold without testing on animals. In my essay, I will discuss this issue from twofold aspects.	<ul style="list-style-type: none"> <li>✓ Thesis statement present</li> <li>✓ Introduction of topic present</li> <li>✓ No Arguments present</li> </ul>	<p>A claim is a controversial statement that should not be accepted without additional support. An unsupported claim in your essay is a weak point of your argumentation, since it can be easily refuted and questioned by an opponent. In order to make your essay more stronger, you should provide reasons for each claim.</p> <p>The example below illustrates a body paragraph including an unsupported claim (bad example). We show that the same paragraph becomes more persuasive after adding premises that support the claim (good example).</p> <p style="text-align: center;"><b>Bad example:</b></p> <p><i>First, [cloning will be beneficial for many people who are in need of organ transplants]<sub>Claim1</sub>. Cloning is the process of producing similar populations of genetically identical individuals that occurs in nature when organisms such as bacteria, insects or plants reproduce asexually.</i></p> <p style="text-align: center;"><b>Good example:</b></p> <p><i>First, [cloning will be beneficial for many people who are in need of organ transplants]<sub>Claim1</sub>. [Cloned organs will match perfectly to the blood group and tissue of patients]<sub>Premise1</sub> since [they can be raised from cloned stem cell of the patient]<sub>Premise2</sub>. In addition, [It shortens the healing process]<sub>Premise3</sub>.</i></p> <p>The author of this paragraph wants to highlight the importance of cloning for people who need organ transplant. In the bad example, no support was provided. So after reading the paragraph it is very unlikely that reader understands <b>why</b> cloning is beneficial for people who need organ transplants. In contrast, the good example includes several premises that support the claim. Also, the first premise deals as a support for the second premise. Due to the provided reasons, the reader can understand why the author claims that what she/he claims. Thus, it is highly recommend to include enough reasons or evidence for your claims in the body paragraphs.</p>
Paragraph2	First of all, as we all know, animals are friendly and vital for people, because if there are no animals in the world, the balance of nature will broke down, and we, human, will die out as well. The animal experiments accelerate the vanishing of some categories of animals. In other words, doing this various testing is a hazard of human's future and next generation.	<ul style="list-style-type: none"> <li>✓ Argument present</li> <li>✓ One argument per paragraph</li> <li>✓ No unsupported claims present</li> <li>✗ Claim present in the first sentence</li> <li>✓ Appropriate number of reasons present</li> </ul>	
Paragraph3	Though animal experiments have negative impact on the natural balance, it is necessary to make sure that people can live a long life. To begin with, it is indisputable that every new kind food or pill may be noxious, and scientists must do something to insure that the new invention benefits people instead of making people ill or even dying. The new foods or medicines are invented to promote the quantity of human's life. Thus even if they are volunteers; they cannot take the place of animals to test the new foods or medicines. Furthermore, it also have potentially harm for human's health without any testing.	<ul style="list-style-type: none"> <li>✓ Argument present</li> <li>✓ One argument per paragraph</li> <li>✓ No unsupported claims present</li> <li>✗ Claim present in the first sentence</li> <li>✓ Appropriate number of reasons present</li> </ul>	
Paragraph4	To sum up, I reaffirm that although there is some disadvantages of animals' profits, the merits of animal experiments still outweigh the demerits.	<ul style="list-style-type: none"> <li>✗ Restatement of thesis statement present</li> </ul>	

(3) Feedback Types

(4) Feedback Details

# Learning support system for arguing skills (Wambsganss et al., 2020)

## ■ System

- A tool that provides visual feedback to the structure and quality of German argumentative texts

Not tailored to specific genre; so far, trained on business process model reviews

- Underlying idea similar to the system of Stab (2017)

Also not publicly available so far, but used at University of St. Gallen



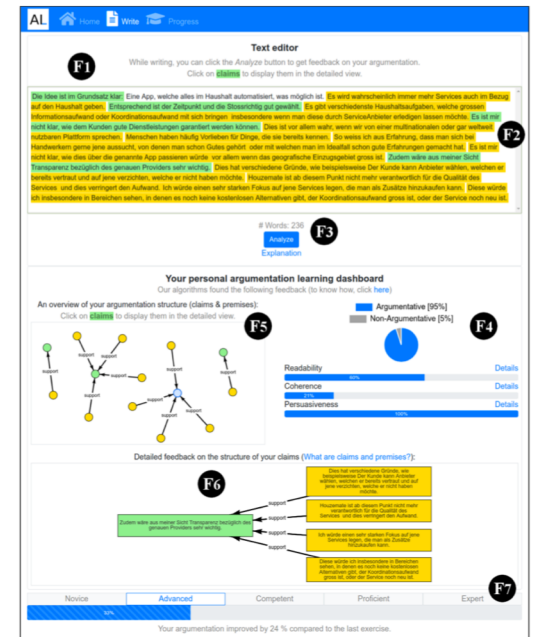
## ■ Argument analysis

- Mine claims, premises, and support relations.
- Assess readability, coherence, and persuasiveness.

