Argumentation Technology for Artificial Intelligence

Part 3: Argument Retrieval

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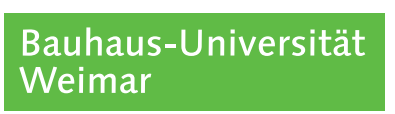
September 24th, 2019



webis.de

3.1 Argument Retrieval Problems

3.2 Argument Ranking

3.3 Resources

3.4 Argument Search Engines

3.5 Shared Tasks

Basic Argument Model

Conclusion	*Mankind will be able to travel to other galaxies.*
Premise 1	*Photon drives can take you up to relativistic velocities.*
Premise 2	*In August 2019 Lightsail2 demonstrated its functioning.*
Premise 3	*NASA announces progress on torpor (human hibernation).*

Argument:

- A conclusion (claim) supported by premises (reasons). [Walton et al. 2008]
  Conclusion and premises are considered as propositions.
- Conveys a stance on a controversial topic. [Freeley and Steinberg, 2009]
  Assignment of truth values to the propositions:
  $\mathcal{I}(\text{“}\textit{Mankind will be able to travel to other galaxies.}\text{”}) = 1,\ \mathcal{I}(\text{“}\textit{Photon} \ldots \text{”}) = 1,\ \ldots$
- The mechanism (“calculus”, “argumentation type”) to obtain (“derive”) the conclusion from the premises is let implicit and is usually informal.

Basic Argument Model

Thesis / Major claim t *Human beings will colonize other planets.*

A_{pro}

c_1 *Mankind will be able to travel to other galaxies.*

P_1

p_1 *Photon drives can take you up to relativistic velocities.*

p_2 *In August 2019 Lightsail2 demonstrated its functioning.*

p_3 *NASA announces progress on torpor (human hibernation).*

Note: $c_1 \succ t$

- "c_1 supports t" (entailment in a cogent, nonobligatory sense)
- "t is compatible with c_1" (but the real argumentation focus)

Basic Argument Model

Thesis / Major claim t *Human beings will colonize other planets.*

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p_1 *Photon drives can take you up to relativistic velocities.*

p_2 *In August 2019 Lightsail2 demonstrated its functioning.*

p_3 *NASA announces progress on torpor (human hibernation).*

A_{con}

c_2 *Mankind will never explore other galaxies.*

P_2

p_4 *Matter cannot pass through wormholes.*

p_5 *Hawkins explained why time travel is impossible.*

Note:

- The standard interpretation $\mathcal{I}$ of all propositions, $t,\ c_i,\ p_j$, is 1 (true).
- $c_1 \approx \neg\, c_2$ "$\neg\, c_2$ is a paraphrase of c_1"

$\Rightarrow$ c_2 can be expressed as c_1 with opposite truth assignment, $\mathcal{I}(c_1) = 0,\ \mathcal{I}(c_2) = 1$

Retrieval Problems (1) Π_{rel}

Query *Will human beings colonize other planets?*

A_{pro}
- c_1 *Mankind will be able to travel to other galaxies.*

- P_1
  - p_1 *Photon drives can take you up to relativistic velocities.*
  - p_2 *In August 2019 Lightsail2 demonstrated its functioning.*
  - p_3 *NASA announces progress on torpor (human hibernation).*

Given in Π_{rel} :

- information need, expressed as query, $q \in Q$
- set of arguments, $\mathbf{A} = \{(c_1, P_1), (c_2, P_2), \ldots, (c_n, P_n)\}$
- $*$ (possibly hidden) human selection of the relevant arguments, $\mathbf{A}^*_q$, $q \in Q$

Sought in Π_{rel} :

- a relevance function $\rho : Q \times \mathbf{A} \to \{0, 1\}$, such that ...

  the macro-averaged F-measure (precision, recall) regarding $\mathbf{A}^*_q$, $q \in Q$, is maximum

Retrieval Problems (2) Π_{rank}

Query *Will human beings colonize other planets?*

A_{pro}

c_1 *Mankind will be able to travel to other galaxies.*

P_1

p_1 *Photon drives can take you up to relativistic velocities.*

p_2 *In August 2019 Lightsail2 demonstrated its functioning.*

p_3 *NASA announces progress on torpor (human hibernation).*

Given in Π_{rank} :

- information need, expressed as query, $q \in Q$
- set of relevant arguments, $\mathbf{A}_q = \{(c_1, P_1), (c_2, P_2), \ldots, (c_m, P_m)\}$
- $*$ (possibly hidden) human ranking of the relevant arguments, $\pi^*_{\mathbf{A}_q}$, $q \in Q$

Sought in Π_{rank} :

- a ranking function $\sigma : Q \times \mathcal{P}(\mathbf{A}) \to \Pi$, such that ...

  the mean rank correlation $\overline{\tau}$ regarding $\pi^*_{\mathbf{A}_q}$, $q \in Q$, is maximum

Retrieval Problems (3) – (6)

3. Π_{counter} Retrieve the "best" counterargument
   Given: query q, argument set $\mathbf{A}$, argument A

4. Π_{sameside} Retrieve (all) arguments with the same stance
   Given: argument set $\mathbf{A}$, argument A

5. Π_{argdoc} Is the document argumentative?
   Given: document d

6. Π_{argquery} Is the query argumentative?
   Given: query q

Notes:

- Π_{counter} can be cast as Π_{rank} if the query is negated.
- Π_{docquery} and Π_{argquery} are decision problems.
- Π_{counter} and Π_{sameside} can be cast as decision problems as well.
- Challenge: development of domain-independent or "topic-agnostic" approaches.

Take Home Messages

3.1 Argument Retrieval Problems

- basic argument model: $(c,\ \{p_1, p_2, \ldots, p_{|c|}\})$
- relevant retrieval problems: Π_{rel}, Π_{rank}, Π_{counter}

