Topic Ontologies for Arguments

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Motivation

- Argument mining and analysis is topic-dependent.

  Example: The following argument has different stances depending on the topic.

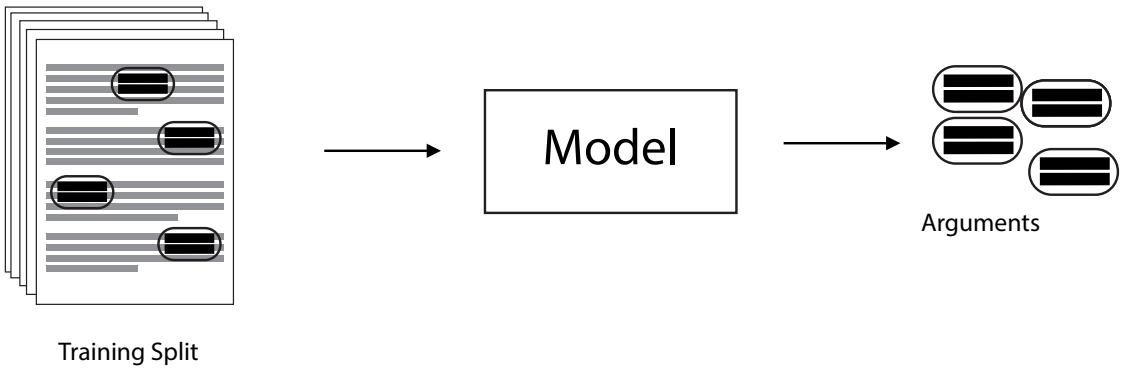
  Argument:

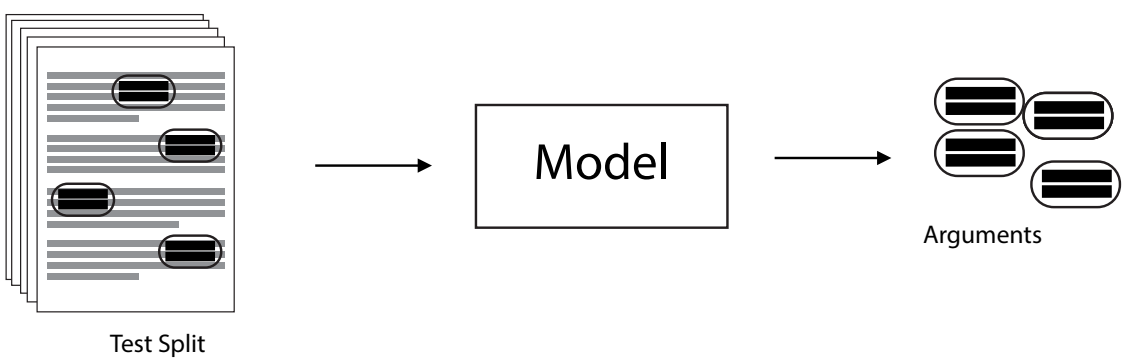
  > "Marijuana should be legalized since it brings economical benefits"

  Topic 1: "Marijuana should be legalized"
  Stance: Pro

  Topic 2: "Does marijuana lead to social anxiety"
  Stance: Neutral

Motivation





Supervised learning methodology for learning argument mining approaches.

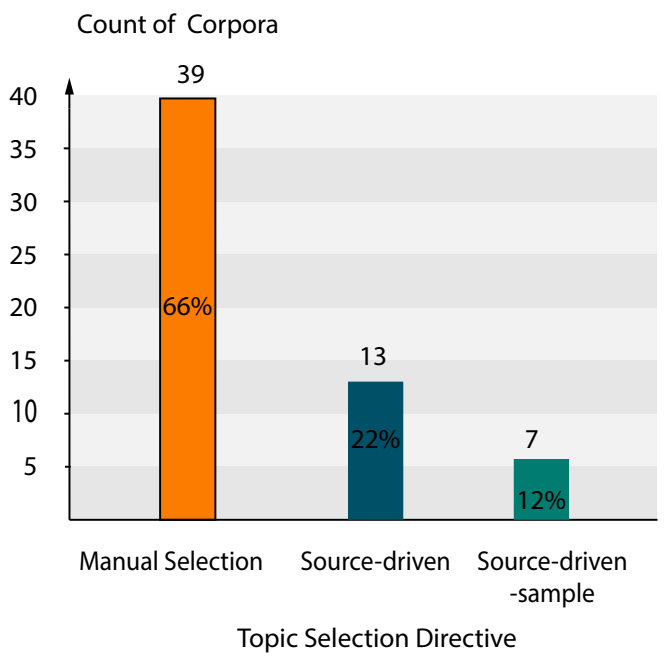
Motivation

How well do argument corpora represent controversial topics?