The assessment is based on rudimentary rule-based approaches.

## ■ Feedback generation

- In-text highlighting of argumentative structure
- Graph visualization of argumentative structure, with detail view showing structural flaws
- Bar-chart visualization of quality dimensions



# Learning support system for arguing skills: Demo

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AL

## An Adaptive Learning Support System for Argumentation Skills

Goal: Improve the users' argumentation skills by providing **immediate, individual feedback** using a **ML-based analysis** of their argumentation structure in written texts.

(thanks to Christina Niklaus from University of St. Gallen for providing this video)

# Augmented writing

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## ▪ Augmented writing

- A variant of writing support that semi-automatically transforms or completes a text segment written by a user

Alternatively, it may suggest alternatives to a given sentence or similar.

- Augmented writing may also include other typical features of writing support.

*”need rescue boats“*



*”Rescue boats are needed in the mediterranean sea, because, without, innocent people will die.“*

## ▪ How does that work?

- Identify and reuse similar content from previous texts.
- Adapt style and phrasing to given text segment.

Recall ”Talk to Transformer“ in this regard (see lecture part VII).

## ▪ Augmented argumentative writing?

- Augmented writing has not been explicitly studied yet for argumentation.
- But potential use cases are apparent.
- Only few augmented writing technologies exist yet, one of which is *textio flow*.

# Augmented writing: Demo (commercial video)

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<https://textio.com/products/flow/>

# Discussion of argumentative writing support

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## ▪ **Need for argumentative writing support?**

- Argumentative writing is a standard task in school education, taught at different ages and across subjects.
- In times of digitization and online education, automation is getting important.
- Could become part of standard text processing tools one day

## ▪ **Computational tasks in argumentative writing support**

- Argument mining and quality assessment lay the ground for writing support.
- Other assessments and standard text analyses may complement this.
- Argument generation may be needed for augmented writing.

## ▪ **Status quo of argumentative writing support**


- The focus of existing systems is clearly on argument mining.
- Quality assessment and feedback generation are rather rudimentary so far.
- The value of the systems may be questionable, if they make errors.

However, this is partly an interface problem only, i.e., useful feedback may be provided even with erroneous output.

# Next section: Conclusion

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# Conclusion

## ■ Applications of computational argumentation

- Argument search to support opinion formation
- Decision assistance through debating systems
- Writing support for argumentative texts

Argument search  
(Wachsmuth et al., 2017e)



Debating technology  
(Sonim et al., 2021)



Writing support  
(Stab, 2017)



Deliberative democracy  
(Piças et al., 2018)



Automated decision making  
(Bench-Capon et al., 2009)



Fact checking  
(Samadi et al., 2018)



## ■ Exemplary applications from industry and academia

- *args.me* opposes pro and con arguments
- *Project Debater* debates humans
- *AL* gives visual feedback to argumentative texts



## ■ Capabilities and limitations

- Computational argumentation will never work perfectly
- Often, tricks make applications practically look fine
- Still, there's much research to be done



