Computational Argumentation — Part VII

Applications of Computational Argumentation

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Learning goals

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

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- **Methods**
  - Processes based on computational argumentation methods
  - What works well in practice and what not
  - ”Tricks“ that can be used in practice

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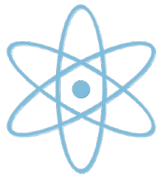
- **Associated research fields**
  - Natural language processing
  - Information retrieval



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- **Within this course**
  - Understand what can be done with computational argumentation and what the status quo is

Outline

I. Introduction to computational argumentation

II. Basics of natural language processing

III. Basics of argumentation

IV. Argument mining

V. Argument assessment

VI. Argument generation

VII. Applications of computational argumentation

VIII. Conclusion

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

What are applications of computational argumentation?

- **Applications**
  - The term *application* is used in multiple ways in NLP:
  - Approaches. Developed approaches process new data.
  - Downstream tasks. General NLP techniques are used for specific tasks.
  - Technologies. Developed approaches are deployed in software.

    This is what is meant here.

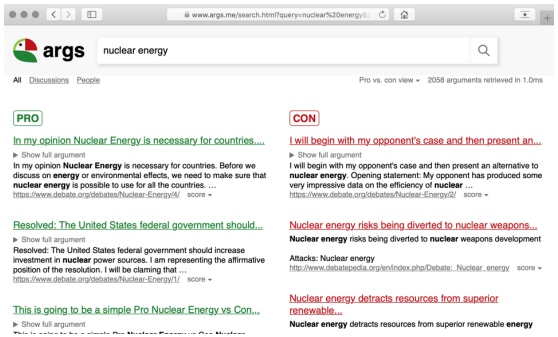
- **Application in technologies**
  - Software applications that use computational argumentation to solve real-world tasks
  - Examples follow on the next slide.

https://de.wikipedia.org

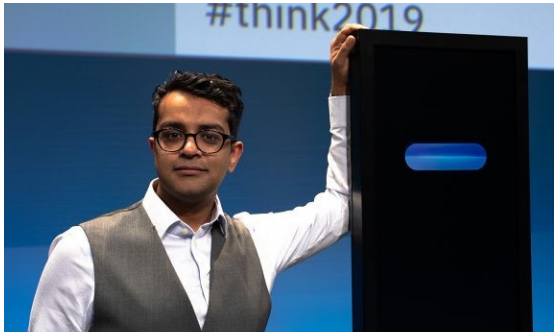
- **Argumentation in these applications**
  - Argumentative uterrances (text or speech) may be given as input.
  - Argumentative uterrances may be provided as output.
  - Other output may be computed from argumentative utterances.

Overview of applications

Argument search
(Wachsmuth et al., 2017b)



Debating technology
(Slonim et al., 2021)



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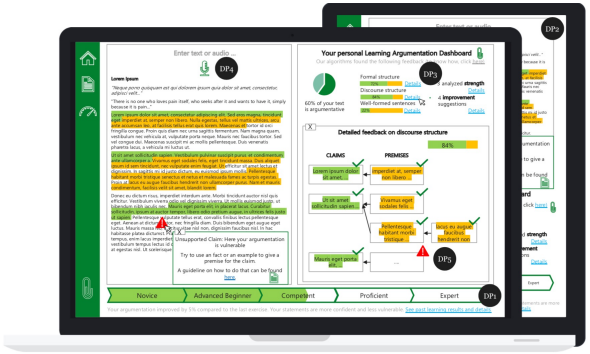
Writing assistance
(Stab, 2017)



(Wambsganss and Rietsche, 2019)

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

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Deliberative democracy
(Plüss et al., 2018)

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Scientific summarization
(Contractor et al., 2012)

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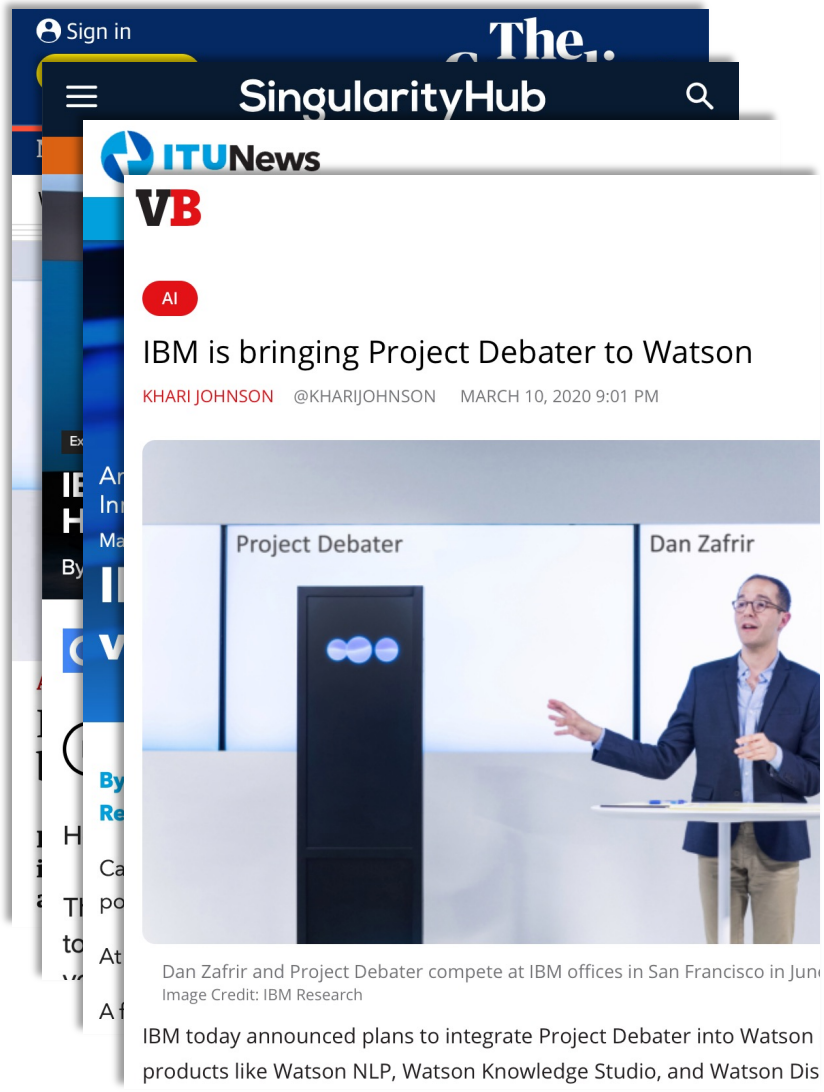
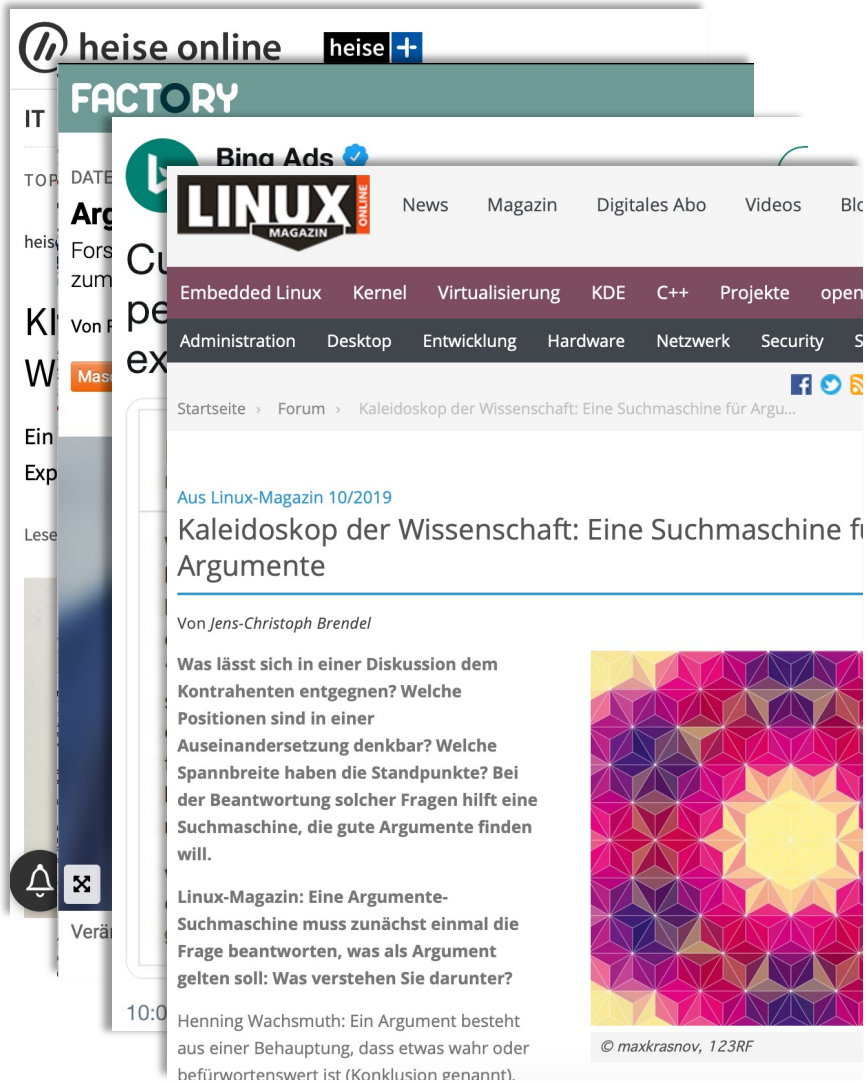
Computational argumentation in the media