Topic Selection of Existing Argument Corpora

A survey of 59 argument corpora shows that researchers take three approaches:

- Manual selection: choosing a set of topics manually
- Source-driven-greedy: a whole source is exploited
- Source-driven-sample: a source is sampled



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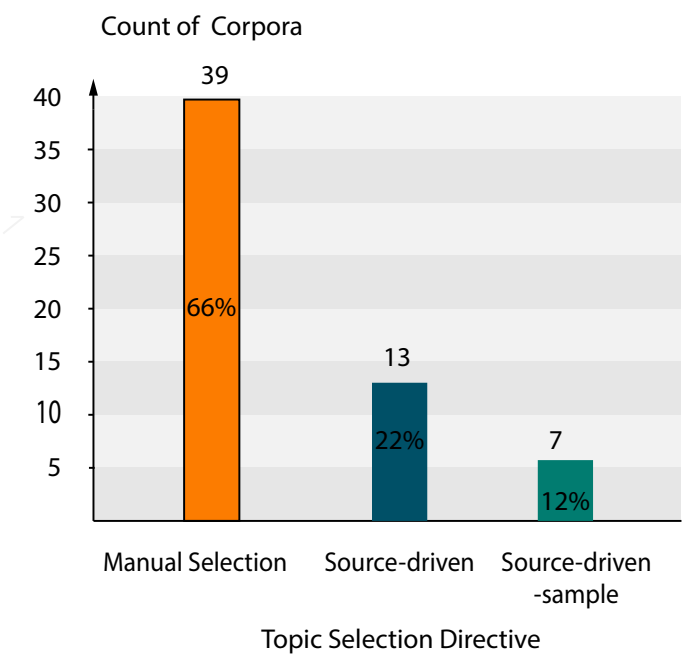
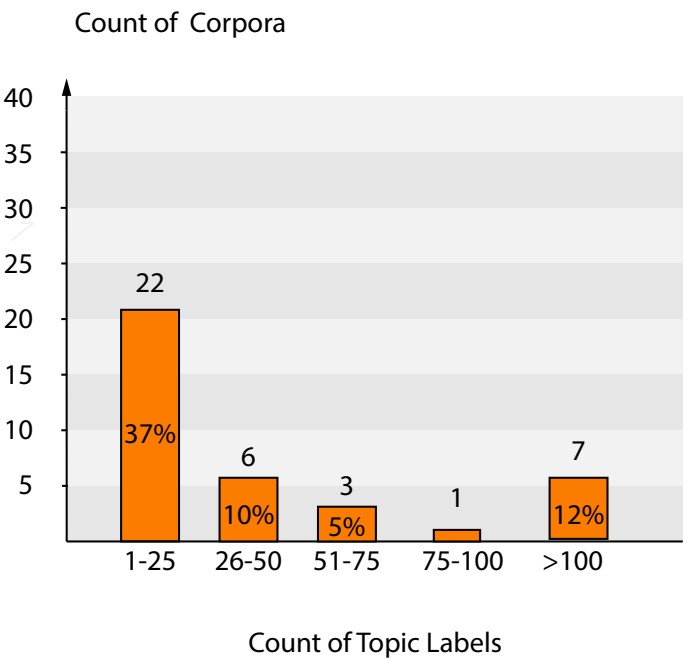
About a third of argument corpora cover less than 25 topics.

