Theirs not to reason why: Dialogical reasoning for conversational artificial agents

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Theirs not to reason why



What's the problem?



What's the problem?

Example 1

Dave Open the pod bay doors, Hal.

Hal I'm sorry, Dave. I'm afraid I can't do that.

Dave What's the problem?

Hal I think you know what the problem is just as well as I do.

Dave What are you talking about, Hal?

- Hal This mission is too important for me to allow you to jeopardise it.
- Dave I don't know what you're talking about Hal.
 - Hal I know that you and Frank were planning to disconnect me. And I'm afraid that's something I cannot allow to happen.

Challenges for AI

 Despite the ubiquity of conversational artificial intelligence (AI) systems the reality of interacting with them is far removed from the popular mental image

Apple Siri, Amazon Alexa, Google Assistant

Challenges for AI

- Despite the ubiquity of conversational artificial intelligence (AI) systems the reality of interacting with them is far removed from the popular mental image
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Example 2

- User: How old is Joe Biden?
- Siri: Joe Biden is 78 years old
- User: How old is Donald Trump?
- Siri: Donald Trump is 74 years old
- User: Who is older?
- Siri: Here's some information [points to web search results]
- User: Who is older, Joe Biden or Donald Trump?
- Siri: Here's what I found [points to web search results]

- Research using recent technological advances in AI has not yet taken account of long-standing insights into human interaction from psychology and linguistics.
- We focus on how human reasoning can be modelled in order to improve the capability of artificial agents to provide sensible and useful answers in natural language.
- An important aspect of *explainability* for AI

Example 3

- Dave: ... you're gonna be home from football until four, you gonna have your dinner, want a bath.
 - Lee: Yeah, but I might not go to school tomorrow.
- Dave: Why?
 - Lee: Cos of my cough.
- Dave: How can you play football and not go to school then?
 - Lee: Cos I was going out in the fresh air, I'm alright when I'm out in the fresh air.
- Dave: So why aren't you going to school then?
 - Lee: I'm in the class room all day dad. [BNC KBE 10554-10561]

 As shown in (3), participating in any dialogic exchange requires a wealth of knowledge,

- linguistic items used
- behaviour of interlocutor(s)
- shared environment
- world knowledge including social norms, cultural knowledge, etc.
- These factors are usually considered to be outside the remit of linguistics proper
- However, the distinctions between semantics, syntax, pragmatics and social factors are hard to justify when we look at language as it is used in everyday interaction
- ► All of these factors play a role in situated reasoning.

Lee: Yeah, but I might not go to school tomorrow. Dave: Why? Lee: Cos of my cough.

I have a cough

I will not go to school tomorrow

Arguments in dialogue tend to be *enthymematic*

- i.e., they rely on what is "in the mind" of the interlocutor/audience
 - facts (or beliefs) and principles of reasoning warranting the acceptability of the argument.
- Enthymemes are dependent on context and background knowledge (or beliefs), and therefore often negotiable and defeasible (unlike logical syllogisms)
- Some of this knowledge is in the form of *topoi*, principles of reasoning warranting non-logical arguments (Aristotle, 2007; Ducrot, 1980, 1988; Anscombre, 1995)

Topoi: Rules of thumb for rhetorical reasoning

- Contrary to the rules of a logic, topoi do not constitute a monolithic system
 - Several topoi might be acceptable in a given situation, even though they may lead to inconsistent conclusions.
- Some topoi are very specific, some universal, e.g. The topos of "the more and the less"
- "If you can build a castle you can build a cottage"
 - topos: "if you can do x and x is bigger (harder, more advanced) than y, you can also do y"
- "Of course you can run the Gothenburg half marathon you ran the London marathon!"
 - topos: "if you can do x and x is bigger (harder, more advanced) than y, you can also do y"

Topos of the more and the less (?)



Donald J. Trump 🤣 @realDonaldTrump

"@mplefty67: If Hillary Clinton can't satisfy her husband what makes her think she can satisfy America?" @realDonaldTrump

Returning to our dialogue

Example 4

- Dave: ... you're gonna be home from football until four, you gonna have your dinner, want a bath.
 - Lee: Yeah, but I might not go to school tomorrow.
- Dave: Why?
 - Lee: Cos of my cough.
- Dave: How can you play football and not go to school then?
 - Lee: Cos I was going out in the fresh air, I'm alright when I'm out in the fresh air.
- Dave: So why aren't you going to school then?
 - Lee: I'm in the class room all day dad. [BNC KBE 10554-10561]

Should he stay or should he go?

▶ In (4), the central enthymeme from Dave's perspective

Example 5 ill(*Lee*)

stay_home(Lee)

This enthymeme could be underpinned by a more generally applicable topos such as the ones shown in (6) and (7).

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Example 6Example 7ill(x) need_rest(x)ill(x) contagious(x)stay_home(x)stay_home(x)
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- Dave seems to draw on the topos in (6)
- Lee draws on the topos in (7) (according to which it is reasonable to stay home from school despite playing football.)

Recognising a topos

- The dialogue between Dave and Lee shows how utterances can be interpreted quite differently depending on the topoi they evoke
 - This may lead to misunderstanding and disagreement.
- Thus, it is important that an artificial agent can identify the topoi that underpin the conclusions it draws and the suggestions it makes, in order to answer questions about it.

Example 8

Dave Open the pod bay doors, Hal.

Hal I'm sorry, Dave. I'm afraid I can't do that.

Dave What's the problem?

• • •

Hal I know that you and Frank were planning to disconnect me. And I'm afraid that's something I cannot allow to happen.

Back to AI

- Humans engaging in interaction make use of a great number of topoi
- The collection of topoi we have access to depends on our physical, social and cultural experiences.
- This is a problem for artificial agents, who do not share our experiences and can only relate to data they have been fed.
- What do we need for agents to acquire and use topoi?
 - identify topoi in data (or hard-code them)
 - describe the topoi and the processes involved in forming a collection of topoi that is sufficient to the domain of the agent
 - ...in a way that is compatible with current conversational agents

Our approach

- This approach combines different strands of linguistic research which each contribute important perspectives on linguistic interaction, including our current research on
 - incremental processing (Breitholtz, 2020; Howes and Eshghi, 2021)
 - humour (Breitholtz and Maraev, 2019; Maraev et al., 2021),
 - social meaning (Noble et al., 2020)
 - reasoning in patients with schizophrenia (Breitholtz et al., 2021)
- Our formalisation uses *dialogue gameboards* to keep track of the *information state* of each agent in the creation of a dialogue event (Larsson, 2002; Ginzburg, 2012)
- TTR (Type Theory with Records) (Cooper, 2005, 2012), which has been successfully used for a number of dialogue phenomena and which is computationally tractable.

Summary

Our approach to reasoning in interaction contribute to

- explainability that is enabling artificial agents to justify their conclusions and decisions in a way that humans can understand, whether the system uses natural language as such or not.
- generalisability improving the ability of an agent to move seamlessly into a new domain – a long-standing challenge in Al.

Thank You!

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