Next section: Argument search

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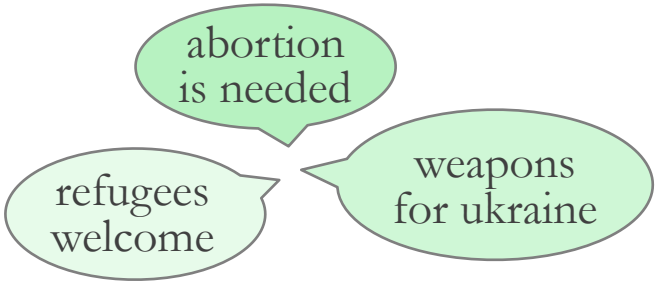
b) Argument search
c) Debating technology
d) Argumentative writing support
e) Conclusion

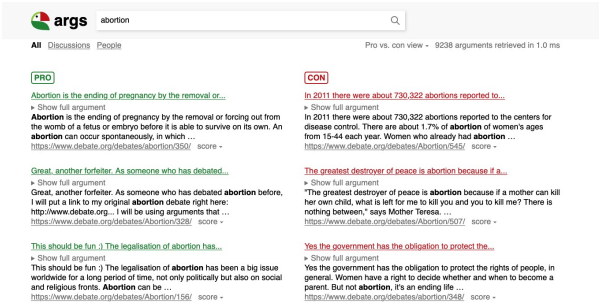
What is argument search?

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

- **Goals**
  - Help people form self-determine opinions.
  - Make it easy to find relevant arguments.
  - Avoid being biased towards either stance.