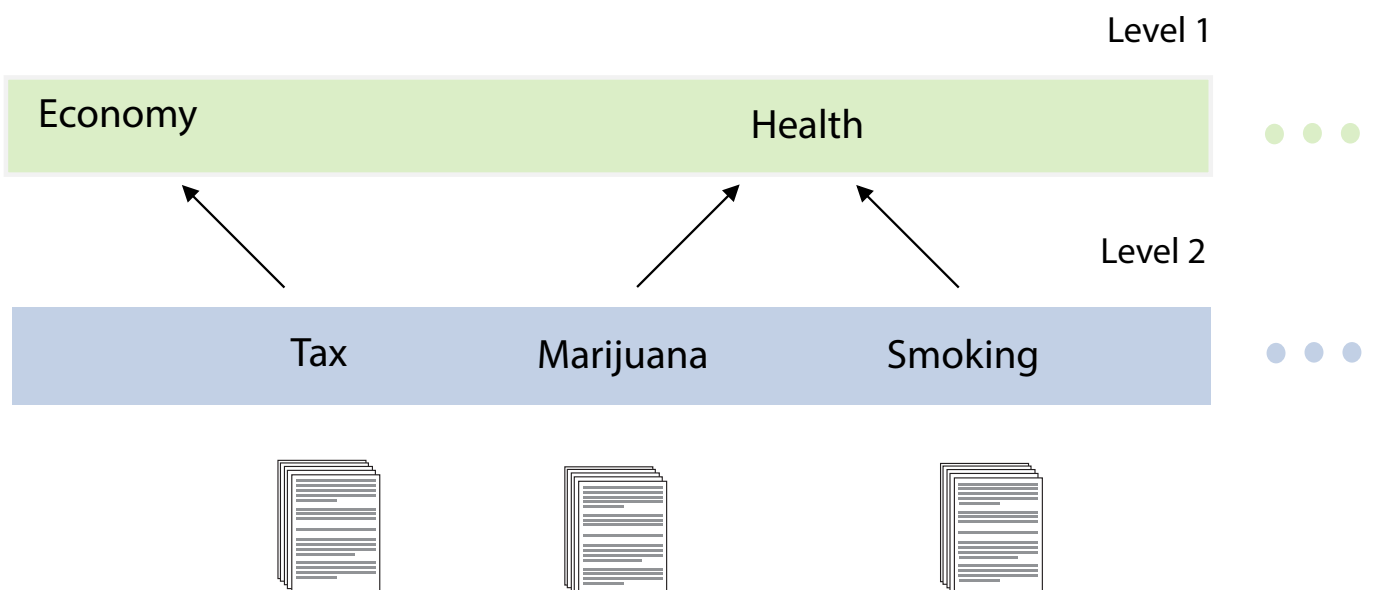




Topic Ontologies

Ontology is an explicit specification of a conceptualization: it defines the terms of a specific domain.

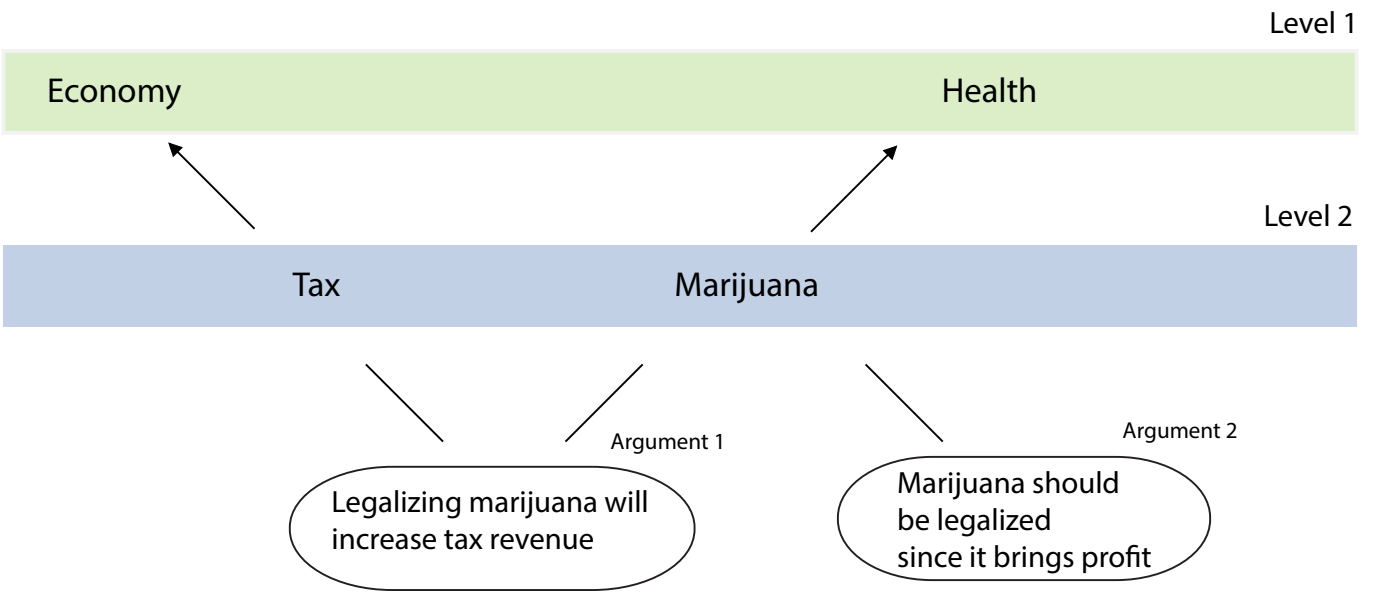
A topic ontology is a directed acyclic graph, whose nodes are topics and the edges imply "is-part-of" relations.