args.me

# References

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- **Ajjour et al. (2018)**. Yamen Ajjour, Henning Wachsmuth, Dora Kiesel, Patrick Riehm, Fan Fan, Giuliano Castiglia, Rosemary Adejoh, Bernd Fröhlich, and Benno Stein. Visualization of the Topic Space of Argument Search Results in args.me. In Proceedings of the 2018 Conference on Empirical Methods in Natural Language Processing: System Demonstrations, pages 60–65, 2018.
- **Ajjour et al. (2019)**. Yamen Ajjour, Henning Wachsmuth, Johannes Kiesel, Martin Potthast, Matthias Hagen, and Benno Stein. Data Acquisition for Argument Search: The args.me Corpus. In Proceedings of the Joint German/Austrian Conference on Artificial Intelligence (Künstliche Intelligenz), pages 48–59, 2019.
- **Alshomary et al. (2020b)**. Milad Alshomary, Nick Düsterhus, and Henning Wachsmuth. Extractive Snippet Generation for Arguments. In Proceedings of the 43rd International ACM SIGIR Conference on Research and Development in Information Retrieval, to appear, 2020.
- **Bench-Capon et al. (2009)**. Trevor Bench-Capon, Katie Atkinson, and Peter McBurney. Altruism and Agents: An Argumentation Based Approach to Designing Agent Decision Mechanisms. In: Proceedings of The 8th International Conference on Autonomous Agents and Multiagent Systems – Volume 2, pages 1073–1080, 2009.
- **Kiesel et al. (2020)**. Johannes Kiesel, Kevin Lang, Henning Wachsmuth, Eva Hornecker, and Benno Stein. Investigating Expectations for Voice-based and Conversational Argument Search on the Web. In: Proceedings of the 2020 ACM SIGIR Conference on Human Information Interaction & Retrieval, to appear 2020.
- **Plüss et al. (2018)**. Brian Plüss, Mennatallah El-Assady, Fabian Sperrle, Valentin Gold, Katarzyna Budzynska, Annette Hautli-Janisz, and Chris Reed. ADD-up: Visual Analytics for Augmented Deliberative Democracy. In Proceedings of 7th International Conference on Computational Models of Argument, Demo Paper, pages 471-473, 2018.
- **Robertson and Zaragoza (2009)**. Stephen Robertson and Hugo Zaragoza. 2009. The Probabilistic Relevance Framework: BM25 and Beyond. *Foundations and Trends in Information Retrieval* 3(4):333–389.

# References

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- **Samadi et al. (2016)**. Mehdi Samadi, Partha Talukdar, Manuela Veloso, and Manuel Blum. ClaimEval: Integrated and Flexible Framework for Claim Evaluation Using Credibility of Sources. In Proceedings of the Thirtieth AAAI Conference on Artificial Intelligence, pages 222–228, 2016.
- **Slonim et al. (2021)**. Noam Slonim, Yonatan Bilu, Carlos Alzate, Roy Bar-Haim, Ben Bogin, Francesca Bonin, Leshem Choshen, Edo Cohen-Karlik, Lena Dankin, Lilach Edelstein, Liat Ein-Dor, Roni Friedman-Melamed, Assaf Gavron, Ariel Gera, Martin Gleize, Shai Gretz, Dan Gutfreund, Alon Halfon, Daniel Hershcovich, Ron Hoory, Yufang Hou, Shay Hummel, Michal Jacovi, Charles Jochim, Yoav Kantor, Yoav Katz, David Konopnicki, Zvi Kons, Lili Kotlerman, Dalia Krieger, Dan Lahav, Tamar Lavee, Ran Levy, Naftali Liberman, Yosi Mass, Amir Menczel, Shachar Mirkin, Guy Moshkovich, Shila Ofek-Koifman, Matan Orbach, Ella Rabinovich, Ruty Rinott, Slava Shechtman, Dafna Sheinwald, Eyal Shnarch, Ilya Shnayderman, Aya Soffer, Artem Spector, Benjamin Sznajder, Assaf Toledo, Orith Toledo-Ronen, Elad Venezian, and Ranit Aharonov. An autonomous debating system. *Nature* 591:379–384, 2021.
- **Stab (2017)**. Christian Stab. Argumentative Writing Support by means of Natural Language Processing, Chapter 5. PhD thesis, TU Darmstadt, 2017.
- **Wachsmuth et al. (2016)**. Henning Wachsmuth, Khalid Al-Khatib, and Benno Stein. Using Argument Mining to Assess the Argumentation Quality of Essays. In: Proceedings of the 26th International Conference on Computational Linguistics, pages 1680–1692, 2016.
- **Wachsmuth et al. (2017e)**. Henning Wachsmuth, Martin Potthast, Khalid Al-Khatib, Yamen Ajjour, Jana Puschmann, Jiani Qu, Jonas Dorsch, Viorel Morari, Janek Bevendorff, and Benno Stein. Building an Argument Search Engine for the Web. In Proceedings of the Fourth Workshop on Argument Mining, pages 49–59, 2017.
- **Wambsganss and Rietsche (2019)**. Thiemo Wambsganss and Roman Rietsche. Towards Designing an Adaptive Argumentation Learning Tool. In Proceedings of the Fortieth International Conference on Information Systems, 2019.

# References

---

- **Wambsganss et al. (2020).** Thiemo Wambsganss, Christina Niklaus, Matthias Cetto, Matthias Söllner, Siegfried Handschuh, and Jan Marco Leimeister. AL: An Adaptive Learning Support System for Argumentation Skills. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems, 2020.