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

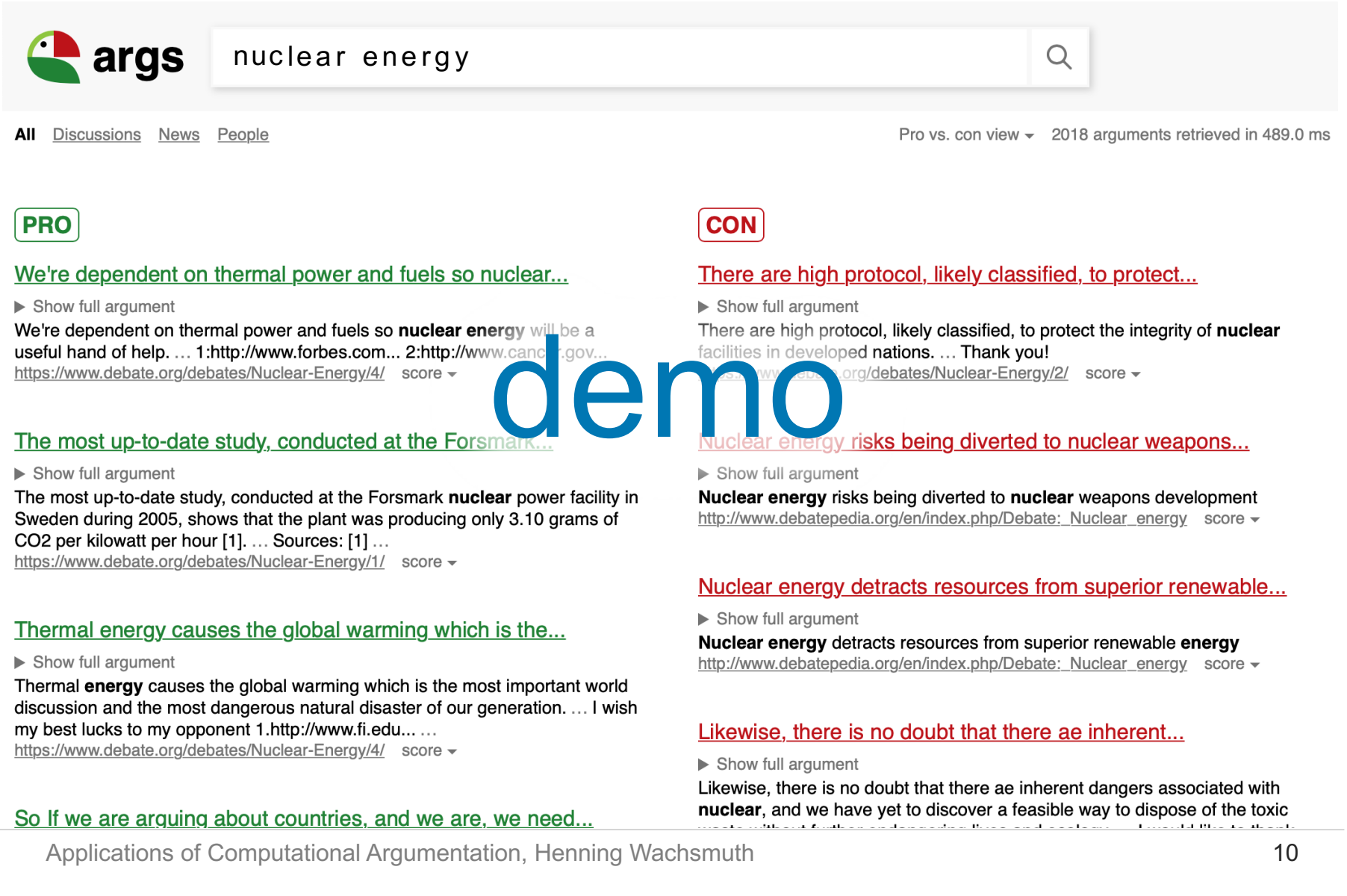


Overview of argument search

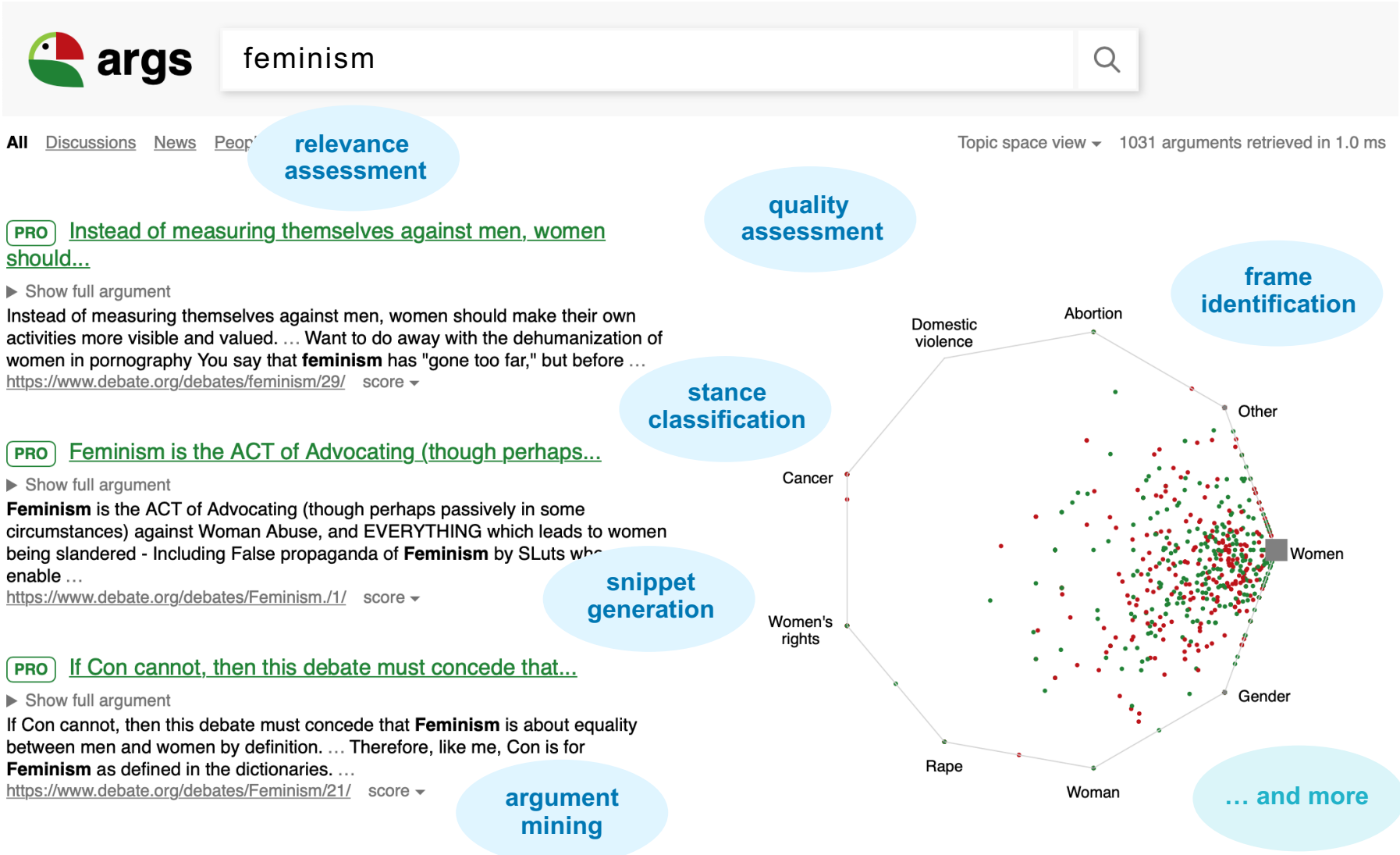
- **Characteristics of argument search**
  - All existing systems oppose pro and con arguments for an issue.
  - Main differences lie in the sources, processing paradigms, and interfaces.
- **Available argument search engines**
  - args.me. Indexes debate portal arguments; retrieves arguments relevant to a query
  - ArgumenText. Indexes diverse web pages; mines arguments relevant to a query
  - PerspectroScope. Similar to ArgumentText for debate portals and Wikipedia texts
  - Bing Multi-Perspective Answers. Part of Bing; 1 pro and 1 con point on selected issues