Use Cases for Argument Topic Ontologies

Argument topic ontologies have different applications that we foresee:

- Topic Sampling
- Argument Analysis
- Argument Generation



Trustworthy Argument Topic Ontologies

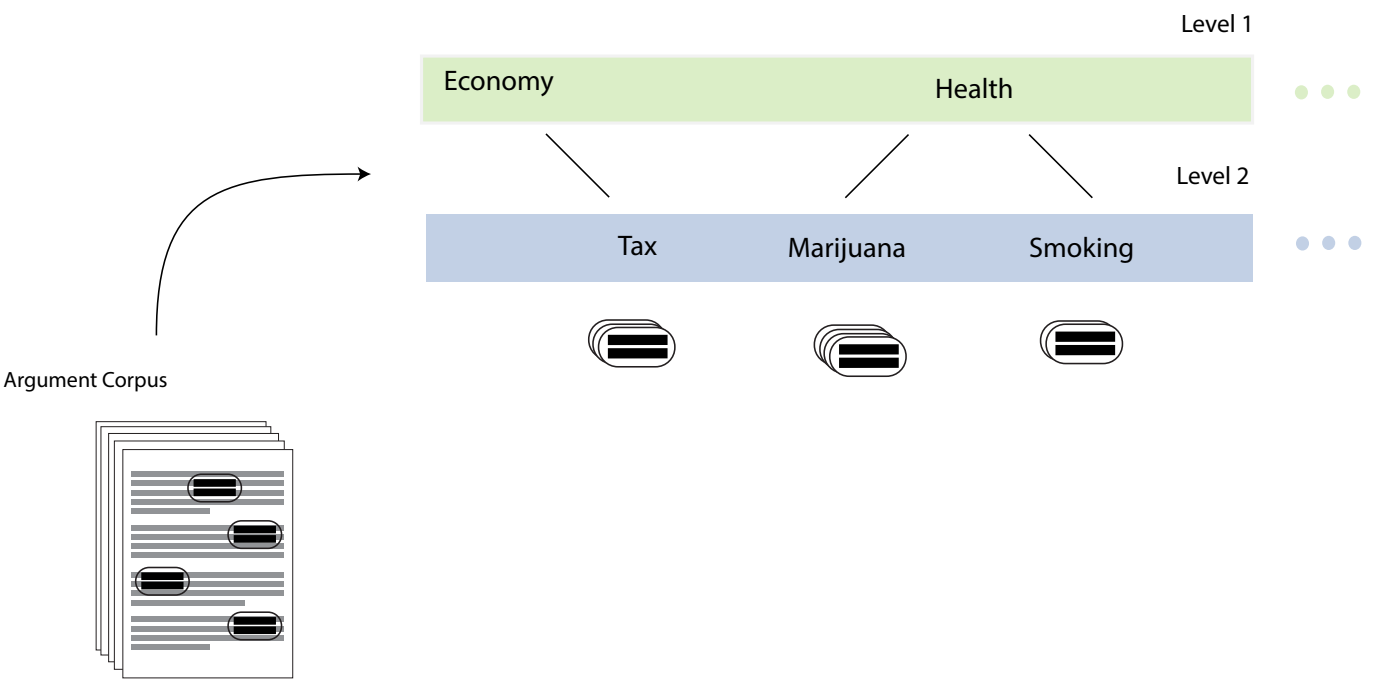
Selecting and organizing topics require domain knowledge. Hence, we resort to three authoritative sources.

