Computational Argumentation – Part I

Introduction to Computational Argumentation

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Learning goals

- **Concepts**
  - The need for processing argumentation
  - Some general aspects of argumentation
  - Benefits and challenges of computational argumentation

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- **Methods**
  - First idea of the analysis and synthesis of arguments

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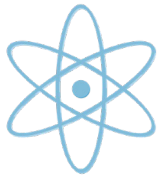
- **Associated research fields**
  - Argumentation theory
  - Natural language processing



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- **Within this course**
  - First overview of the topics covered

Outline

Welcome to the post-factual age!

It was January 22, 2017… https://www.youtube.com/watch?v=VSrEEDQgFc8 (1:36 – 2:05)

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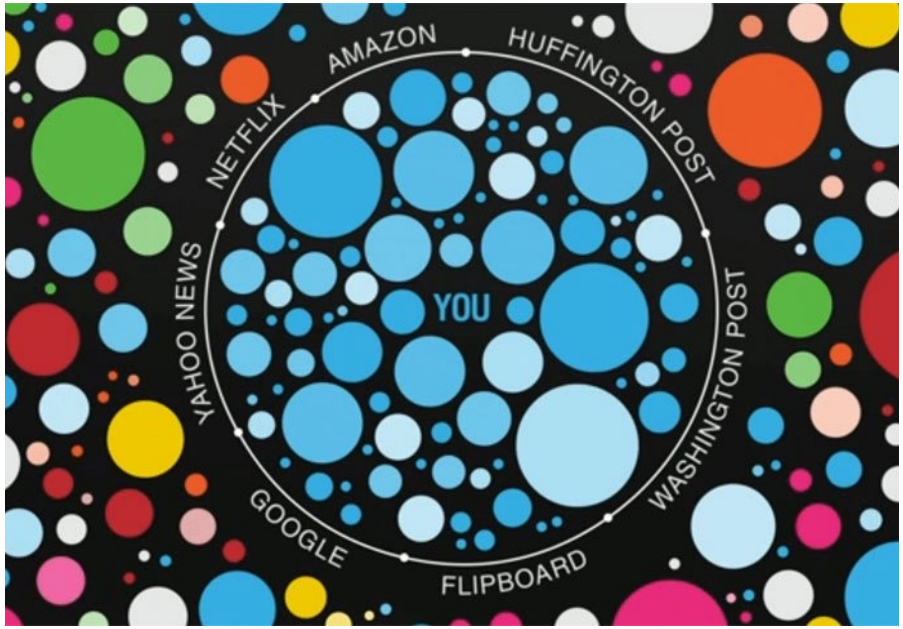
How could we end up there?

Filter bubbles



We get what fits our past behavior

Echo chambers

We like 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*

Can computers help?

Example: Project Debater
https://www.youtube.com/watch?v=nJXcFtY9cWY

Need for studying? https://chat.openai.com (April 18, 2023)

Next section: Argumentation

I. Introduction to computational argumentation

II. Basics of natural language processing

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IV. Argument mining

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a) Introduction

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d) Tasks in computational argumentation

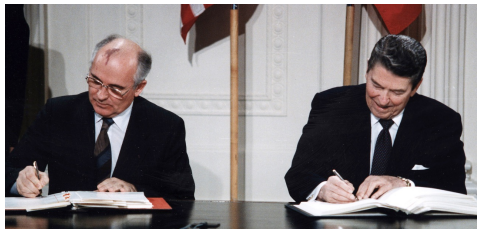
e) Conclusion

Why do people argue?

- **Causes of argumentation**
  (Freeley and Steinberg, 2009)
  - A (possible) conflict of interests or positions
  - No (clearly) correct answer or solution
  - So: Controversy

- **Goals of argumentation**
  (Tindale, 2007)
  - Persuasion
  - Agreement
  - Justification
  - Deliberation

  ... and similar



What is argumentation?