3.1 Argument Retrieval Problems

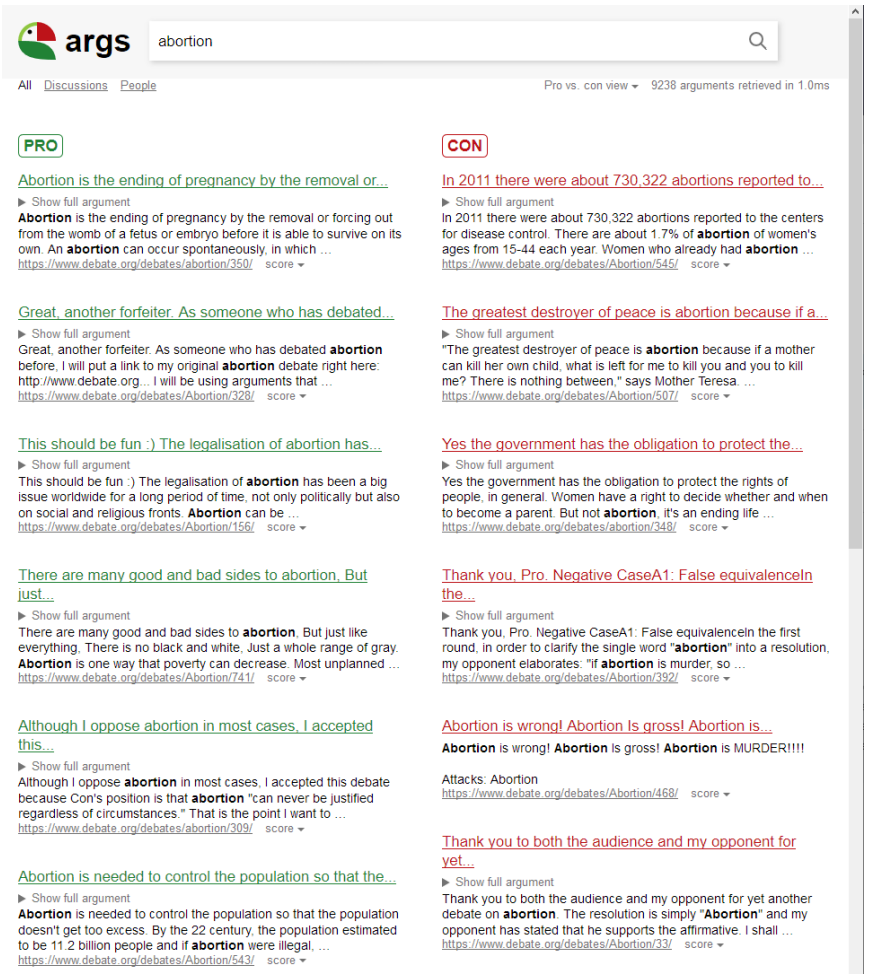
3.2 Argument Ranking

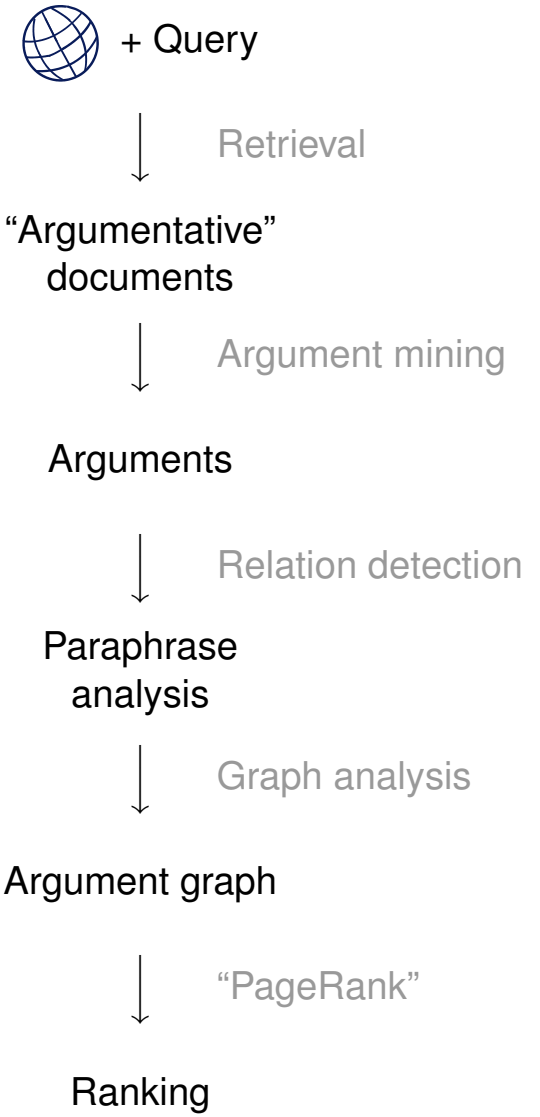
3.3 Resources

3.4 Argument Search Engines

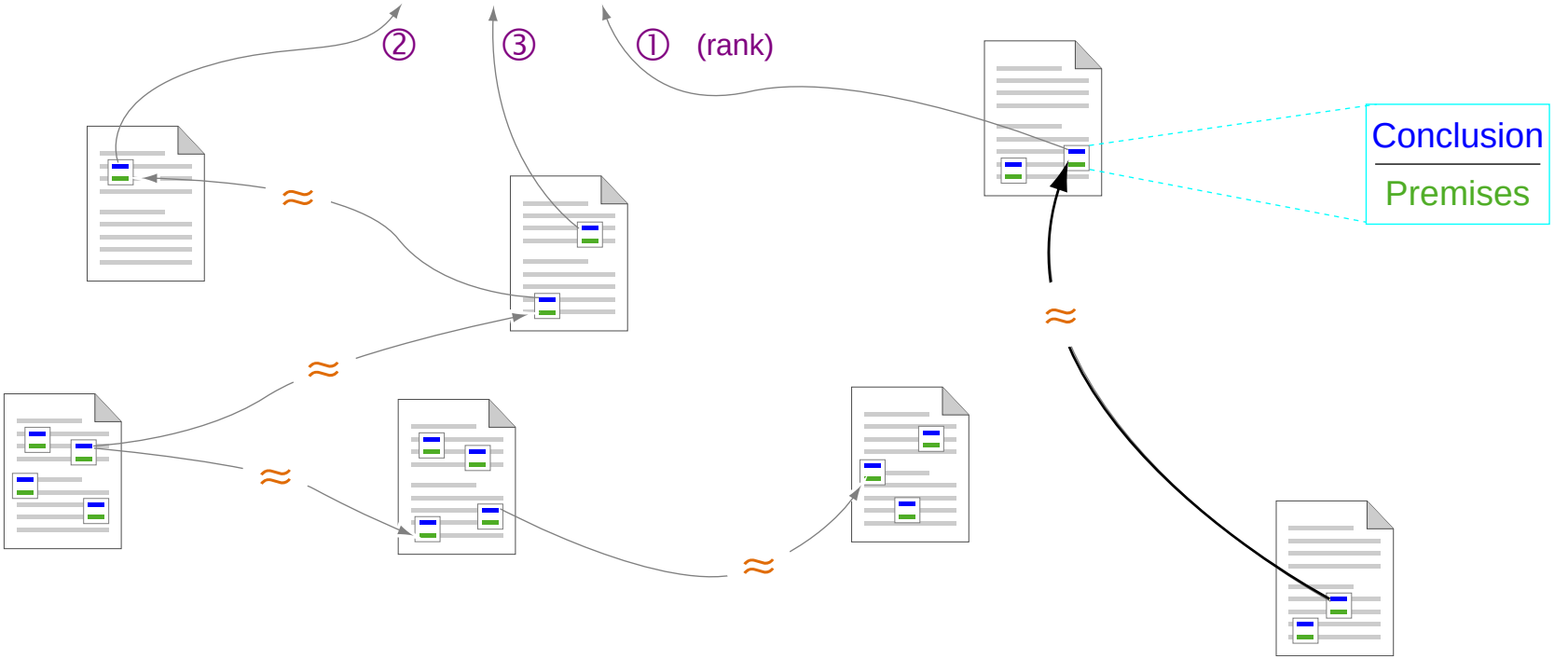
3.5 Shared Tasks

(1) A Topic-Agnostic Solution for Π_{rank}





Query *Reintroduce death penalty?*



Death penalty should be abolished.

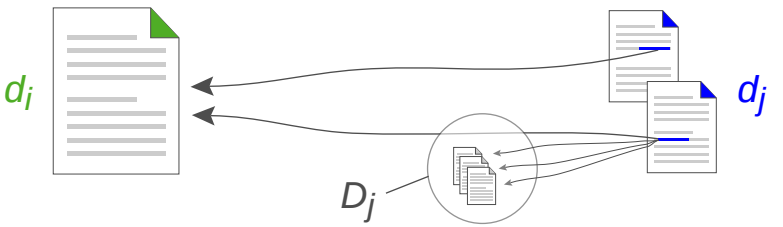
It does not prevent people from committing crimes.

≈

The death penalty doesn't deter people from committing serious violent crimes.

A survey of the UN on the relation between the death penalty and homicide rates gave no support to the deterrent hypothesis.

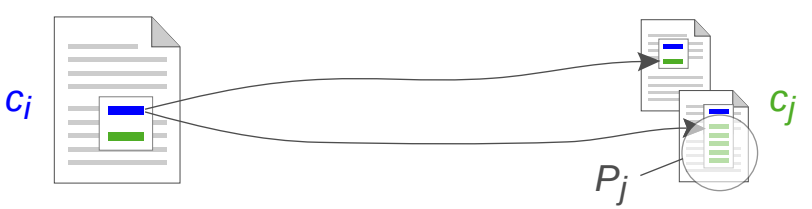
$$p(d_i) = (1-\alpha) \cdot \frac{1}{|D|} + \alpha \cdot \sum_j \frac{p(d_j)}{|D_j|}$$



Original PageRank [Page et al. 1999]

1. ground relevance + recursive relevance
2. d_j links to $d_i \rightsquigarrow$ increase PageRank(d_i)
3. reward exclusive links
4. uniform ground relevances (sum to 1)

$$\hat{p}(c_i) = (1-\alpha) \cdot \frac{p(d_i) \cdot |D|}{|A|} + \alpha \cdot \sum_j \frac{\hat{p}(c_j)}{|P_j|}$$



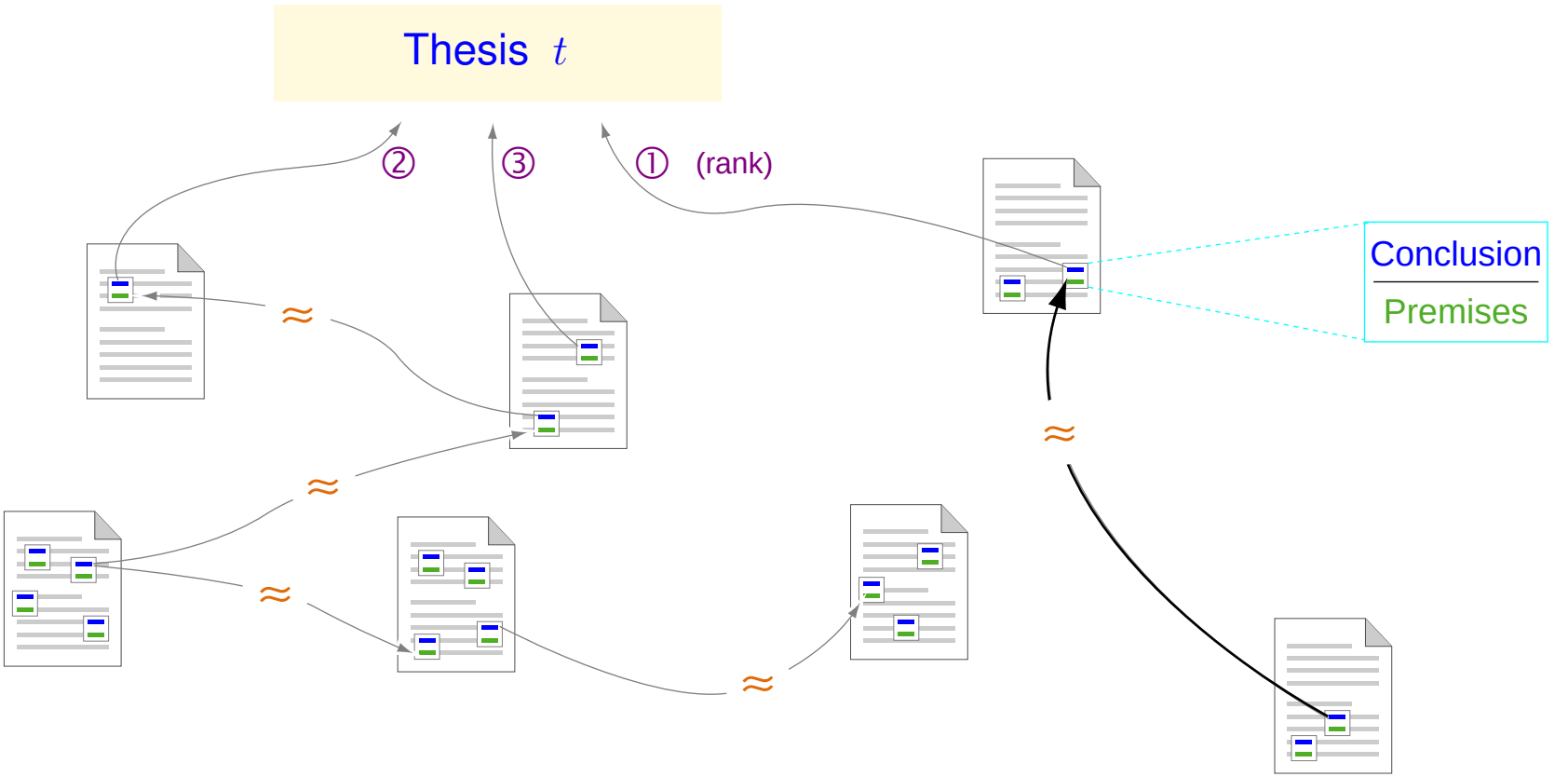
ArgRank [Wachmuth/Stein, 2017]