Ontology	Topics	Authors	Docs
World Economic Forum Level-1	137	334	940
World Economic Forum Level-2	822	217	550
Wikipedia Level-1	14	78,014	68
Wikipedia Level-2	748	1,930	1
Debatepedia	89	145	62

Categorizing Arguments into Topic Ontologies

Assessing the coverage of 59 argument corpora by categorizing the arguments within a topic ontology in two ways:

1. Mapping the topic labels of an argument corpus to a topic ontology.
2. Automatic corpus units categorization within a topic ontology.



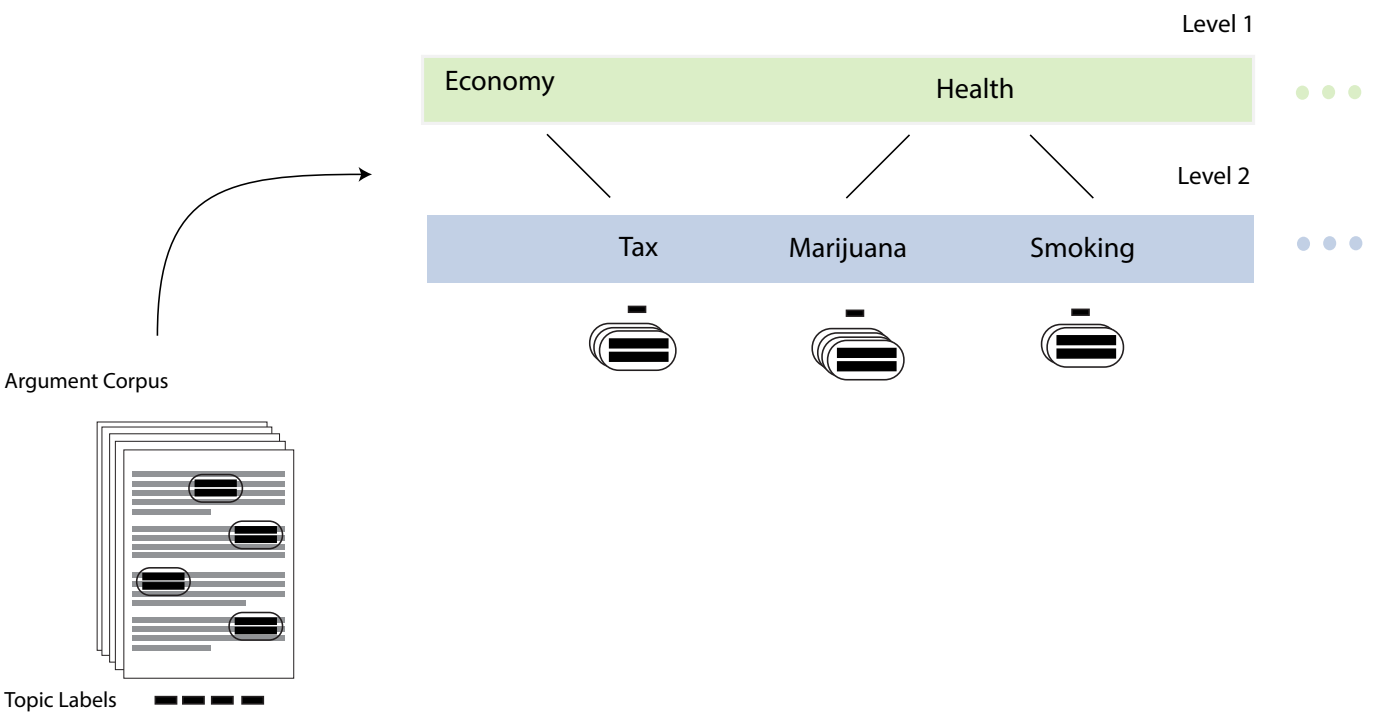
1. Mapping Topic labels to a Topic Ontology

1. Normalization

   (e.g., “Abortion should be banned” -> abortion).