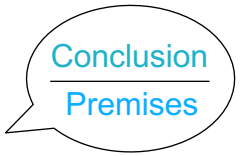
- **Argument**
  - A claim (conclusion) supported by reasons (premises) (Walton et al., 2008)
  - Conveys a stance on a controversial issue (Freeley and Steinberg, 2009)

Conclusion
Premises

Conclusion	*The EU should allow rescue boats in the Mediterranean Sea.*
Premise 1	*Many innocent refugees will die if there are no such boats.*
Premise 2	*Nothing justifies to endanger the life of innocent people.*

  - Most natural language arguments are defeasible (Walton, 2006)
  - Often, some argumentative units are implicit (Toulmin, 1958)

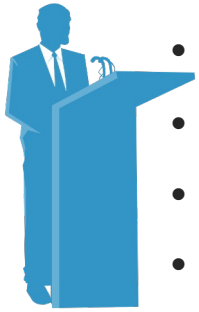
- **Argumentation**
  - The usage of arguments to persuade, agree, deliberate, or similar
  - Also includes rhetorical and dialectical aspects



Argumentative genres

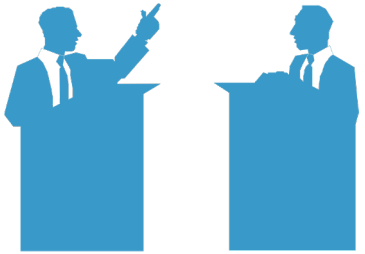
- **Written monologue**
  - Persuasive essays
  - Opinionated articles/editorials
  - Argumentative blog posts
  - Customer and scientific reviews
  - Scientific articles
  - Law texts

  ... among others



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

  ... among others



- **Spoken monologue** (possibly transcribed)
  - Political speeches
  - Law pleadings

