Towards Using Logical Reasoning for Assessing the Structure and State of a Human Debate

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Position
Researcher at DFKI Saarbrücken, Language Technology
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Research interests
Computational models of natural argument
Natural language processing, specifically generation
Dialog systems
Proof presentation
Intelligent tutoring systems
Game playing
The Vision
Logical Reasoning Supports a Human Debate

Human Debate

\[ \text{argument}_1 \]
\[ \ldots \]
\[ \text{argument}_i \]
\[ \ldots \]
\[ \text{argument}_j \]
\[ \ldots \]

Logical System

\[ \text{argument graph} \]
\[ \text{consistency check} \]
\[ \text{sets of acceptable arguments} \]

formal representation

logical consequences
The Current Situation

Human Debate

Arguments raised incrementally
Role (Support, Attack) and place indicated by humans

Computational Models of Natural Argument

Logical models of argumentation, non-monotonic reasoning
Issues of arguing in natural language

Interaction Language <-> Logic

Very sparse, an exception is
A. Wyner, T. van Engers, and K. Bahreini.
“From policy-making statements to first-order logic“
Problems with Human-Based Approach

Limitations
Arguments in restricted English
Superficial exploitation of natural language only
Human interpretation on discourse level needed

Human assessments may be inaccurate
Not a proper argument, just a further description
Inexact place of an argument
Logical or world knowledge flaws

Logical representations may contain redundancies and inaccuracies

Accurate role and attachment point of an argument essential
Argument Graph

Argument 1

Argument 2

Argument 3

Argument 4

Human Debate

Attachment/role needed

?... Text...

Argument
Linguistic Tools Supporting Automated Mapping

Discourse parser (Nanyang Technological University)

Rhetorical structure and relations between arguments
Richness of relations indicate Support/Attack/Description
Contrast -> Attack; Explanation -> Support

Structure built from assertions indicate dependencies

Limited quality - low use of discourse markers in debates

Textual entailment component (AllenNLP’s)
High degree of inconsistency indicates Attack
High degree of consistency indicates Support/Description
The Example Debate Addressed (Wyner et al.)

1. Every householder should pay tax for the garbage which the householder throws away.
2. No householder should pay tax for the garbage which the householder throws away.
3. Paying tax for garbage increases recycling.
4. Recycling more is good.
5. Paying tax for garbage is unfair.
6. Every householder should be charged equally.
7. Every householder who takes benefits does not recycle.
8. Every householder who does not take benefits pays for every householder who does take benefits.
9. Professor Resicke says that recycling reduces the need for new garbage dumps.
10. A reduction of the need for new garbage dumps is good.
11. Professor Resicke is not objective.
12. Professor Resicke owns a recycling company.
13. A person who owns a recycling company earns money from recycling.
14. Supermarkets create garbage.
15. Supermarkets should pay tax.
16. Supermarkets pass the taxes for the garbage to the consumer.
**Example - „pseudo-argument“ - a Description**

**Evidence**

Assessed as an *Elaboration* by the discourse parser

66 percent entailment for this pair of statements

- Every householder should pay taxes for the garbage …
- Paying tax for garbage increases recycling. Recycling more is good

should be

- Every householder should pay taxes for the garbage …
- Paying tax for garbage increases recycling. Recycling more is good
Rhetorical Analysis Demo

Enter your raw text here (currently only supports English):

Every householder should pay tax for the garbage which the householder throws away. Paying tax for garbage increases recycling. Recycling more is good.

Satellite (leaf 2) (rel2par Elaboration) | Text: which the householder throws away.

Satellite (span 3 4) (rel2par Elaboration)

Nucleus (leaf 3) (rel2par span) | Text: Paying tax for garbage increases recycling.

Satellite (leaf 4) (rel2par Elaboration) | Text: Recycling more is good.
Textual Entailment

Premise
Paying tax for garbage increases recycling

Hypothesis
Recycling more is good.

Summary
It is somewhat likely that the premise entails the hypothesis.

<table>
<thead>
<tr>
<th>Judgment</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entailment</td>
<td>69.9%</td>
</tr>
<tr>
<td>Contradiction</td>
<td>0.5%</td>
</tr>
<tr>
<td>Neutral</td>
<td>29.6%</td>
</tr>
</tbody>
</table>
Example - more accurate structure

Evidence

Rhetorical structure indicates nested interpretation

No householder should pay taxes for the garbage …

Paying tax for garbage is unfair

Every household should be charged equally

should be

No householder should pay taxes for the garbage …

Paying tax for garbage is unfair

Every household should be charged equally
Rhetorical Analysis Demo

Enter your raw text here (currently only supports English):

No householder should pay tax for the garbage which the householder throws away. Paying tax for garbage is unfair. Every householder should be charged equally.

Perform discourse parsing (includes segmentation)

Output in Textual format:

Root (span 1 4)

Nucleus (span 1 2) (rel2par span)

Nucleus (leaf 1) (rel2par span) | Text: No householder should pay tax for the garbage

Satellite (leaf 2) (rel2par Elaboration) | Text: which the householder throws away.

Satellite (span 3 4) (rel2par Elaboration)

Nucleus (leaf 3) (rel2par span) | Text: Paying tax for garbage is unfair.

Satellite (leaf 4) (rel2par Elaboration) | Text: Every householder should be charged equally.
Analysis of Natural Language Content

Current state

NL assertions mapped on (atomic) arguments

Advanced state

Exploiting structured and prioritized arguments

Proposed strategy

Normalizing content specifications
Mapping onto knowledge representation repositories
(e.g. OpenCyc, the biggest)

Specific functionality

Appeal to Expert Opinion in the sample dialog (11) to (13)
Challenging Dr. Resickes objectivity by personal interests
Future Research

Technical issues
  Installation of linguistics tools
  (demo versions seem to change, results are not reproducible)

Conceptual issues
  Categorization for (typical) argumentative utterances
    („x is good/bad“, „x in/decreases“ …)
  Systematic procedure for building an argumentation graph
  Analyzing focused portions of the argumentative discourse

Limitations
  Reasoning functionality, world knowledge, irony, …
References


“OpenCyc,” URL: https://github.com/asanchez75/opencyc/.

“OpenCyc,” URL: https://www.qrg.northwestern.edu/OpenCyc/index opencyc.html.


“Rhetorical-Analysis-Demo.
” URL: http://alt.qcri.org/demos/Discourse Parser Demo/

“Textual-Entailment-Demo.
” URL: https://demo.allennlp.org/textual-entailment/MjI2ODQ0OQ==