1. ground strength + recursive relevance
2. c_i premise for $c_j \rightsquigarrow$ increase ArgRank(c_i)
3. reward exclusive premises
4. ground strength $\sim$ PageRank

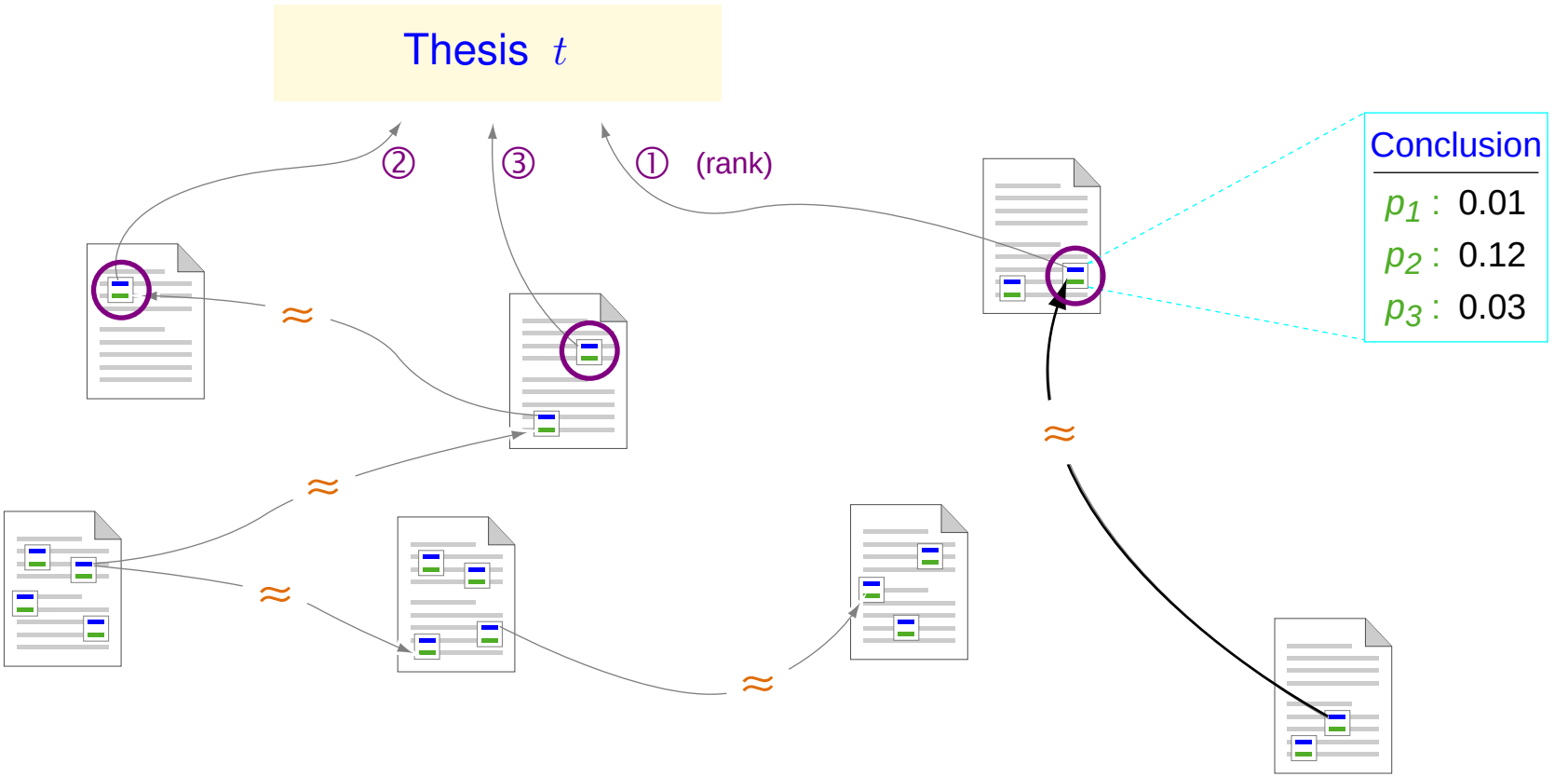
"Reversal of Evidence"

PageRank: Author cannot enforce links to her web page.
ArgRank: Author cannot enforce use of her argument.

From Premise Scores to Argument Ranks



From Premise Scores to Argument Ranks



How to weigh the premise scores of the matching arguments?

(maximum, average, etc.)

Ranking with Argument Graphs

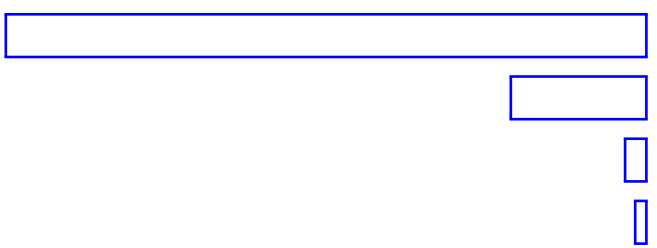
Case Study: Graph Construction

Construction of a raw graph using 57 corpora from the Argument Web:

28 875 Argument units, used in . . .

17 877 Arguments

Processing steps towards an argument graph:



3 113 Conclusions with $\geq$ 1 argument, where . . .

498 have multiple premises, from which . . .

70 have a relevant claim, from which . . .

32 are used in 110 intelligible arguments.

Ranking with Argument Graphs

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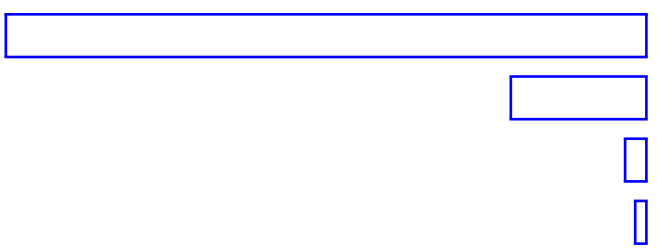


3 113 Conclusions with ≥ 1 argument, where ...

498 have multiple premises, from which ...

70 have a relevant claim, from which ...

32 are used in 110 intelligible arguments.

Acquisition of a ranking ground truth:

- 7 experts from NLP and IR ranked all arguments (110) for each conclusion (32)
- $\tau = 0.59$ as highest agreement between two experts (mean: $\tau = 0.36$)

Ranking with Argument Graphs

Case Study: Results

	Premise score computation				
	Minimum	Average	Maximum	Sum	Best
Ranking approach	τ	τ	τ	τ	τ
1. PageRank	**0.01**	0.02	0.11	**0.28**	**0.28**
2. Frequency	–0.10	–0.03	–0.01	0.10	0.10
3. Similarity	–0.13	–0.05	0.01	0.02	0.02
4. Sentiment	**0.01**	**0.11**	**0.12**	0.12	0.12
5. Most premises	-	-	-	-	0.19
6. Random	-	-	-	-	0.00

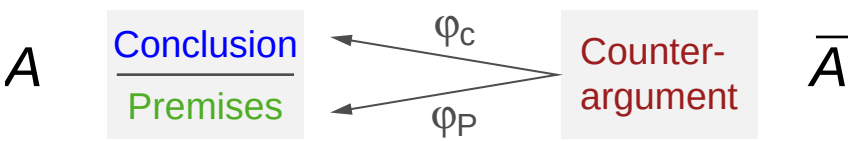
Approach 1: An argument's relevance corresponds to the ArgRank of its premises.

(2) A Topic-Agnostic Solution for Π_{counter} [idebate]

(2) A Topic-Agnostic Solution for Π_{counter}

Idea: Given an argument A, the best counterargument $\overline{A}^*$ employs premises that are similar wrt. topic, but takes the opposite stance.

➜ Consider both similarities to the premises and conclusion [Walton 2009] :



How to compute these similarities?

How to combine these similarities?

(= What is a sensible hypothesis space of promising model functions?)

(2) A Topic-Agnostic Solution for Π_{counter}

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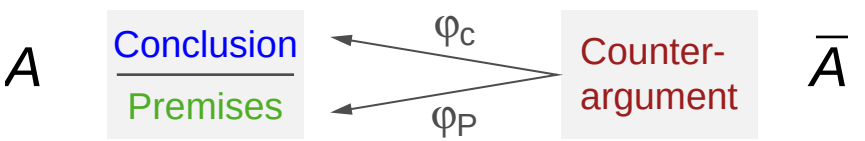


Proposed model function to rank counterarguments [Wachsmuth et al., 2018] :

$$R(A, \overline{A}) = \alpha \cdot \underbrace{\left(\varphi_{\text{conclusion}} \circ \varphi_{\text{Premises}}\right)}_{\text{topic similarity} \rightarrow \text{max}} - (1-\alpha) \cdot \underbrace{\left(\varphi_{\text{conclusion}} \circ \varphi_{\text{Premises}}\right)}_{\text{stance similarity} \rightarrow \text{min}}$$

where

- φ combines both word and embedding similarities
- $\circ \in \{\min, \max, +, *\}$
- $\alpha \in [0; 1]$

(2) A Topic-Agnostic Solution for Π_{counter}

Corpus and Analysis

Theme	Debates	Points	Counters
Culture	46	278	278
Digital freedoms	48	341	341
Economy	95	590	588
⋮			
Sport	23	130	130
$\sum$	**1069**	**6779**	**6753**

Corpus:

- based on the iDebate.org portal
- Download: ArguAna Counterargs

Retrieval experiments (selected results):

Find the best counterargument within . . .	True-to-false ratio	Accuracy*
all counters of the same debate	1 : 3	0.75
all counters of the same theme	1 : 136	0.54
all arguments of the entire portal	1 : 2 800	0.32

* The parameters for $R(A, \overline{A})$ were determined by a systematic ranking analysis.