- **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



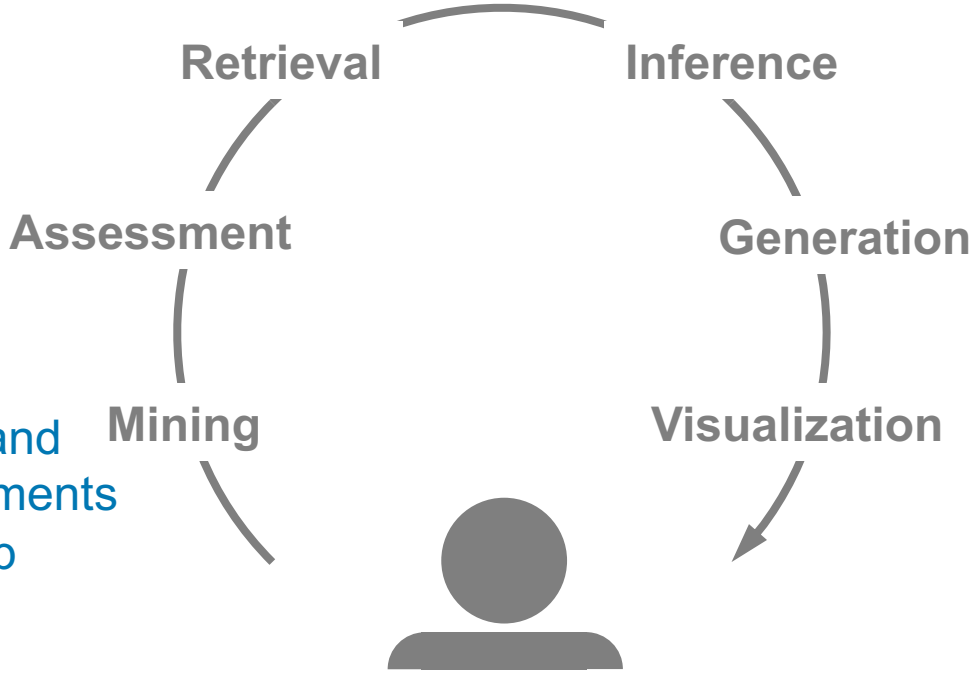
Computational tasks in argument search



Argument search process: Concept

Find and rank arguments relevant to a query

Derive further information related to arguments

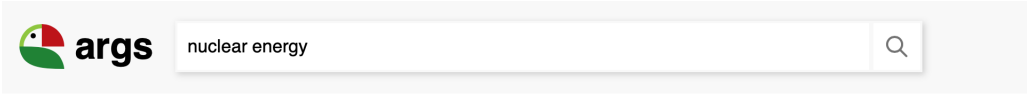


Assess properties of arguments, such as quality

Create results in response to query

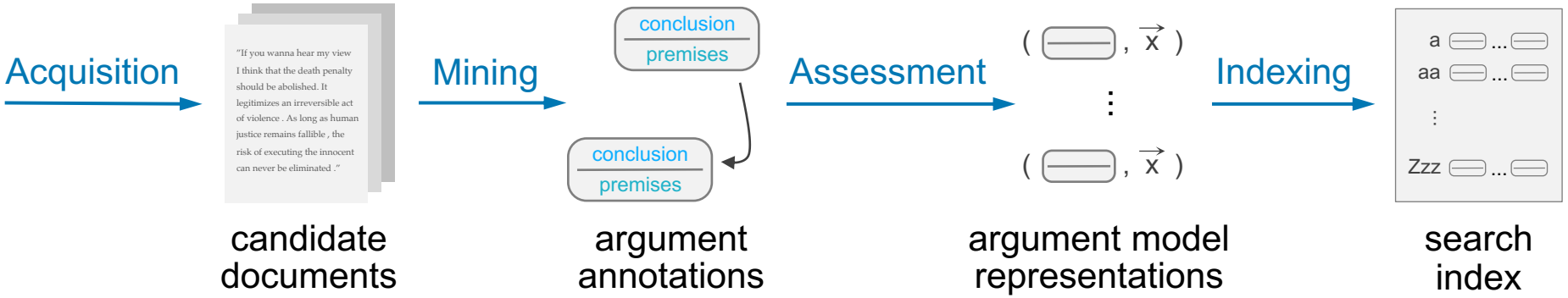
Mine content and structure of arguments from the web

Present results and allow for interaction

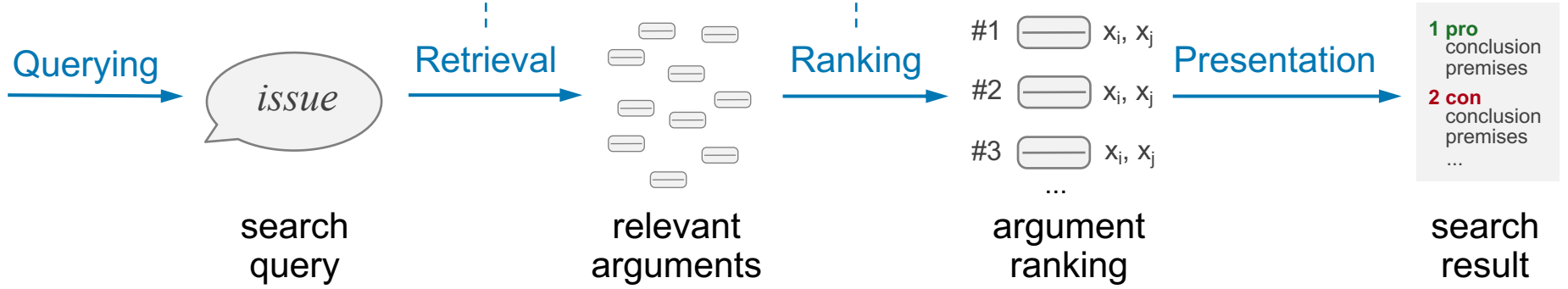


Argument search process in args.me (Wachsmuth et al., 2017e)

- **Indexing process**
  (offline)

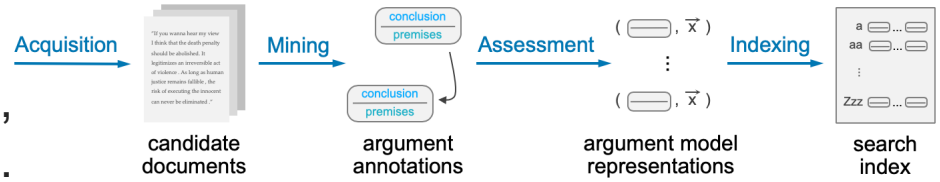


- **Retrieval process**
  (online)

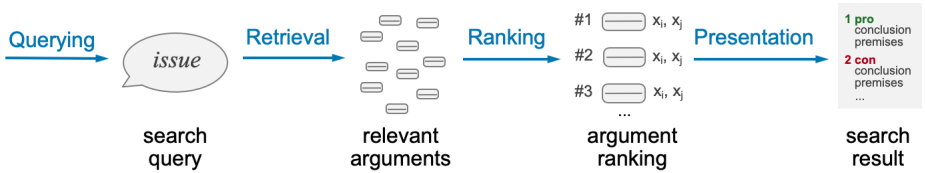


Argument search process in args.me: Steps

- **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

- **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, debatepedia.org, debatewise.org, 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*

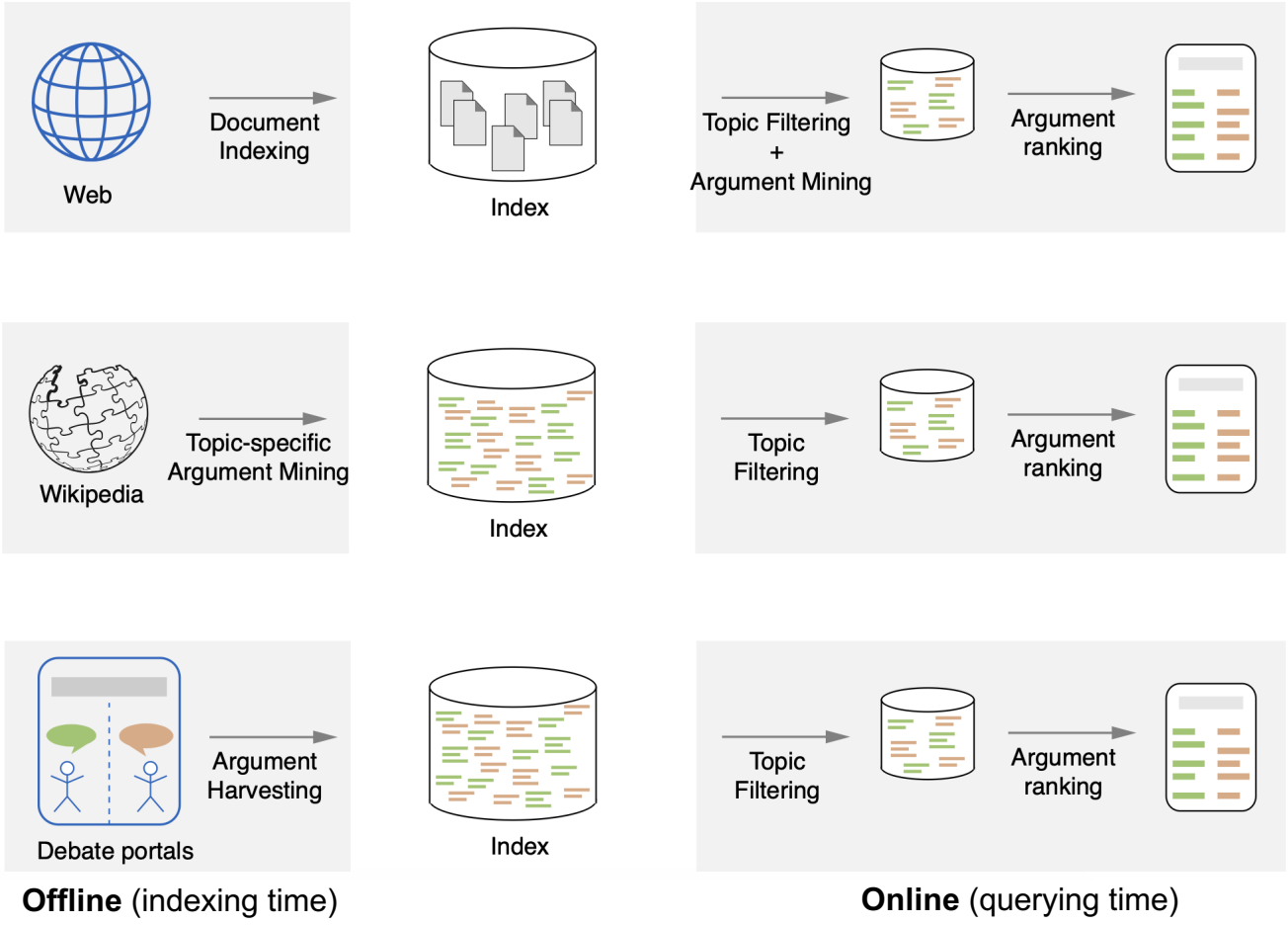
Point against. *The UN has performed a valuable service in preventing wars and in peacekeeping.*