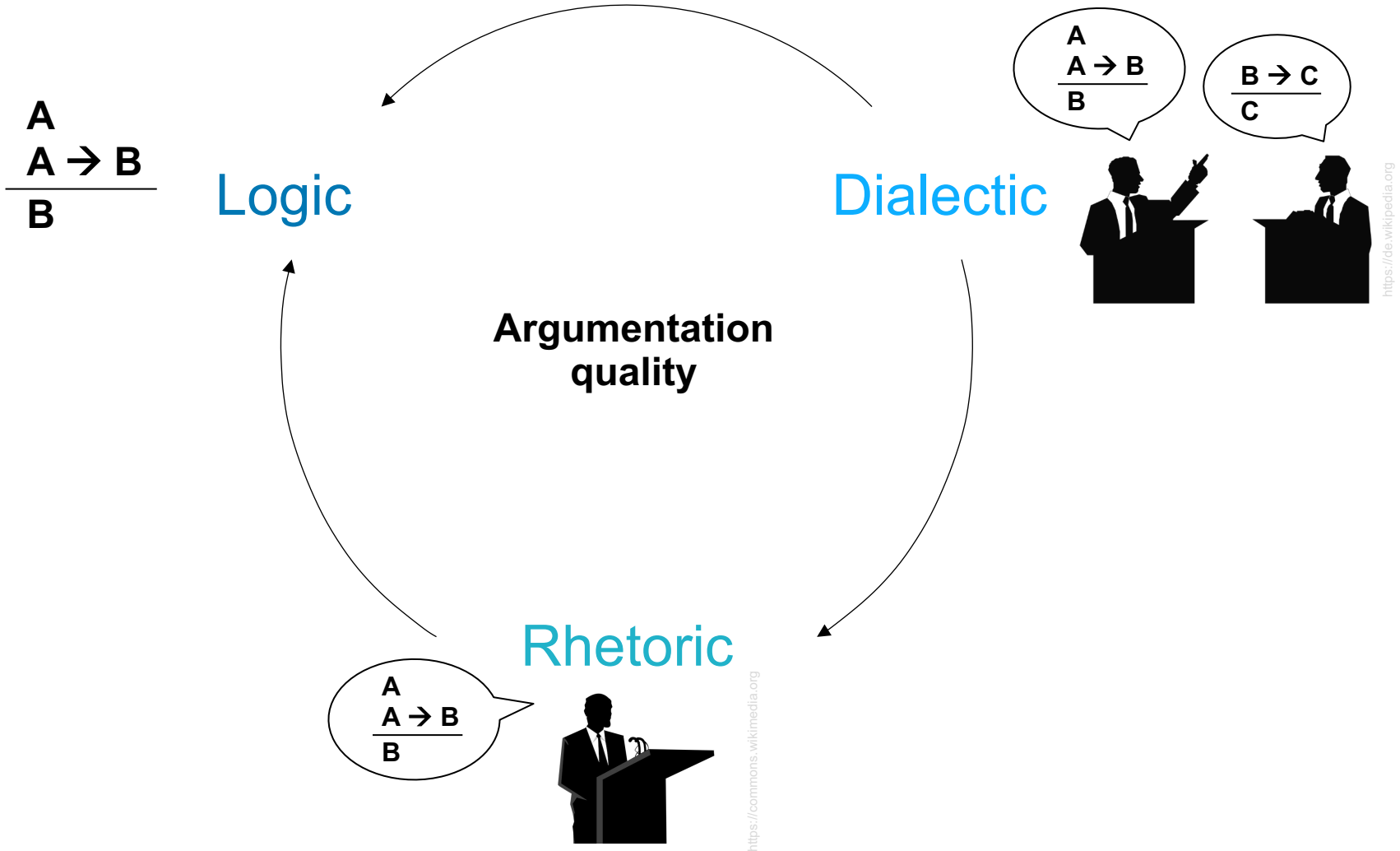
  ... among others

- **Spoken dialogue** (possibly transcribed)
  - Classical debates
  - Everyday discussions

  ... among others

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

What is *good* argumentation?



Who is involved 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.

” The EU should allow rescue boats. Many innocent refugees will die if there are no such boats.“

” According to a recent UN study, the number of rescue boats had no effect on the number of refugees who try.“

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II. Basics of natural language processing
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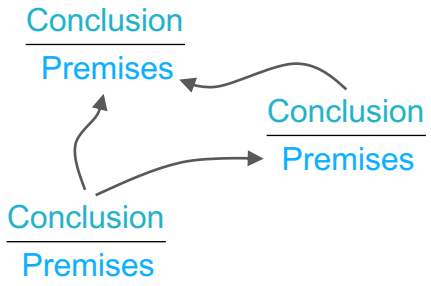
a) Introduction
b) Argumentation
c) **Computational argumentation**
d) Tasks in computational argumentation
e) Conclusion

What is computational argumentation?

- **Computational argumentation**
  - The computational analysis and synthesis of natural language arguments
  - Several different tasks, usually tackled with data-driven methods

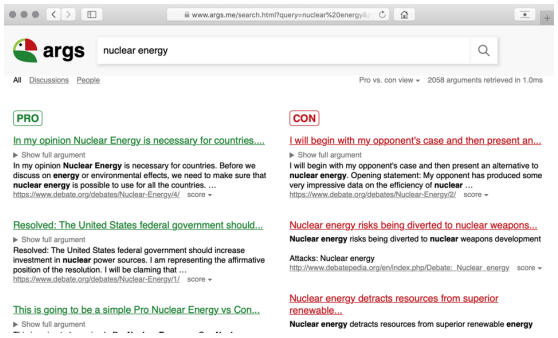


$$(1-\alpha)\cdot\frac{p(d)\cdot|D|}{|A|} + \alpha \cdot \sum_i \frac{\hat{p}(c_i)}{|P_i|}$$

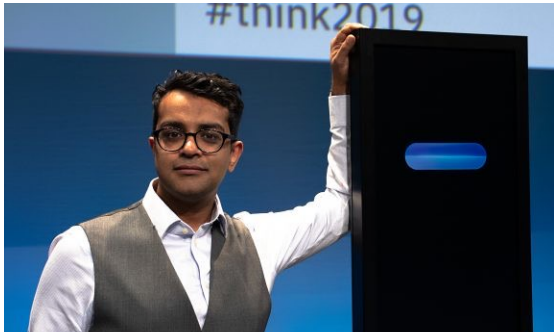
- **Main research aspects**
  - Models of arguments and argumentation
  - Computational methods for analysis and synthesis
  - Resources for development and evaluation
  - Applications built upon the models and methods

Applications of computational argumentation

- **Argument search** (Wachsmuth et al., 2017)
  - 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



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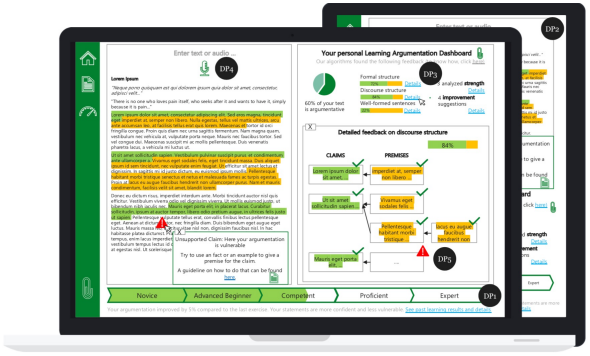
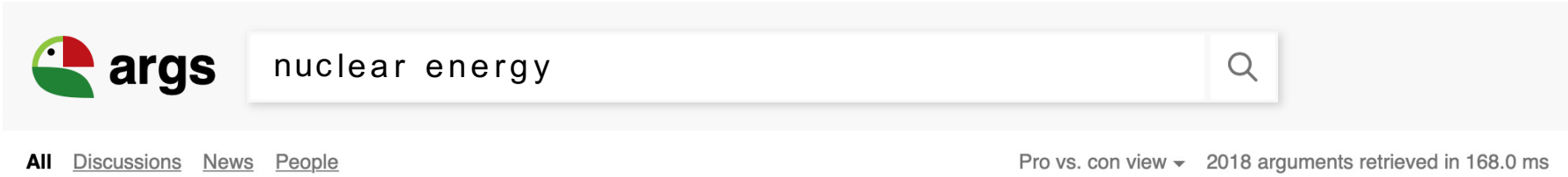
- **Argumentative writing support** (Stab, 2017)
  - What. Assess quality of argumentative text and provide feedback to text
  - Why. Support learning of argumentative writing