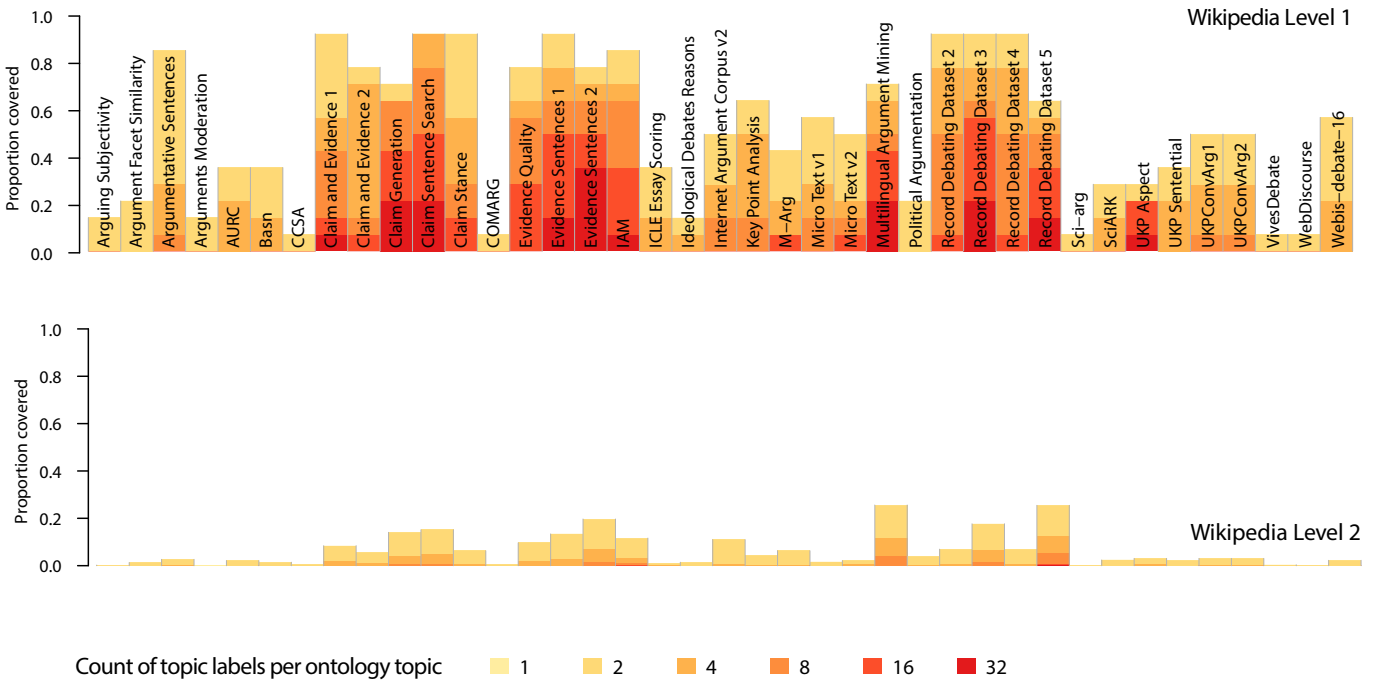
2. Retrieval: using a topic label as a query to retrieve an ontology topic.