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

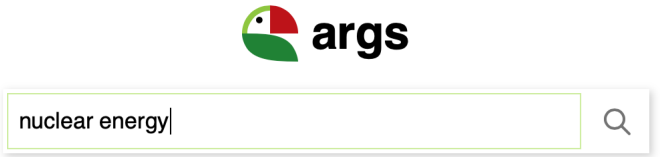
Indexing process: Acquisition paradigms (Ajjour et al., 2019)

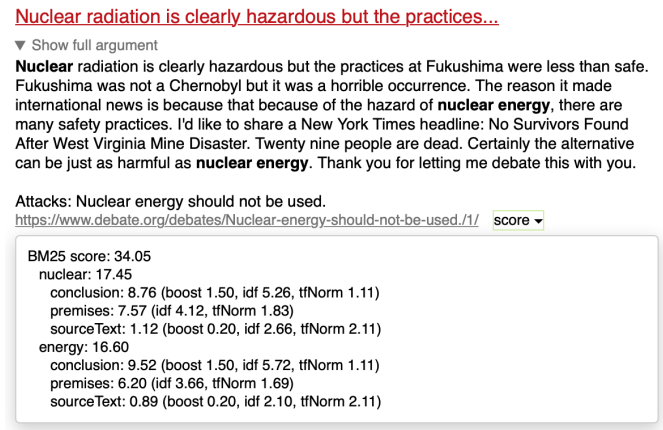
- **Argument aquisition paradigm**
  - A choice of data sources, along with a method to obtain arguments
- **ArgumenText**
  - Lower precision
  - Higher recall
  - Slower
- **Project Debater**
  - Higher precision
  - Lower recall
  - Faster
- **args.me**
  - High precision
  - Low recall
  - Faster

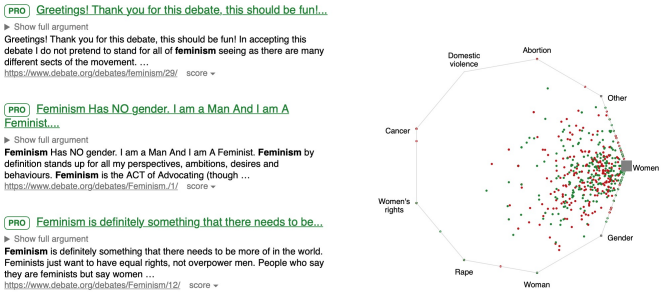


Retrieval process in args.me

- **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.
- **Ranking**
  - Arguments are scored with weighted BM25F.
    BM25F is a variant of TF-IDF (Robertson and Zaragoza, 2009).
  - No real quality assessment so far
- **Presentation**
  - Different views (pro vs. con, topic space)
  - Snippets based on extractive summarization
    (Alshomary et al., 2020b)

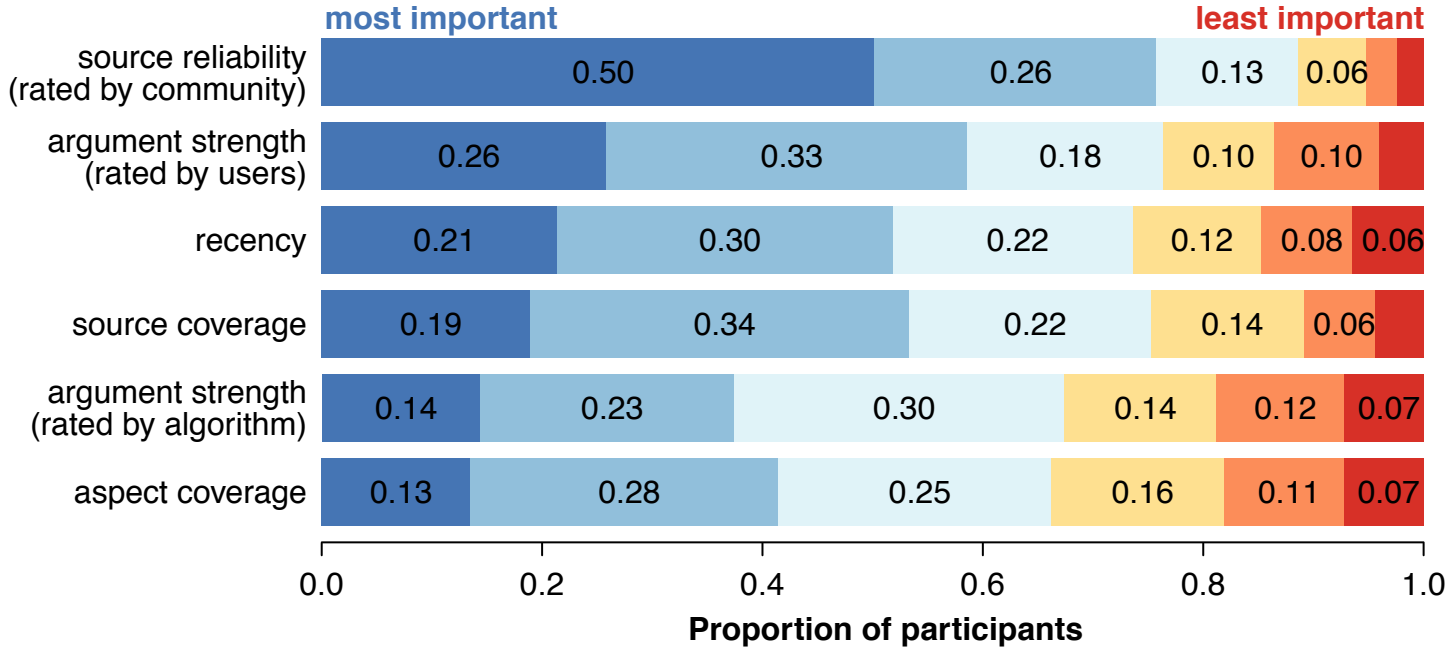






Retrieval process: How to rank search results? (Kiesel et al., 2020)

- **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.