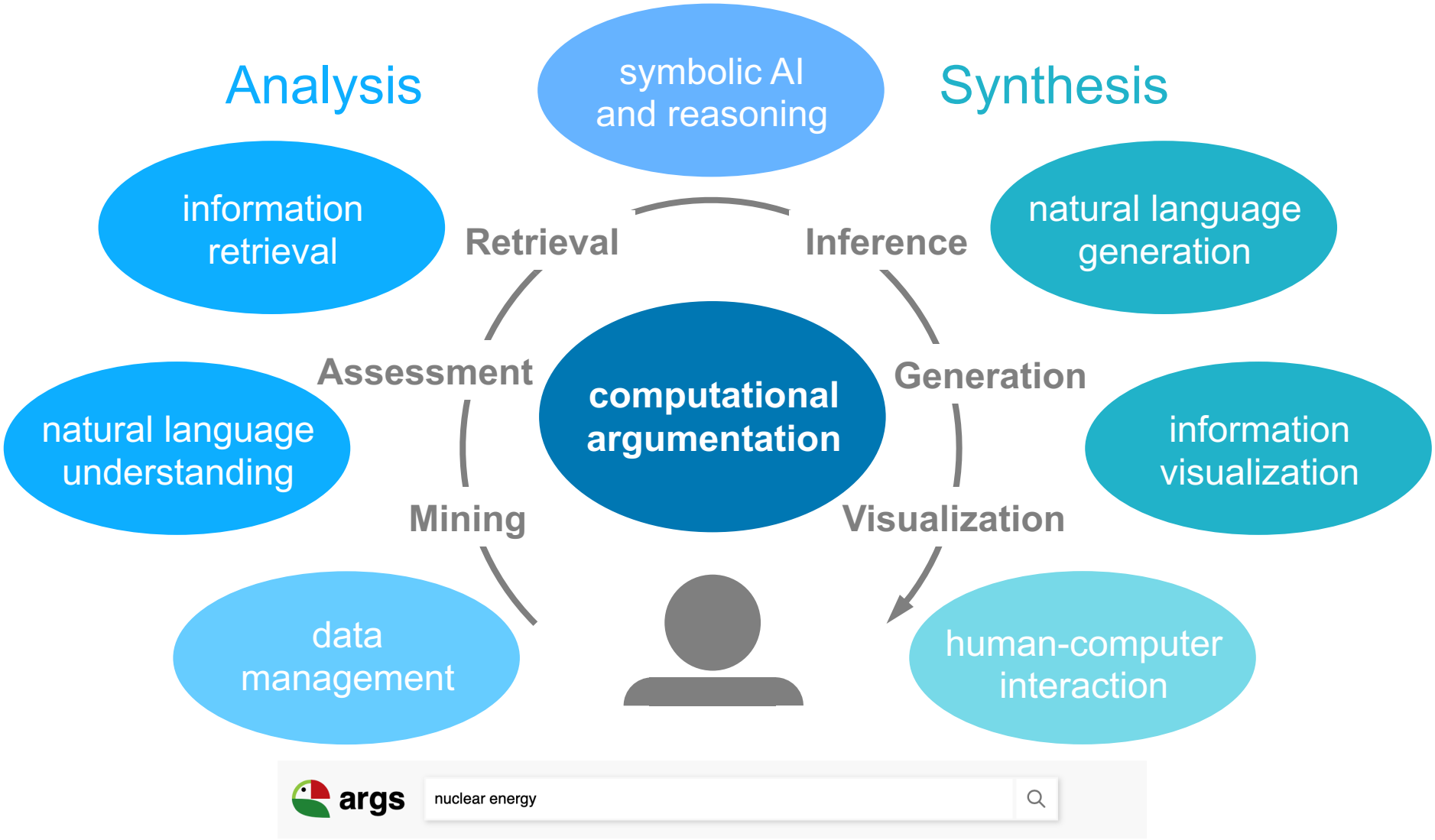


(Wambsganss and Rietsche, 2019)