Take Home Messages

3.2 Argument Ranking

- topic agnostic solution for Π_{rank}, based on Page rank
- topic agnostic solution for Π_{counter}, realized via grid search

3.1 Argument Retrieval Problems

3.2 Argument Ranking

3.3 Resources

3.4 Argument Search Engines

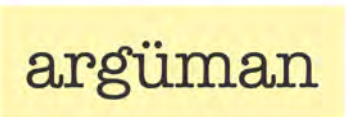
3.5 Shared Tasks


ARCHELOGOS
PROJECTS


idea


PRO
DEBATEPEDIA
CON


DEBATE
.ORG


argüman


argument interchange
Home of the AIF: Infrastructure for the argument web


CreateDebate


TRUTHMAPPING


PROCON.ORG


convinceme
start a debate


argunet


ObViz


ForandAgainsT
The Best Place to State your Case


Evidence Hub
for open education

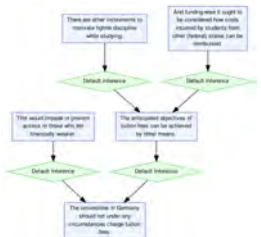

intelligence²
DEBATES

Argumention-Related Resources

Leverage effort	Resource type		Examples
low	Technology	Visual inspection Acquisition, Tagging	Argument Web Truthmapping
	Corpora	Argumentative structure analysis Argumentation quality analysis Stance detection	AIFdb data IBM Debater data UKP data Webis data
medium	Debate portals	English German	Kialo idebate Debatepedia Argumentia
high	Discussion pages	Focus on persuasion Controversial issues Focus on deliberation	changemyview reddit WikiTalk
very high	Articles	Editorials, Essays Legal Scientific publications	New York Times ACL anthology

The Argument Web [Library]

AIFdb Corpora

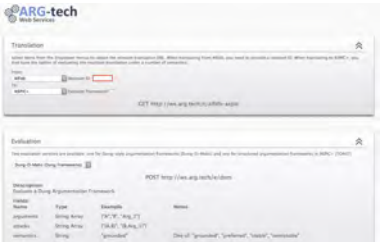


Structured argument data
in uniform format

AIFdb Search

Search interface
for argument resources

ARG-tech API



Several argument
web services

Argublogging

Widget for argument
annotation in blogs

OVA

Online visualization and
analysis of arguments

Arvina

Dialogue platform
based on AIFdb

Take Home Messages

3.3 Resources

- plethora of resources, which are mainly of academic nature
- tools, corpora, debates, discussions, argumentative texts

3.1 Argument Retrieval Problems

3.2 Argument Ranking

3.3 Resources

3.4 Argument Search Engines

3.5 Shared Tasks

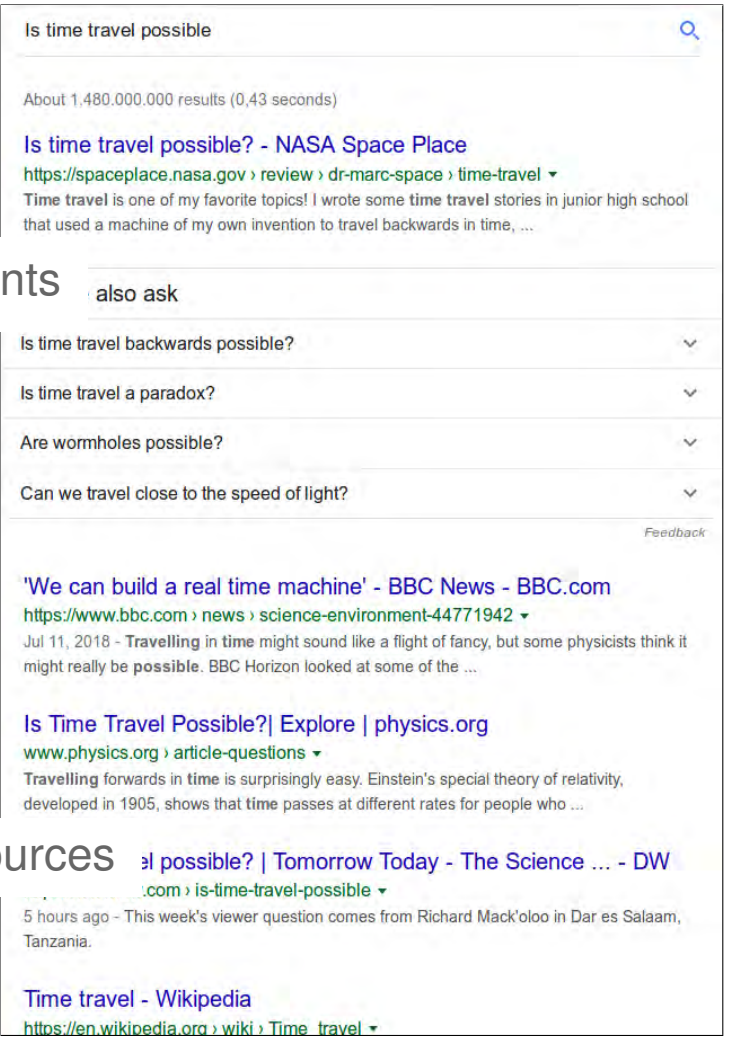
Vision of Argument Search*

Arguments in future web search:

- support forming opinions
- make it easy to find relevant arguments
- deliberation: learn about other views
- education: learn to debate

Search results should . . .

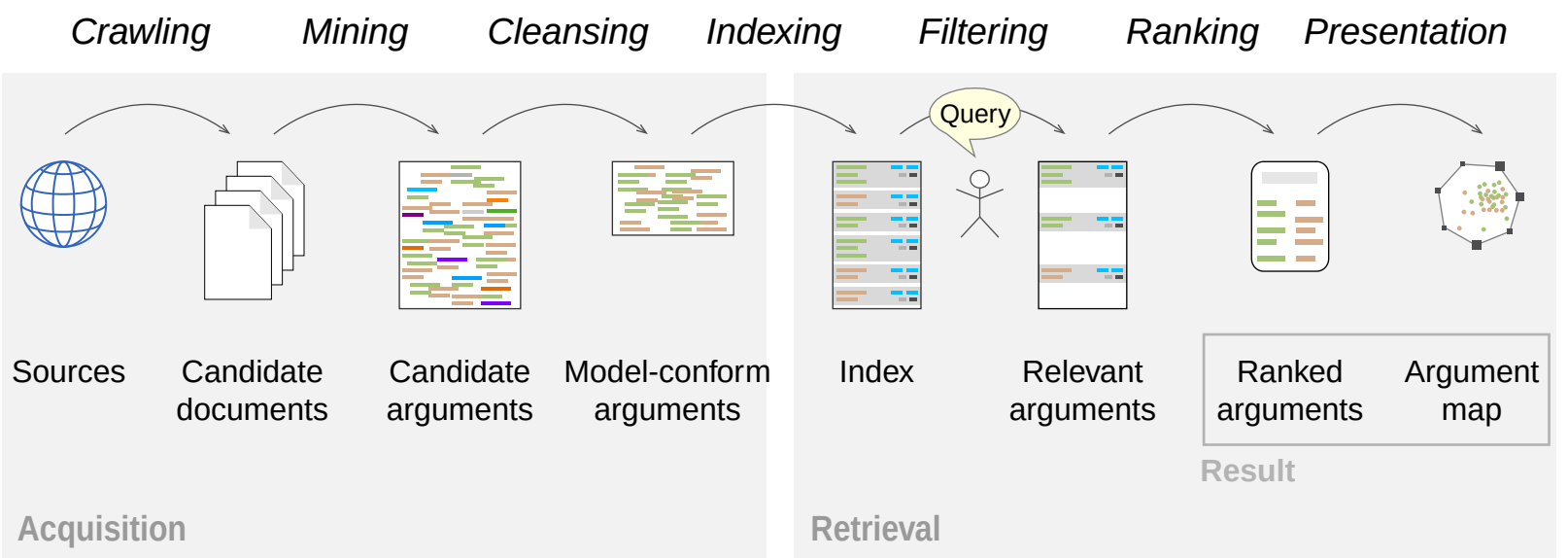
- rank the best arguments highest
- cover diverse aspects
- cover reliable and heterogeneous sources
- be up-to-the-minute
- be traceable and evaluable



* Wachsmuth: Argumentation Retrieval and Analysis. IR Autumn School ASIRF (2018).