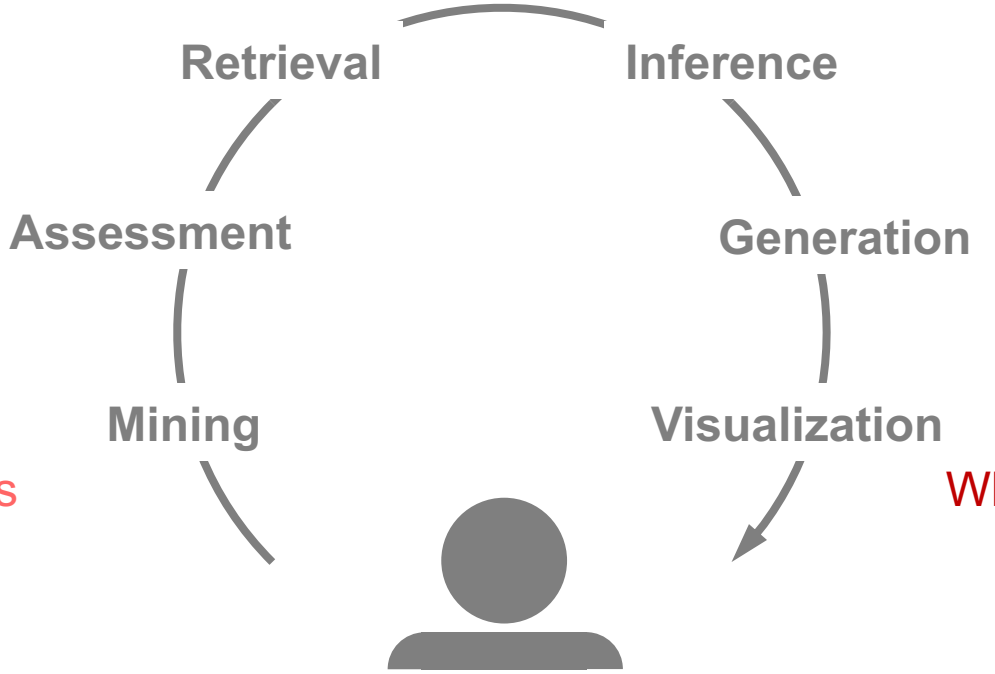
Ethical questions in argument search

Should results be personalized for the user?

Should computers generate new ”knowledge“?

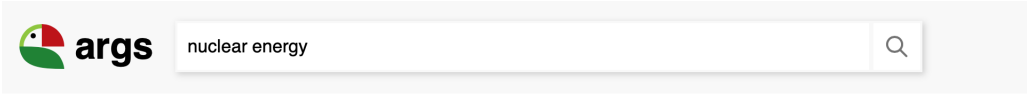
Who decides what a good argument is?

To what extent should users be persuaded?



What sources to consider?

Which arguments to highlight?



Next section: Debating technology

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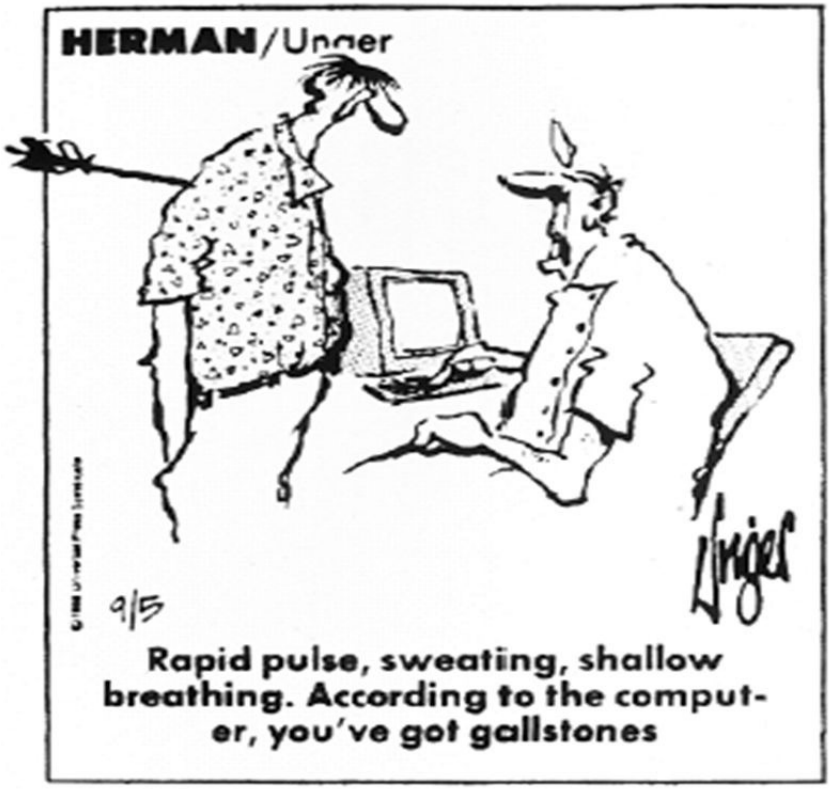
What is debating technology?

- **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 methods for *decision assistance.*

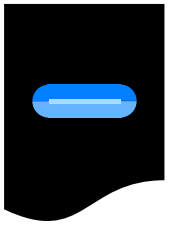


- **Decision assistance** (aka decision support)
  - Analysis of data to help people make decisions about problems

- **Scenarios of decision assistance**
  - Professional scenarios include medical diagnosis and market trading.
  - Also, personal assistants such as Siri and Alexa directly entail applications.
  - Weighing pros and cons may support more informed decisions.

Example: Project Debater

- **Project Debater**
  - A system that can debate humans on (potentially) arbitrary issues
  - In 2019, showcased on *intelligence*^{2} against a top human debater

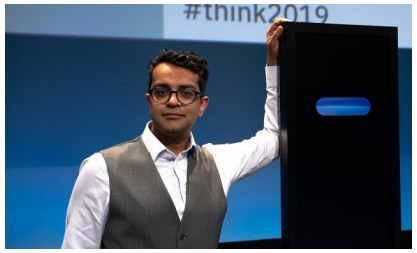


- **Intelligence^2 debates**
  - US TV show where two parties debate against each other
  - Stages. Opening (4 minutes each), rebuttal (4 each), closing (2 each)
  - Goal. Change stance of audience (who votes before and afterwards)
  - Winner. The side who has more votes after the debate than before

    Additional question in the given debate: ”Who better enriched your knowledge?“

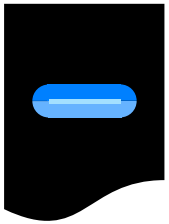
- **Showcase** https://research.ibm.com/interactive/project-debater/live/
  - Issue. ”We should subsidize preschool“

    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



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

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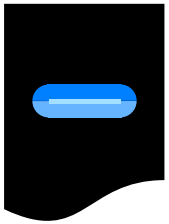
Project Debater showcase: Rebuttal

- **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 Nataranjan (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

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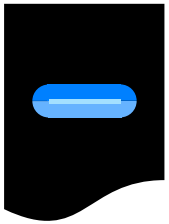
Project Debater showcase: Closing and results