Argument search: args.me



Analysis and synthesis tasks

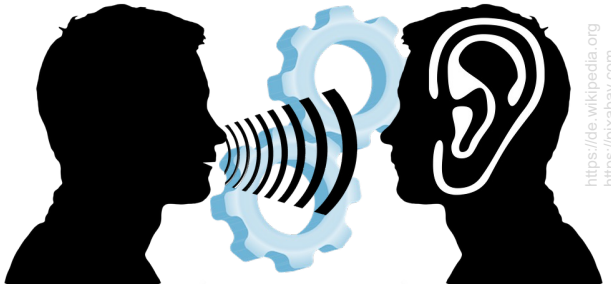


A natural language processing perspective

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

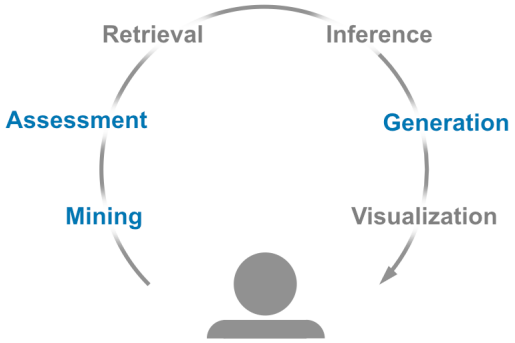
Analysis
Synthesis

- **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

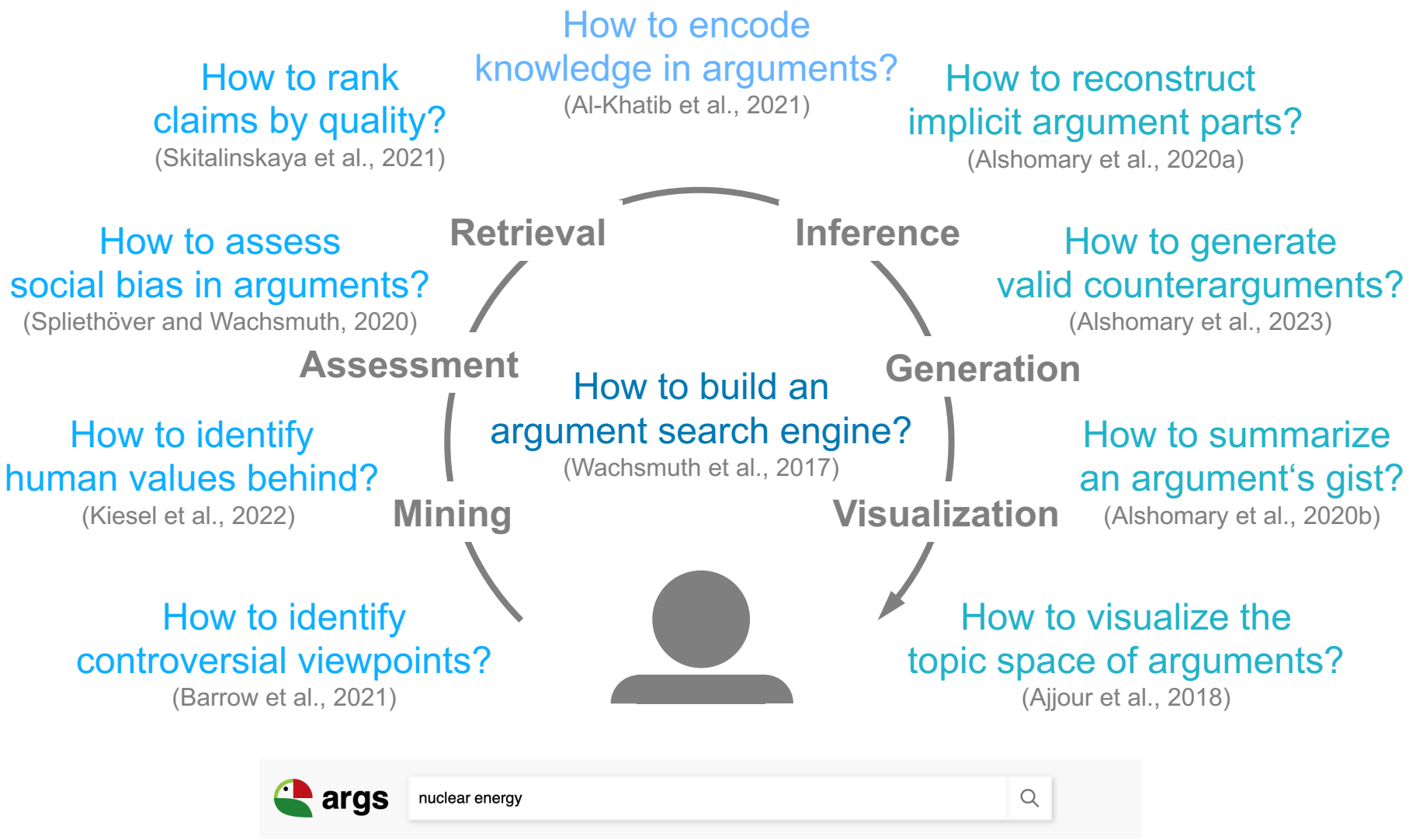


- **Main NLP tasks in computational argumentation**
  - Mining arguments and their relations from text
  - Assessing various properties of arguments
  - Generating arguments and argumentative texts

  Often, not all tasks need to be tackled in applications



(Our) Research on computational argumentation



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Overview of NLP tasks in computational argumentation

- **Argument(ation) mining**
  1. Segmenting a text into argumentative units
  2. Classifying the types of units
  3. Identifying relations between units or arguments

  ... along with variations of these

If you wanna hear my view, I think that the EU should allow rescue boats in the Mediterranean Sea. Many innocent refugees will die if there are no such boats.

- **Argument(ation) assessment**
  4. Classifying an argument‘s stance on an issue
  5. Classifying an argument‘s scheme
  6. Scoring or comparing argumentation quality

  ... along several other assessed properties

If you wanna hear my view, I think that the EU should allow rescue boats in the Mediterranean Sea. Many innocent refugees will die if there are no such boats.

- **Argument(ation) generation**
  7. Summarizing argumentative texts