Argument Search Engines

Basic Elements and Process



Argument Search Engines

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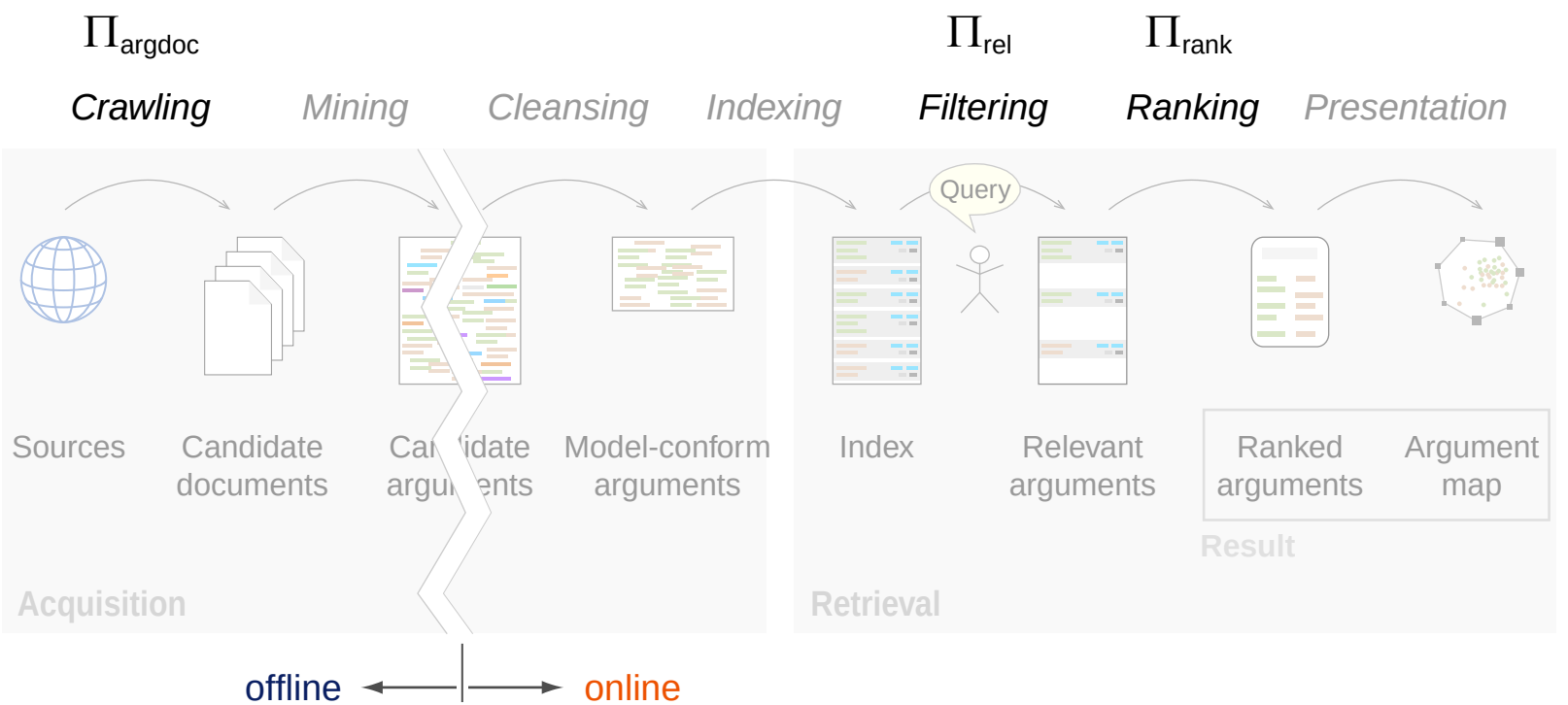
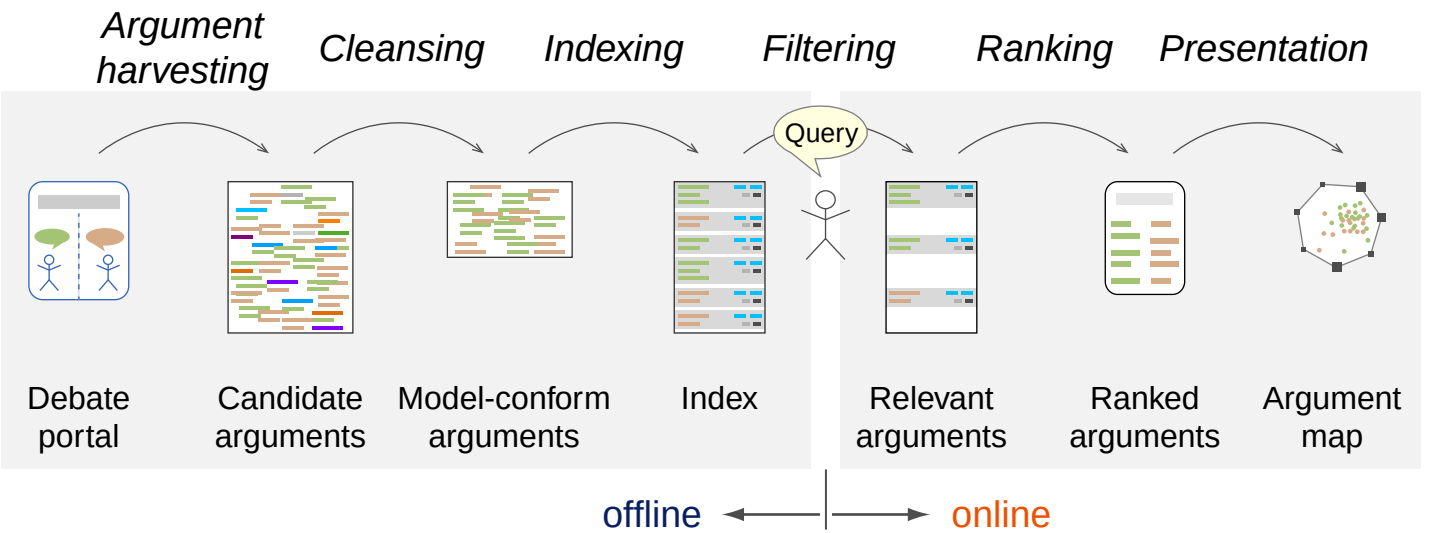


Acquisition paradigm [Ajjour et al., KI 2019]:

- distribution of processing steps regarding offline time and online time
- tradeoff between precision, recall, and topicality

Acquisition Paradigms

(a) args.me [Demo]



- Research focus: argument ranking
- Supervision level: medium (distantly supervised)

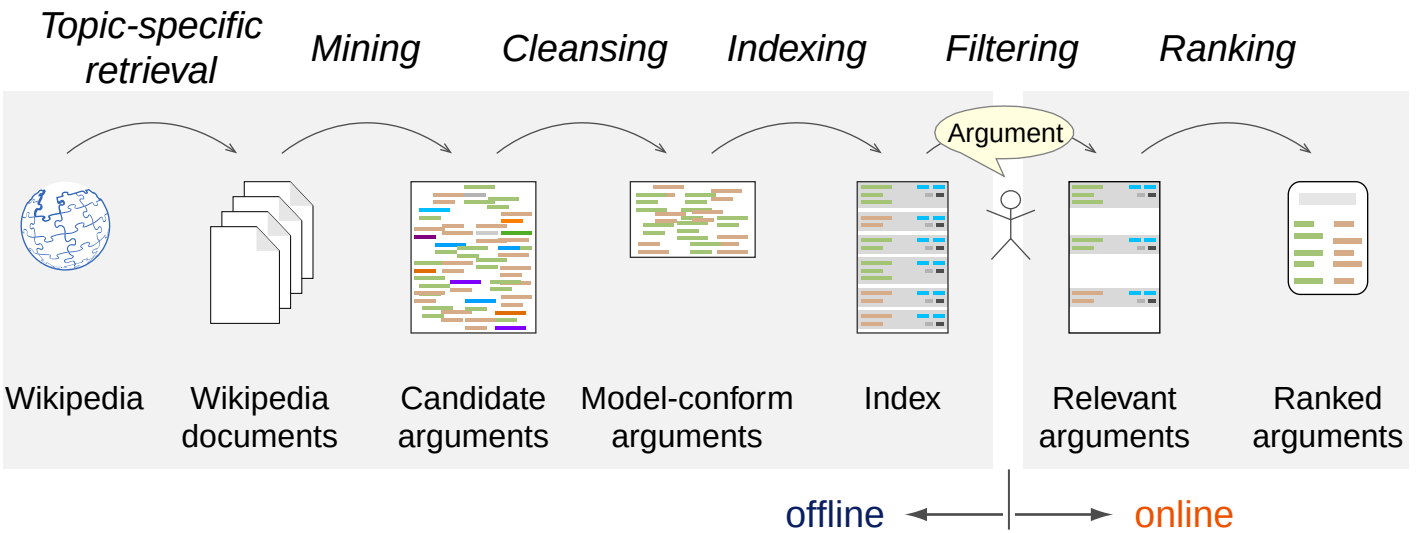
➜ Effectiveness profile: high precision, low recall

➜ Stance balance: guaranteed

➜ Efficiency: high

Acquisition Paradigms

(b) IBM Debater [Project]



- Research focus: debating technology
- Supervision level: medium (recognized source)