- **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

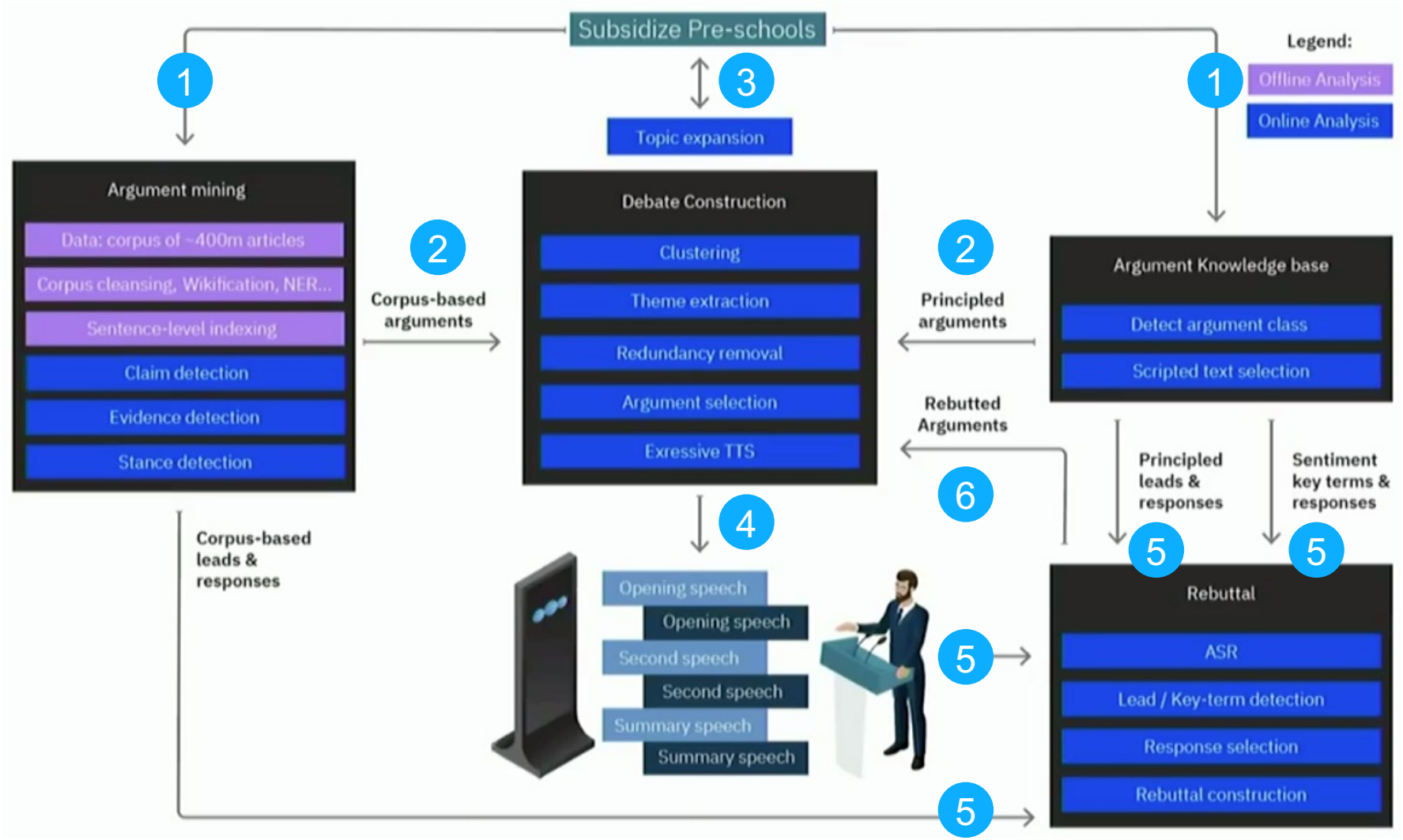
https://flickr.com

- **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 Nataranjan, 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

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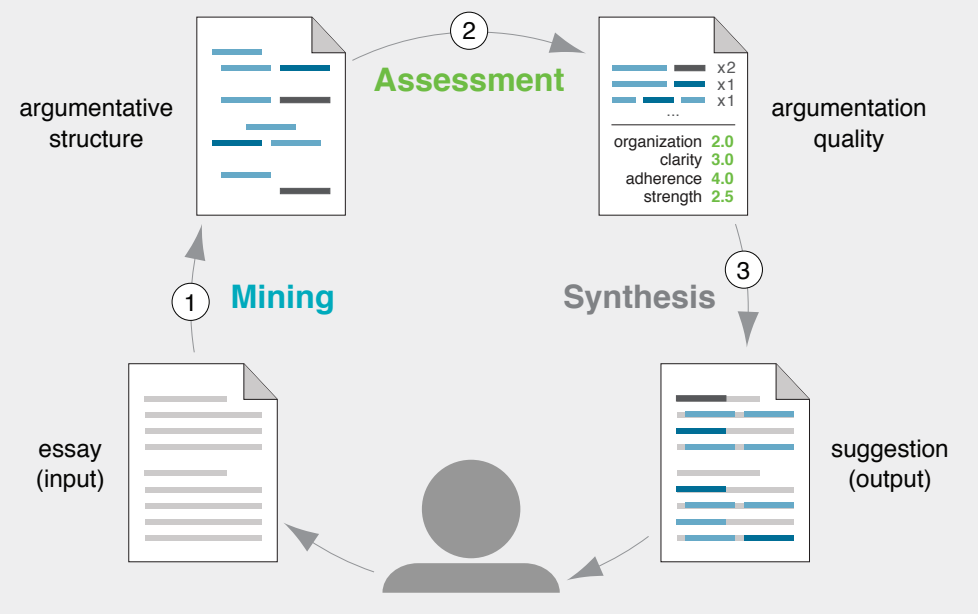
What is argumentative writing support?

- **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 daft
  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

- **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**
  - Argument-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)
  - ChatGPT provides respective support to some extent

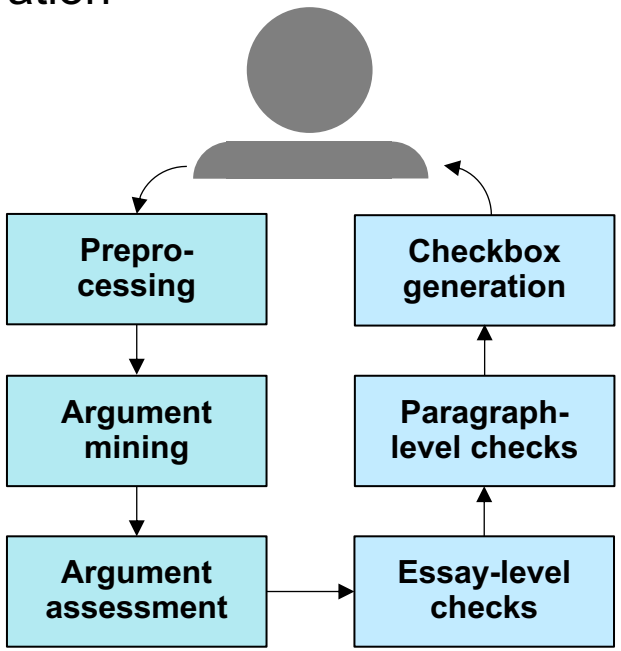
- **Related applications**
  - Build-in tools for orthography and syntax checking (e.g., in Microsoft Word)
  - Professional writing tools even analyze style, tone, etc. (e.g., Grammarly)
  - Augmented writing tools actively complete text drafts (e.g., textio flow)