  8. Synthesizing units and arguments for an issue
  9. Synthesizing counterarguments to arguments

  ... along with related non-argumentative language

Having rescue boats also may have negative effects. Even more people may die trying, believing that they may be rescued.

Task 1: Segmenting a text into argumentative units

- **Unit segmentation**
  - Argumentative units. Text segments with an argumentative function
    Usually, the premises and conclusions of arguments
  - Task. Given a text, split it into argumentative units and other parts

non-argumentative **argumentative**

” If you wanna hear my view, I think that the EU should allow rescue boats in the Mediterranean Sea. Many innocent refugees will die if there are no such boats. Nothing justifies to endanger the life of innocent people.”

- **How does it work?**
  - Usually, tokens are classified in context using supervised sequence labeling
  - Rather reliable within narrow genres (F_1 0.72–0.82) (Ajjour et al., 2017)
  - Unsolved across genres

Task 2: Classifying the types of units

- **Unit type classification**
  - Unit types. Roles in an argument, or claim and evidence types
    Examples: (1) Roles: Thesis, conclusion, premise; (2) evidence types: Statistics, testimony, anecdote
  - Task. Given an argumentative unit, assign one type from a set of types

Conclusion

” If you wanna hear my view, I think that the EU should allow rescue boats in the Mediterranean Sea. Many innocent refugees will die if there are no such boats.

Premise

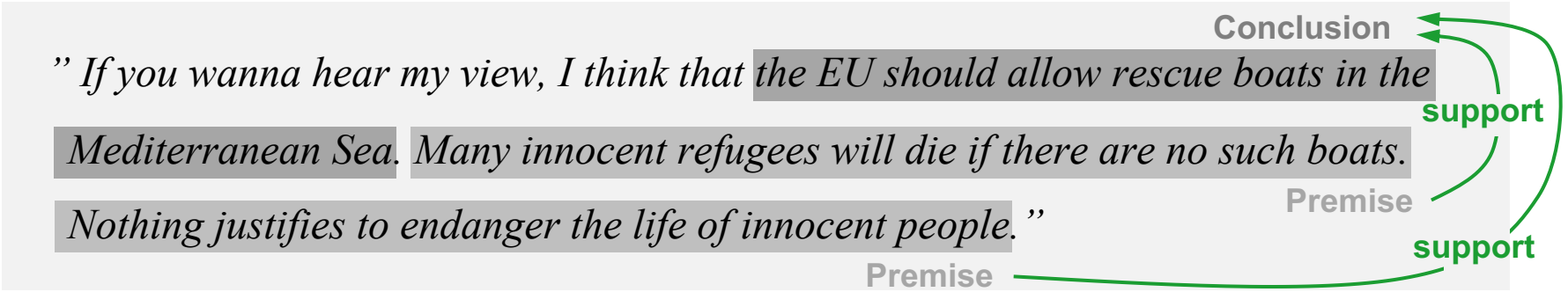
Nothing justifies to endanger the life of innocent people. ”