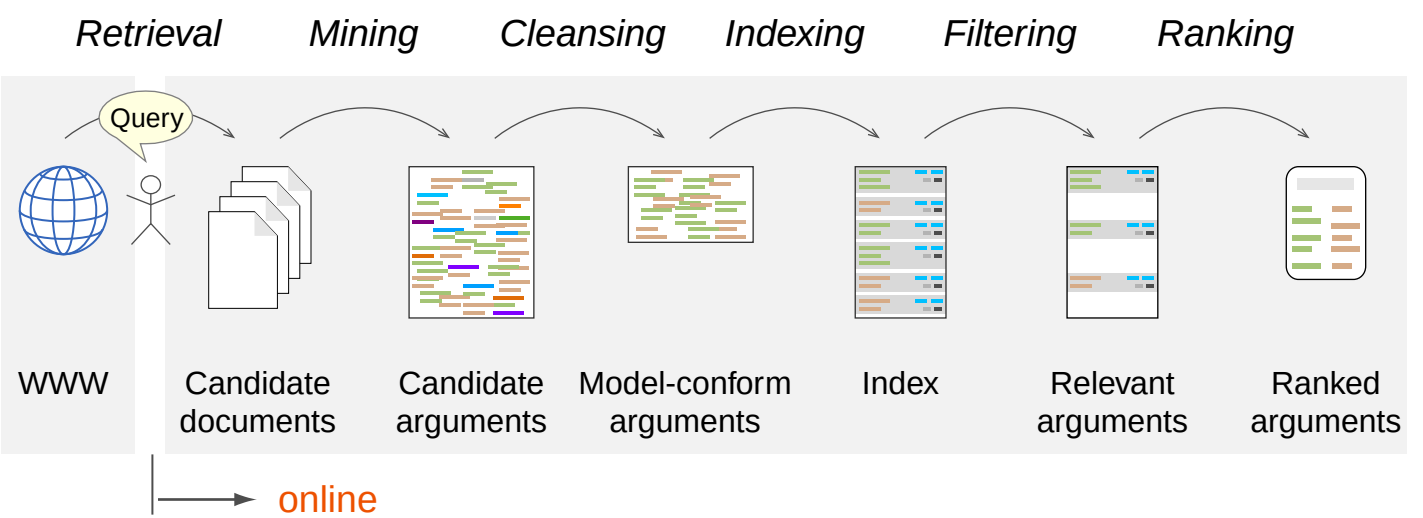
➜ Effectiveness profile: high precision, high recall on topic

➜ Stance balance: guaranteed

➜ Efficiency: high

Acquisition Paradigms

(c) ArgumenText [Demo]



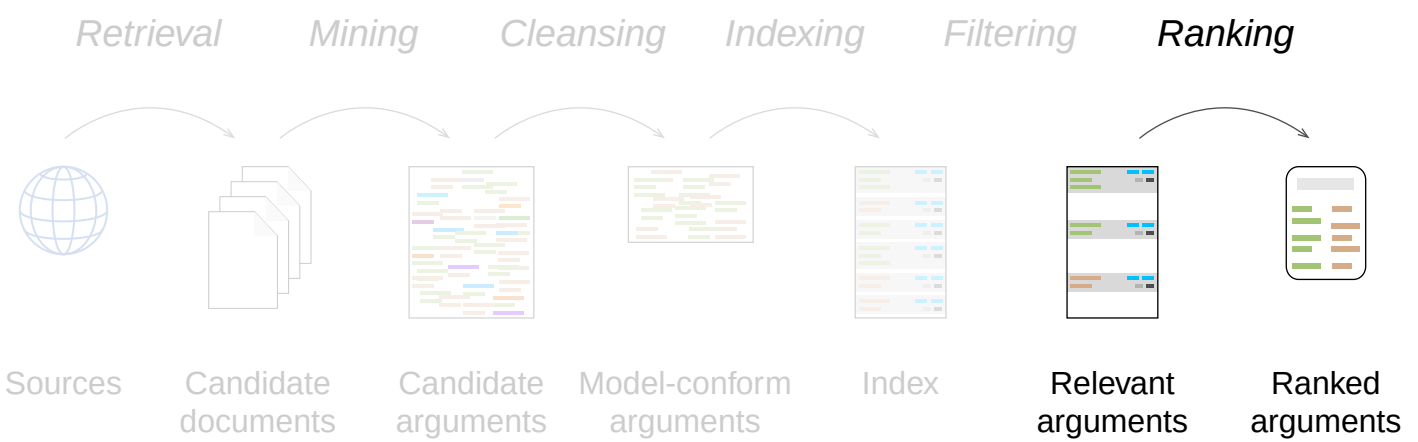
- Research focus: argument mining
- Supervision level: low

→ Effectiveness profile: low precision, high recall

→ Stance balance: cannot be guaranteed

→ Efficiency: low

Ranking Paradigms

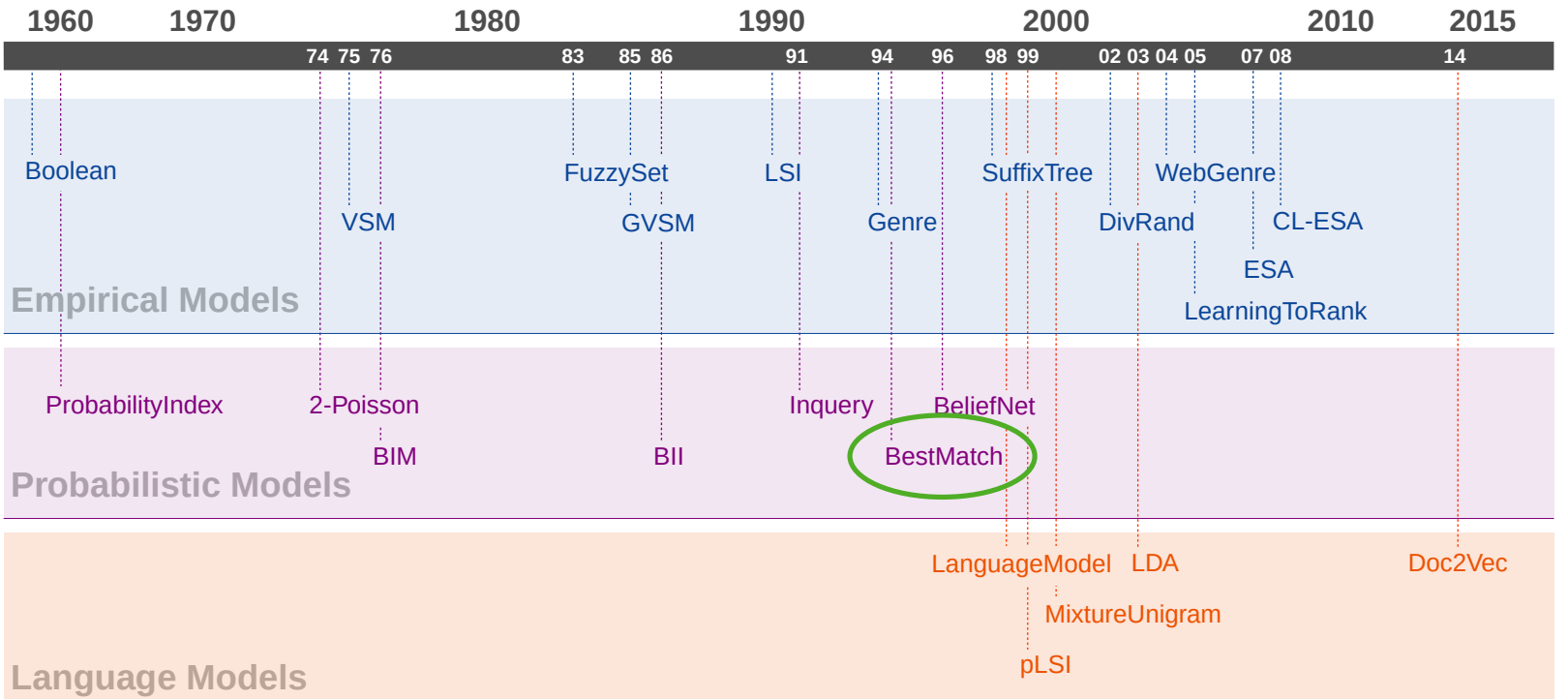


Designing a ranking algorithm:

- Analyze conclusions, premises, or both?
- Use fulltext or elite terms only?
- Exploit metadata and sentiment?
- Analyze relations between arguments?

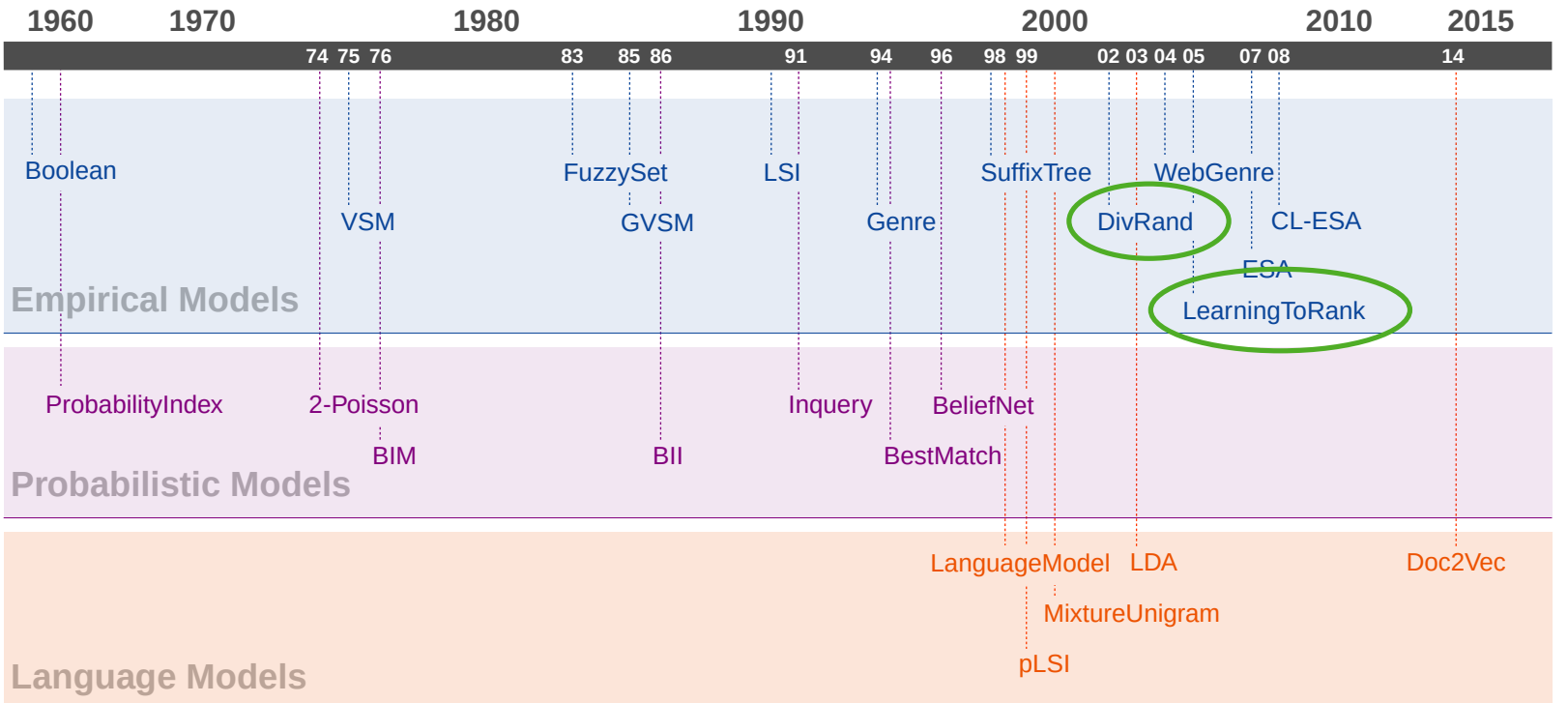
...