  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



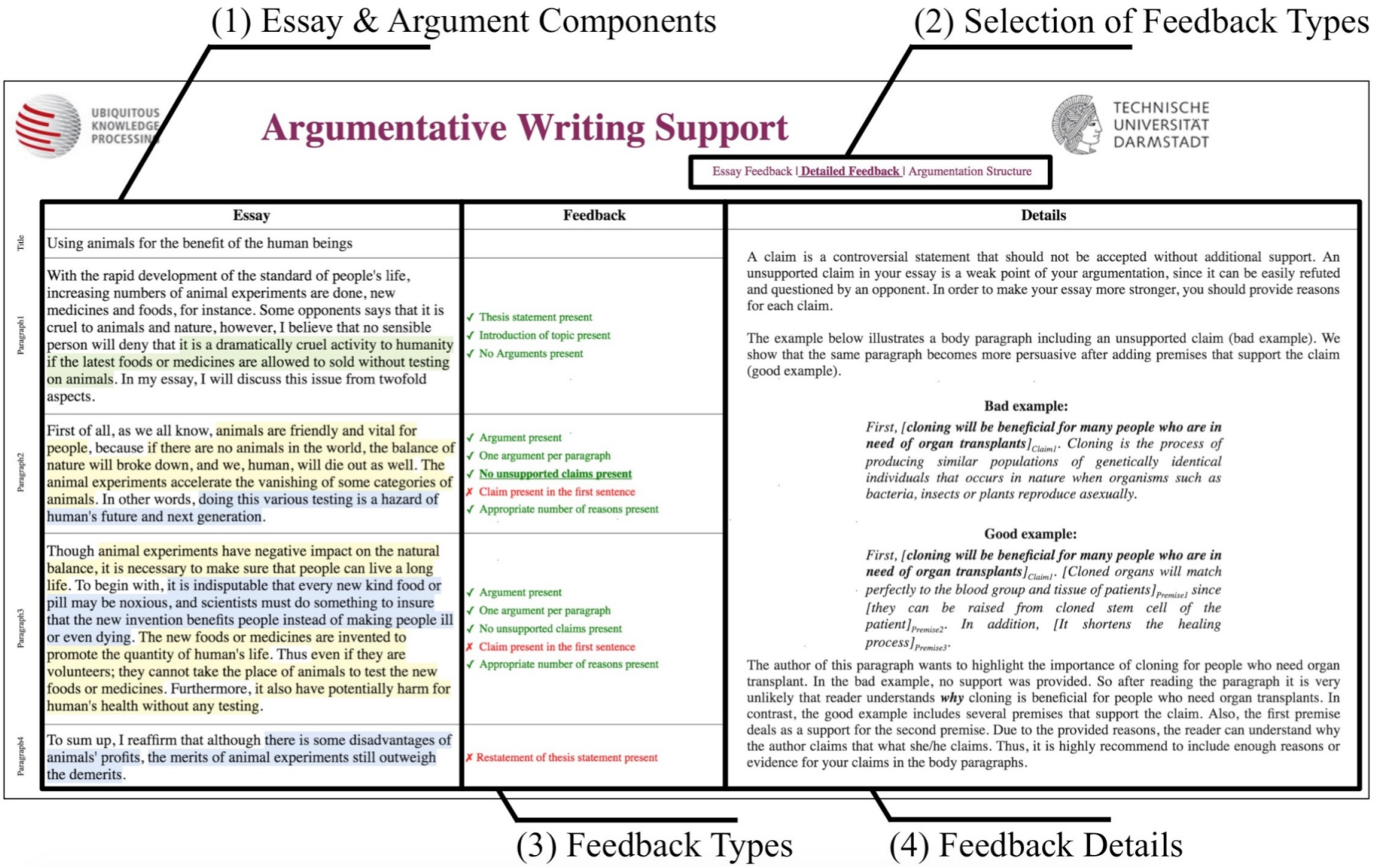
- **Argument analysis**
  - Preprocess essay with several NLP analyses.
  - Mine arguments using model of Stab (2017).
  - Assess myside bias of the essay and local sufficiency of each paragraph.

- **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.

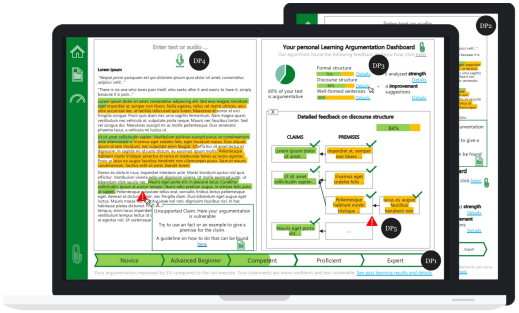
Argumentative writing support system for essays: Demo



from (Stab, 2017)

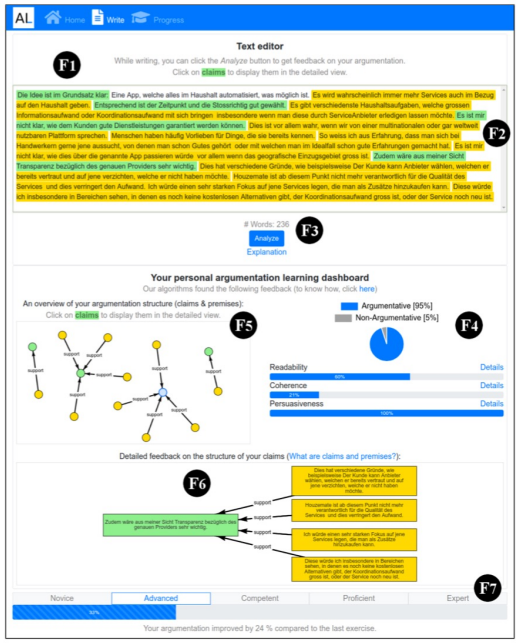
Learning support system for arguing skills (Wambsganss et al., 2020)

- **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



(Wambsganss and Rietsche, 2019)

- **Argument analysis**
  - Mine claims, premises, and support relations.
  - Assess readability, coherence, and persuasiveness.
    The assessment is based on rudimentary rule-based approaches.



from (Wambsganss et al., 2020)

- **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

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

- **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.

    ChatGPT-like technologies may be employed for similar ideas.

- **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)

https://www.youtube.com/watch?v=F7zRLnkUS-I

Next section: Conclusion

I. Introduction to computational argumentation

II. Basics of natural language processing

III. Basics of argumentation

IV. Argument mining

V. Argument assessment

VI. Argument generation

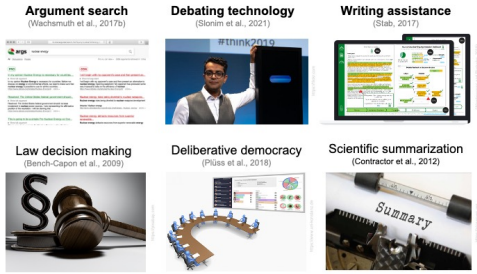
VII. Applications of computational argumentation

VIII. Conclusion

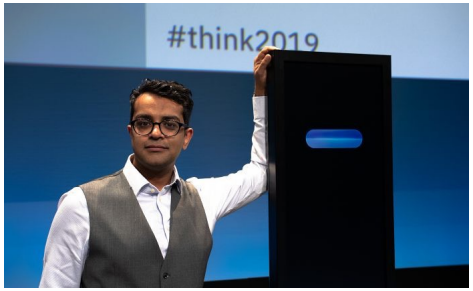
a) Introduction
b) Argument search
c) Debating technology
d) Argumentative writing support
e) Conclusion

Conclusion

- **Applications of computational argumentation**
  - Argument search to support opinion formation
  - Decision assistance through debating systems
  - Writing support for argumentative texts



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



https://flickr.com

- **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

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