Premise

- **How does it work?**
  - Usually approached with supervised text classification
  - Reliable on ”explicit” argumentation, such as in essays (F_1 0.87) (Stab, 2017)
  - Rather reliable on genres such as news editorials (F_1 0.77) (Al-Khatib et al., 2017)
  - Minority classes may be problematic, though

Task 3: Identifying relations between units or arguments

- **Relation identification**
  - Argumentative relations. Premise to conclusion, or argument to argument
    Usually, support or attack, partly more fine-grained subtypes
  - Task. Given two units/arguments, what relation holds between them, if any



- **How does it work?**
  - Diverse techniques from standard classification to graph-based optimization
  - Semi-reliable for explicit argumentation (F_1 0.73) (Stab, 2017)
  - Unsolved for ”hidden“ argumentation, even hard for humans (Al-Khatib et al., 2017)

Task 4: Classifying an argument‘s stance on an issue

- **Stance classification**
  - Stance. Someone‘s position towards a target, such as an issue or claim
    Stance is pro or con, sometimes also none or neutral
  - Task. Given a unit/argument, classify the stance it conveys on a given target
    Conceptual overlap with relation classification

Pro towards rescue boats **Conclusion**

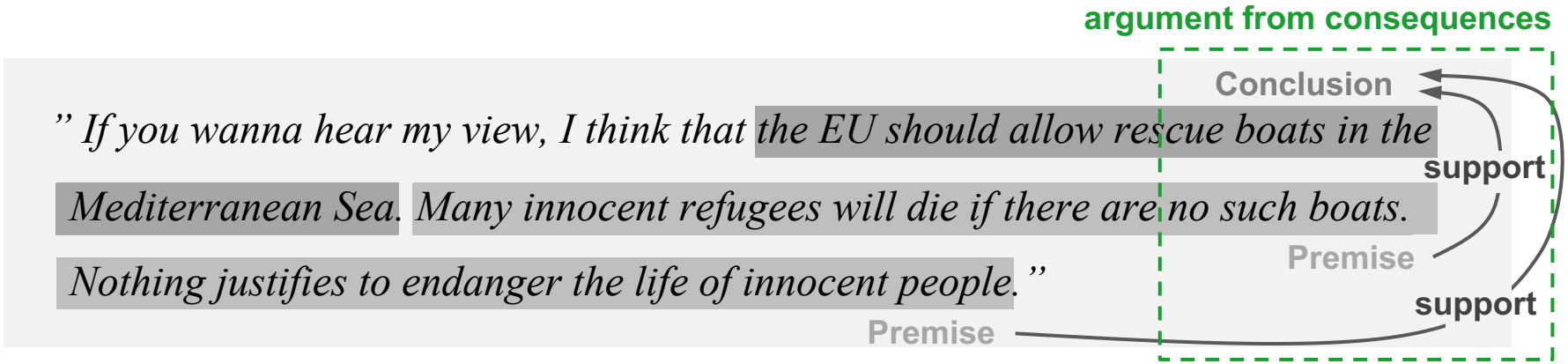
” If you wanna hear my view, I think that the EU should allow rescue boats in the Mediterranean Sea. Many innocent refugees will die if there are no such boats. Nothing justifies to endanger the life of innocent people.”

Premise Premise

- **How does it work?**
  - Usually supervised classification, exploiting various types of knowledge
  - Issue-specific approaches with F_1 ~ 0.70–0.75 (Hasan and Ng, 2013)
  - Open-topic worse (0.69), but works for confident cases (0.94) (Bar-Haim et al., 2017)

Task 5: Classifying an argument‘s scheme

- **Scheme classification**
  - Argumentation scheme. Form of inference from premises to conclusion
    Several schemes exist, such as argument from cause to effect, expert opinion, analogy, ... (Walton et al., 2008)
  - Task. Given conclusion and premises, assign a scheme from a scheme set



- **How does scheme classification work?**
  - Usually supervised one-against-others classification
    So far, only done for a small set of very frequent schemes
  - 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: Scoring or comparing argumentation quality

- **Argument quality assessment**
  - Argument quality. Logical, rhetorical, or dialectical strength of an argument
  - Scoring task. Given a unit/argument, rate it on a given scale
  - Comparison task. Given two units/arguments, decide which one is better

cogent? effective? reasonable?