Ranking Paradigms in IR



$$\rho(q, A) \equiv \text{BM25}(q, A) = \sum_{i=1}^{|q|} \frac{\text{IDF}(t_i) \cdot \text{TF}(t_i, A) \cdot (k_1 + 1)}{\text{TF}(t_i, A) + k_1 \cdot \left(1 - b + b \cdot \frac{\text{LEN}(A)}{\text{avdl}}\right)}$$

Ranking Paradigms in IR



- New research indicates that *Divergence from Randomness* and *Learning to Rank* are significantly more effective retrieval models to address Π_{rank}.

  [Pottast et al., SIGIR 2019]

More on args.me [args.me]

Argument sources:

#	Debate Portal	Argument Units	Arguments	Debates
1	idebate.org	16 084	15 384	698
2	debatepedia.org	34 536	33 684	751
3	debatewise.org	39 576	33 950	2 252
4	debate.org	210 340	182 198	28 045
5	forandagainst.com	29 255	26 224	3 038
$\sum$		329 791	291 440	34 784

Design decisions:

- Argument model: conclusion + 1 premise with stance information
- Query: free text phrase, interpreted as AND query
- Retrieval: exact matching against conclusion
- Ranking: BM25F based on conclusion (1.0), premise (0.5), and debate (0.2)

More on args.me [args.me]

Top queries (Sep.'17 – Apr.'19) :

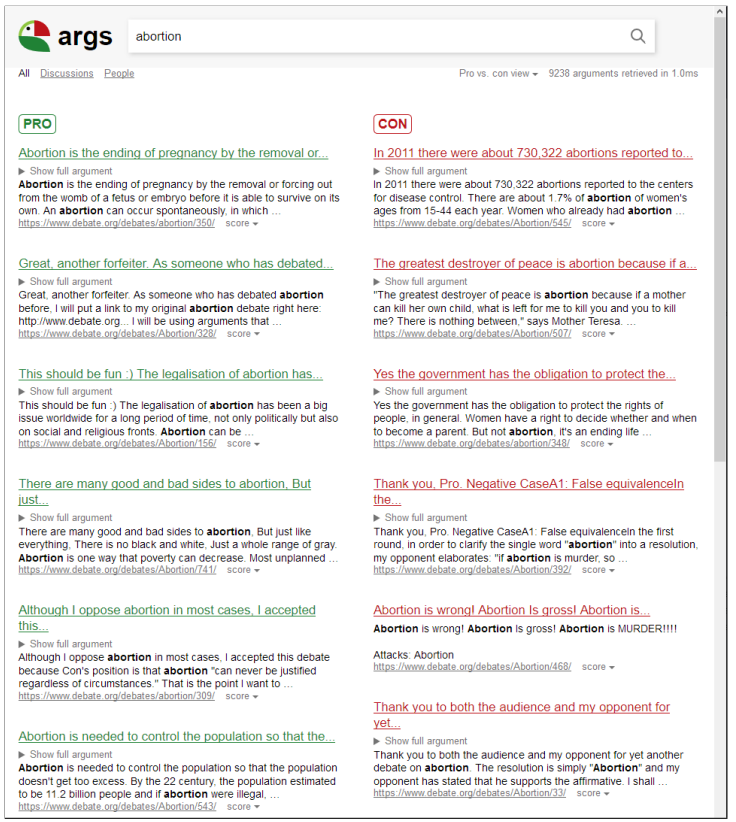
	Query	Absolute	Relative
1	`climate change`	251	3.5%
2	`feminism`	193	2.7%
3	`abortion`	158	2.2%
4	`trump`	146	2.0%
5	`brexit`	128	1.8%
6	`death penalty`	73	1.0%
7	`google`	58	0.8%
8	`vegan`	57	0.8%
9	`nuclear energy`	56	0.8%
10	`donald trump`	47	0.7%

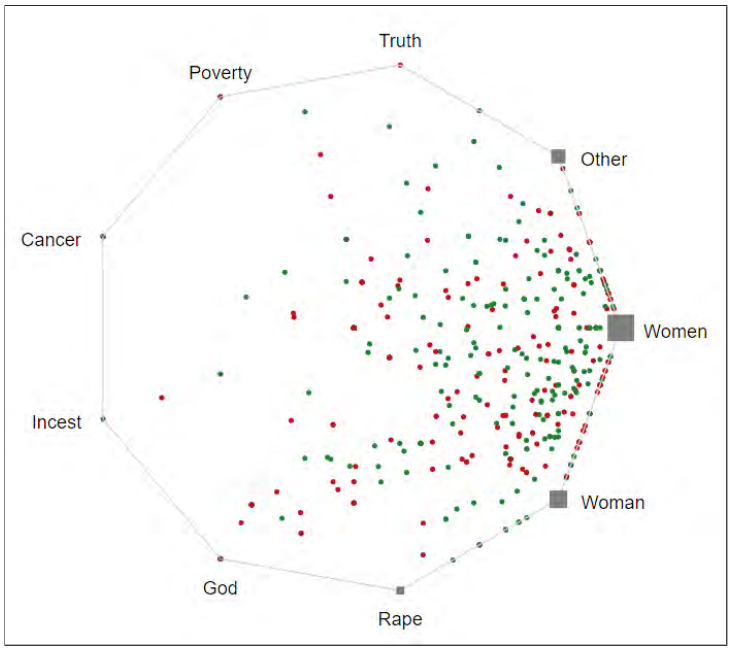
Coverage of 1082 Wikipedia controversial issues :

- 78% match with ≥ 1 argument
- 42% match with ≥ 1 conclusion

More on args.me [args.me]

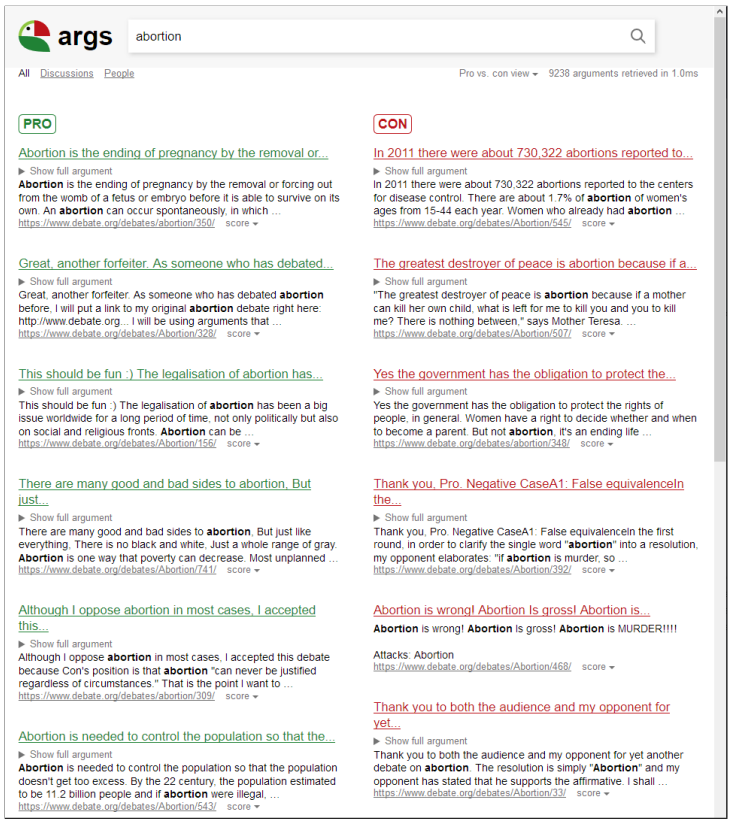
Presentation and Analytics

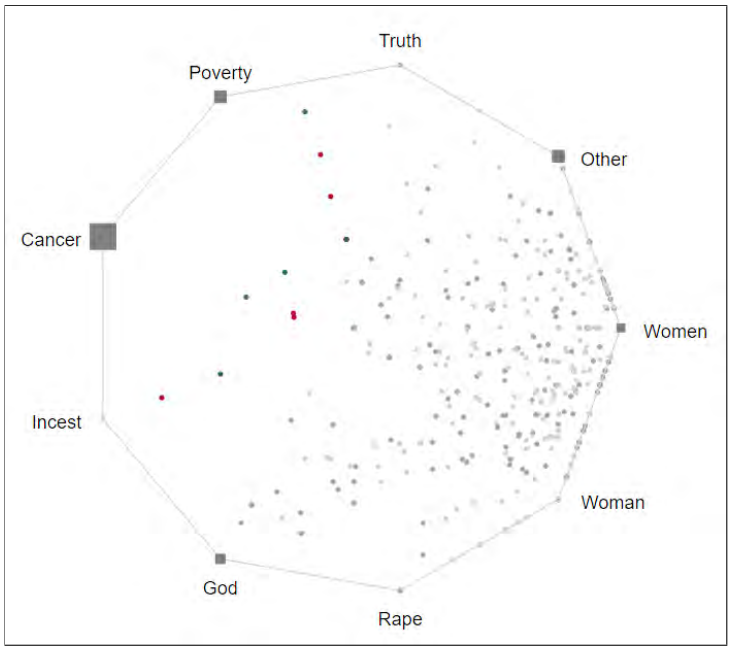




More on args.me [args.me]