3. Annotation: is a topic label a subtopic or synonymous of the retrieved ontology topics.



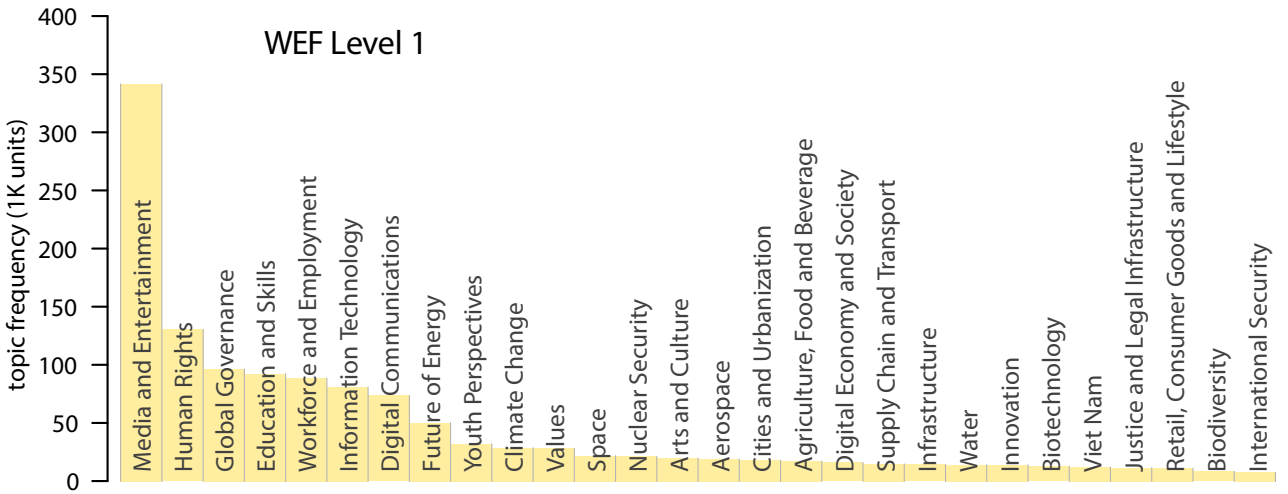
Argument Corpora Topic Coverage

The porportion of ontology topics covered by each corpus using the mappings.



Argument Corpora Topic Distribution

The distribution of corpus units over the ontology topics for the first level of World Economic Forum.



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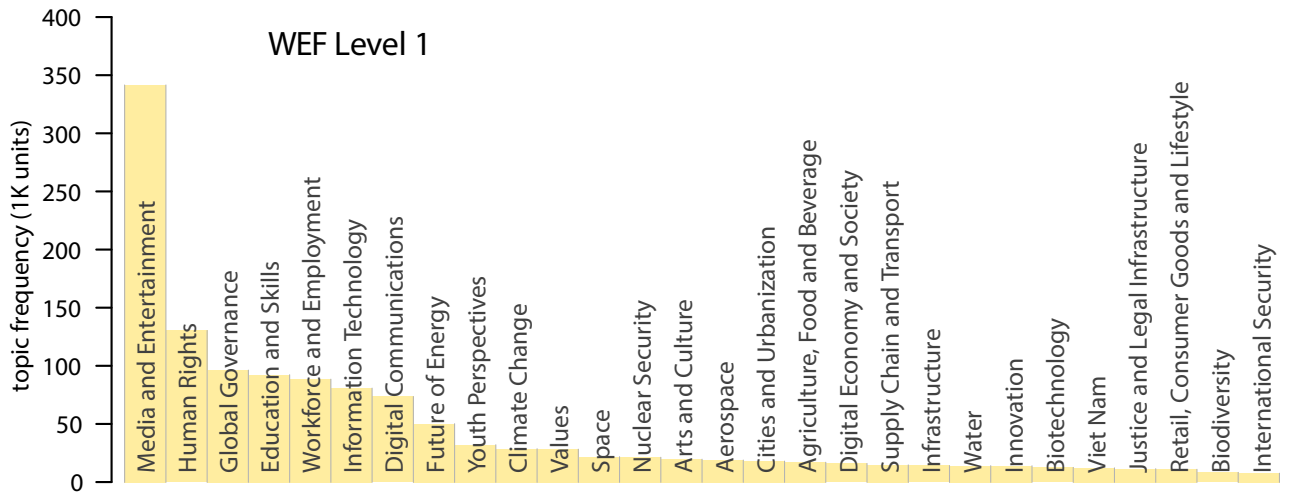

- The distribution of the topics is skewed.
- Only a small set of topics is covered.

2. Automatic Corpora Unit Categorization

About a third of argument corpora do not provide corpora topic labels and hence is not included in the previous analysis.

Approach: Semantic indexing calculates the cosine similarity between a corpus unit and the documents categorized under an ontology topic.

Evaluation: Pooled evaluation for 104 corpora units with a depth of five ontology topics.

F1-score of the approaches

Approach	**Wikipedia**		**WEF**	
	Level-1	Level-2	Level-1	Level-2
Direct match	0.06	0.40	0.29	0.19
Semantic Indexing	0.43	**0.59**	**0.34**	**0.33**
Text2vec-SI$_{BERT}$	**0.47**	0.31	0.28	0.23

Conclusion

Contributions:

- Survey and analysis of 59 argument corpora with regard to their topics.
- Introduced topic ontologies to formally model the context of arguments.
- Effective approach to categorize arguments within a topic ontology.
- Released ontologies and topic mappings at

  https://zenodo.org/record/5180409

Findings:

- Argument corpora cover a small set of topics and the distribution is skewed.
- The generalizability of existing argument mining approaches is questionable.