" If you wanna hear my view, I think that the EU should allow rescue boats in the Mediterranean Sea. Many innocent refugees will die if there are no such boats. Nothing justifies to endanger the life of innocent people."

Premise

acceptability: 4 / 5

acceptable? clear? relevant?

Premise

more acceptable than

"It's the main job of the EU to save people's lives, no matter whether they belong here."

- **How does it work?**
  - Several techniques, from supervised learning to graph-based analyses
  - Diverse results, general feasibility open

    Inherent subjectiveness is a main problem

Task 7: Summarizing argumentative texts

- **Argumentation summarization**
  - Summary. A short(er) text covering the key points from one or more long(er) texts in a coherent fashion
  - Task. Given one or more argumentative texts, create a summary

> *" If you wanna hear my view, I think that the EU should allow rescue boats in the Mediterranean Sea. Many innocent refugees will die if there are no such boats. Nothing justifies to endanger the life of innocent people."*

→ *"Without rescue boats, many innocent refugees will die."*

- **How does that work?**
  - Extractive approaches rather *analyze*, e.g., to rank units (Alshomary et al., 2020b)
  - Abstractive approaches often learn to rewrite texts (Wang and Ling, 2016)

Task 8: Synthesizing units and arguments

- **Argument synthesis**
  - Unit task. Given an issue, generate an argumentative unit discussing it
    The unit could convey a stance, frame an aspect, provide evidence, or similar
  - Argument task. Given a stance on an issue and a pool of other units, phrase a text with arguments supporting the stance
    Units may also be retrieved or generated on-the-fly. Other variations of the task also exist.

Pro *towards rescue boats* →

" If you wanna hear my view, I think that the EU should allow rescue boats in the Mediterranean Sea. Many innocent refugees will die if there are no such boats. While having such boats may make even more people die trying, nothing justifies to endanger the life of innocent people. Got it? "

- **How does that work?**
  - Recycle topics and predicates in new claims, using parsing and classification (Bilu and Slonim, 2016)
  - Construct unit from other units, using neural language models (Gurcke et al., 2021)
  - Compose premises and conclusions in learned ways (El Baff et al., 2019)

Task 9: Synthesizing counterarguments

- **Counterargument synthesis**
  - Given an argument, generate a counterargument (with opposing stance)
  - A counterargument may attack an argument‘s conclusion, one of its premises, or the inference from premises to conclusion

The EU should allow rescue boats in the Mediterranean Sea. Many innocent refugees will die if there are no such boats.

→

Having rescue boats also may have negative effects. Even more people may die trying, believing that they may be rescued.

- **How does that work?**
  - Negate claims using rule-based decision trees (Bilu et al., 2015)
  - More advanced approaches retrieve and rephrase units (Hua et al., 2019)
  - Conditioned neural models generate new opposing texts (Alshomary et al., 2023)

Next section: Conclusion

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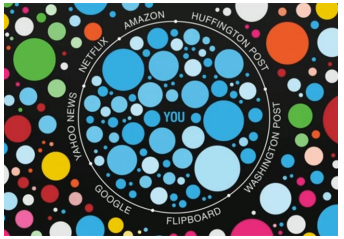
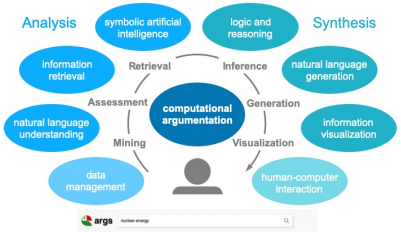
Conclusion

- **Argumentation**
  - Of ever increasing importance in the ”post-factual age“
  - Arguments along with rhetorical and dialectical aspects
  - Used to persuade or agree with others on controversies



- **Computational argumentation**
  - Computational analysis and synthesis of arguments
  - Important applications, such as argument search
  - So far (and here), NLP in the focus



- **Main tasks in computational argumentation**
  - Mining of argumentative units, roles, and relations
  - Assessment of stance, reasoning, quality, ...
  - Generation of units, arguments, and counters

If you wanna hear my view, I think that the EU should allow rescue boats in the Mediterranean Sea. Many innocent refugees will die if there are no rescue boats.

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