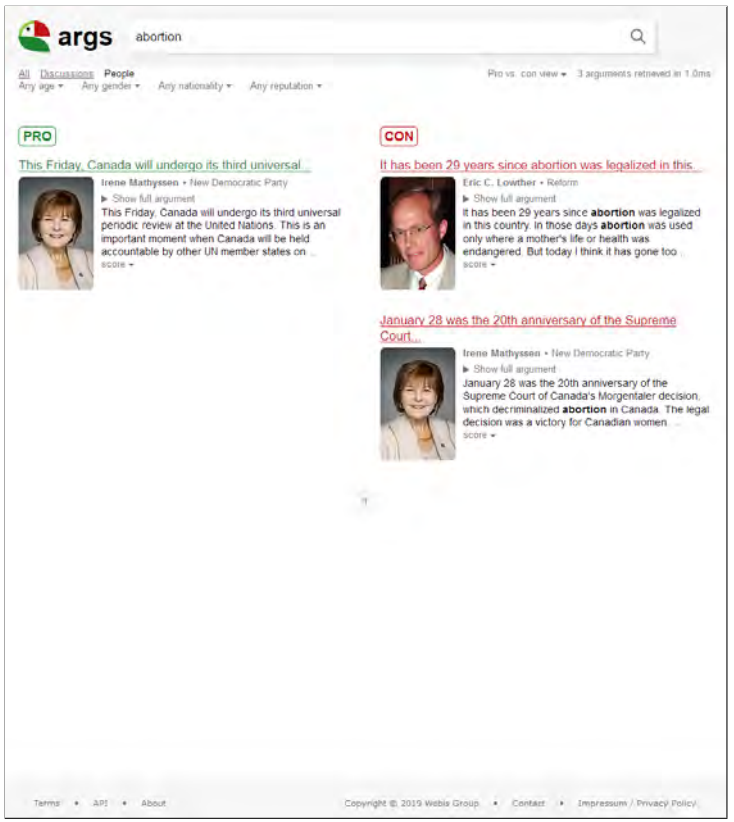
Presentation and Analytics

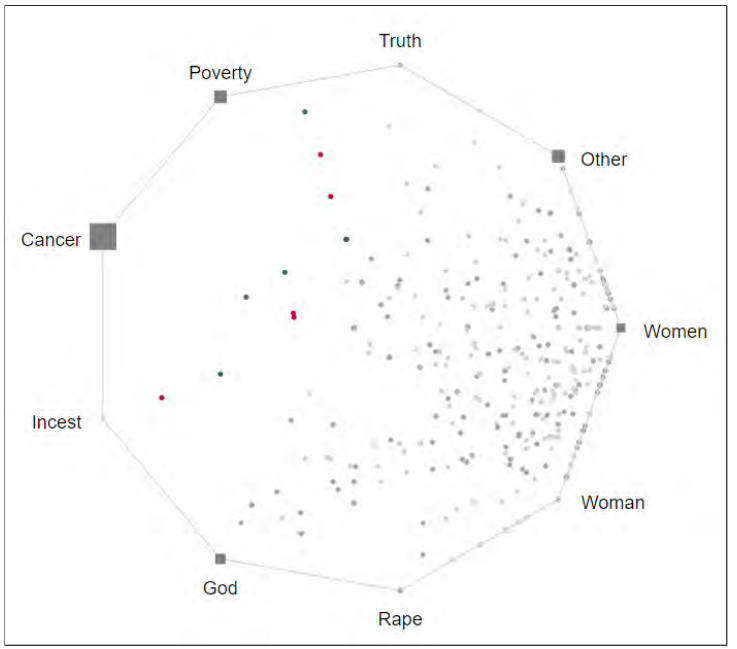




More on args.me [args.me]

Presentation and Analytics





Take Home Messages

3.4 Argument Search Engines

- from “what” search engines to “why” search engines
- acquisition paradigm trades precision, recall, and topicality

3.1 Argument Retrieval Problems

3.2 Argument Ranking

3.3 Resources

3.4 Argument Search Engines

3.5 Shared Tasks

Same Side Stance Classification [sameside.webis.de]

Task: Given two arguments regarding a certain topic, decide whether or not the two arguments have the same stance.

Topic: “Gay marriage should be legalized.”

Argument 1
Marriage is a commitment to love and care for your spouse till death. This is what is heard in all wedding vows. Gays can clearly qualify for marriage according to these vows, and any definition of marriage deduced from these vows.

Argument 2
Marriage is the institution that forms and upholds for society, its values and symbols are related to procreation. To change the definition of marriage to include same-sex couples would destroy its function.

○≠○
different side

Argument 1
Marriage is a commitment to love and care for your spouse till death. This is what is heard in all wedding vows. Gays can clearly qualify for marriage according to these vows, and any definition of marriage deduced from these vows.

Argument 2
Gay marriage should be legalized since denying some people the option to marry is dscrimenatory and creates a second class of citizens.

○=○
same side

Same Side Stance Classification

Task Rationale

Same side classification needs not to distinguish topic-specific pro- / con-vocabulary.

→ ”Only” argument similarity within a stance needs to be assessed.

→ Same side classification may be solved in a topic-agnostic fashion.

Applications:

- measure the bias strength within argumentation
- structure a discussion
- find out who or what is challenging me in a discussion
- filter wrongly labeled stances in a large argument corpus
- . . .

Same Side Stance Classification

Tasks Details

Two topics (domains):

1. Should gay marriage be legalized?
2. Should abortion be legalized?

Within domain setting:

Training. Instances from both domains.

Test. Instances from both domains.

Cross domain setting:

Training. Instances from abortion.

Test. Instances from gay marriage.

Form of an instance:

1. Name of the topic (domain) d.
2. Argument 1 from $\mathbf{A}_d$.
3. Argument 2 from $\mathbf{A}_d$.
4. One of $\{ \bigcirc{=}\bigcirc, \bigcirc{\neq}\bigcirc \}$.

Timeline:

8.6. 2019:	Training data online.
14.6. 2019:	Submission open.
21.7. 2019:	Submission closed.
1.8. 2019:	6th ArgMining workshop.

Same Side Stance Classification

Results "Within Domain"

	Gay marriage			Abortion			All		
Team	Pre	Rec	Acc	Pre	Rec	Acc	Pre	Rec	Acc
Trier University	0.90	0.73	0.83	0.79	0.59	0.71	**0.85**	0.66	0.77
Leipzig University	0.80	0.78	0.79	0.78	0.68	0.75	0.79	0.73	0.77
IBM Research	0.73	0.63	0.70	0.64	0.54	0.62	0.69	0.59	0.66
TU Darmstadt	0.74	0.56	0.68	0.63	0.48	0.60	0.68	0.52	0.64
Düsseldorf University	0.76	0.35	0.62	0.65	0.32	0.57	0.70	0.33	0.60
LMU	0.53	1.00	0.55	0.53	1.00	0.55	0.53	1.00	0.55
...									

Same Side Stance Classification

Results "Cross Domain": Abortion → Gay marriage

	Gay marriage (large)			Gay marriage (small)		
Team	Pre	Rec	Acc	Pre	Rec	Acc
LMU	0.67	0.53	0.63	0.78	0.61	0.72
TU Darmstadt	0.64	0.59	0.63	0.71	0.63	0.68
IBM Research	0.62	0.49	0.60	0.74	0.43	0.64
Paderborn University	0.60	0.38	0.56	0.79	0.33	0.62
Trier University	0.69	0.16	0.54	**1.00**	0.20	0.60
Düsseldorf University	0.72	0.53	0.66	0.68	0.37	0.60
...						

Most of the submitted classifiers are robust regarding:

- imbalances between domain proportions in training and test
- imbalances between domain proportions within test
- imbalances between same side / different side proportions

Argument Retrieval Task @ CLEF 2020 [touche.webis.de]

Argument Retrieval Task @ CLEF 2020 [touche.webis.de]

Task 1: Supporting argumentative conversations

- Scenario: Users search for arguments on controversial topics
- Task: Retrieve “strong” pro/con arguments on the topic
- Data: 300,000 “arguments” (short text passages)

Task 2: Answering comparative questions with arguments

- Scenario: Users face personal decisions from everyday life
- Task: Retrieve arguments for “Is X better than Y for Z?”
- Data: ClueWeb12 or ChatNoir [chatnoir.eu]

- Run submissions similar to “classical” TREC tracks
- Software submissions via TIRA [tira.io]

Touché @ CLEF 2020

1st Shared Task on Argument Retrieval

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Meriem Beloucif
Chris Biemann
Alexander Panchenko
Benno Stein

[touche.webis.de]

Take Home Messages

3.5 Shared Tasks

- build community for relevant problems
- acquire knowledge and best practices, improve benchmarks

Summary

3.1 Argument Retrieval Problems

basic argument model, relevant retrieval problems

3.2 Argument Ranking

topic-agnostic solution for Π_{rank} and Π_{counter}

3.3 Resources

resources: tools, corpora, debates, discussions, argumentative texts

3.4 Argument Search Engines

acquisition paradigm trades between precision, recall, and topicality

3.5 Shared Tasks

build community, acquire knowledge, improve benchmarks