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COGNICA: Cognitive Argumentation

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Cognitive Argumentation [1] is the study of synthesis of cognitive principles within formal computational frameworks of argumentation. Cognitive principles are drawn from our understanding of human reasoning as acquired across a wide range of disciplines, such as Cognitive Science, Philosophy and Linguistics. They inform and regulate the computational process of argumentation to be cognitively compatible to human argumentation and reasoning. By "humanizing" the form of machine argumentation we can facilitate an effective and naturally enhancing integration of machines with the human.

COGNICA[1] is a system that implements the framework of Cognitive Argumentation with emphasis on conditional reasoning. It is based on the particular work of Johnson-Laird and Byrne, "Conditionals: A Theory of Meaning, Pragmatics, and Inference" and the mental models theory that underlies this work [2]. Using argumentation it is possible to accommodate and extend their interpretation of the various types of conditionals used in human discourse. Importantly, these argumentation-based interpretations can be extended from individual conditionals to sets of conditionals of different types that together form a piece of knowledge on some subject of interest.

The COGNICA system has a simple interface of a Controlled Natural Language for expressing different types of conditional sentences. These are automatically translated into the GORGIAS[2] argumentation framework and executed by the GORGIAS system on top of which COGNICA is build. During this translation COGNICA automatically also forms priority arguments across the arguments that result from the different types of conditional statements in the knowledge, thus capturing the interaction between these individual conditional statements. The controlled natural language of COGNICA allows one to enter conditionals of different types as *foreground knowledge*, i.e., the particular knowledge that the system would reason about. This may need to be complemented by some relevant *background knowledge* entered in the system, alongside the foreground knowledge, using exactly the same conditional form of controlled natural language.

Example (Foreground Knowledge)**.**
If *I am not tired* ***then*** *I will swim.*
If *the sea is crowded* ***then possibly*** *I will not swim.*
Only If *if the sea is calm* ***then*** *I will swim.*

Then given a certain situation where some specific facts hold the COGNICA system will consider queries and give a reply of "Yes", "No" or "Maybe". For example, when

[1] http://cognica.cs.ucy.ac.cy/COGNICAb/login.php
[2] http://gorgiasb.tuc.gr/GorgiasCloud.html

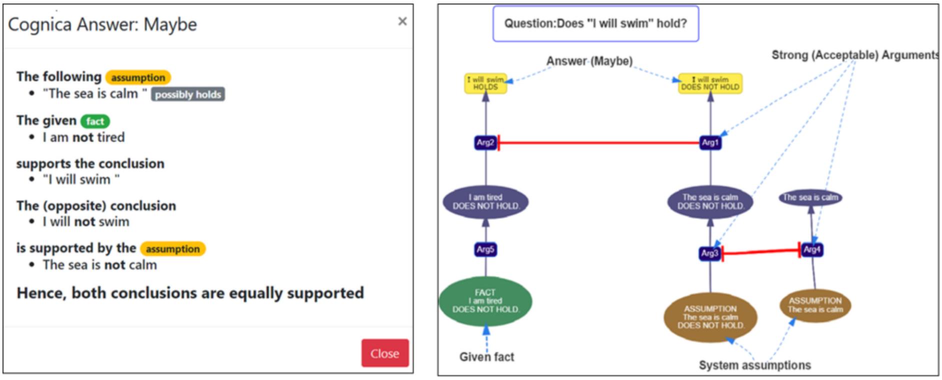

Figure 1. Verbal and Visual explanations of COGNICA for Example 1.

given the facts "I am not tired" and "the sea is not crowded", COGNICA will reply "Maybe" to the query of "Will I swim?".

Importantly, COGNICA provides automatically generated explanations in verbal and graphical form for its answers. Figure 1 shows the explanations for the answer "Maybe" in the above example. Note that the graphical explanations present the argumentative reasoning by COGNICA as *"reasoning pathways"* of the "mind" of the COGNICA system. COGNICA offers the opportunity for carrying out large scale empirical studies of comparison between human and machine reasoning and to examine the nature of an argumentation-based human-machine interaction. For example, to study the effect that explanations can have on humans when reasoning or deciding what action to pursue.

A first such study was carried out where participants were asked to answer questions based on foreground information that typically included three to five conditionals from everyday life. They were then asked to reconsider these questions after they were shown the answer of the COGNICA system together with its explanations (verbal and/or visual). Initial results show that in around 50% of the cases where the conclusion of the human participants differed from the one of the machine, the participants changed their answer when they saw the explanations of the system. It is also possible to observe that this kind of interaction with the system motivates participants to "drift" to more "careful reasoning" as they progress in the experiment, in accordance with the argumentation theory of Mercier and Sperber [3]. The exercise is ongoing and open to anyone. It can be found at `http://cognica.cs.ucy.ac.cy/cognica_evaluation/index.html`. We are also currently designing new such experiments in order to investigate how this argumentation-based and explanation driven machine-human interaction varies across the population with different cognitive and personality characteristics.

References

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