

Computational Argumentation-based Clinical Decision Support

Demonstration

Martin Chapman, Panagiotis Balatsoukas,
Mark Ashworth, Vasa Curcin

Department of Population Health Sciences
King's College London
London, United Kingdom

[martin.chapman,panagiotis.balatsoukas,mark.ashworth,
vasa.curcin]@kcl.ac.uk

Nadin Kökciyan, Kai Essers, Isabel Sassoon,
Sanjay Modgil, Simon Parsons, Elizabeth I. Sklar

Department of Informatics
King's College London
London, United Kingdom

[nadin.kokciyan,kai.essers,isabel.k.sassoon,sanjay.
modgil,simon.parsons,elizabeth.sklar]@kcl.ac.uk

ABSTRACT

This demonstration highlights the design of the CONSULT system, a modular decision-support system (DSS) intended to help patients suffering from chronic conditions self-manage their treatments. The system takes input from multiple sources, including commercial wellness sensors and a patient's electronic health record, to inform a *computational argumentation* engine that constructs weighted opinions using these inputs and knowledge about their sources, and uses an interaction agent driven by *argumentation-based dialogue* to respond to user queries.

KEYWORDS

Argumentation; Human-agent interaction; Decision-support tool

ACM Reference Format:

Martin Chapman, Panagiotis Balatsoukas, Mark Ashworth, Vasa Curcin and Nadin Kökciyan, Kai Essers, Isabel Sassoon, Sanjay Modgil, Simon Parsons, Elizabeth I. Sklar. 2019. Computational Argumentation-based Clinical Decision Support. In *Proc. of the 18th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2019), Montreal, Canada, May 13–17, 2019*, IFAAMAS, 3 pages.

1 INTRODUCTION

The CONSULT (Collaborative mObile decisioN Support for managing mULtiple morbidiTies) project explores the feasibility of employing a collaborative decision-support system (DSS) to help patients suffering from chronic diseases self-manage their treatments. The CONSULT system exhibits the following key properties: (1) integration of data from multiple sources, including commercial wellness sensors, a patient's *Electronic Health Record (EHR)*, input from *Health Care Professionals (HCPs)* and treatment guidelines, to produce an adaptive care plan customised to the patient's current circumstances; (2) application of *computational argumentation* and *provenance* to structure and track the data from these disparate sources, and to identify reinforcing and conflicting information; and (3) interaction with patients via *argumentation-based dialogue* to ensure understanding of the information gathered in (1) and to address, and potentially resolve, any conflicts found in (2).

Research has established that involving patients in the management of their own disease has long-term health benefits [9]. Advances in commercial wireless sensor technology mean that it is

practical for patients to monitor a wide range of health and wellness data at home, including blood pressure and heart function, without direct supervision by medical personnel.

However, currently such sensor data is disconnected from a patient's EHR and personalised treatment plan (constructed in conjunction with an HCP); treatment plans do not adapt dynamically to changes in patient circumstances; and a record of patient decisions about and responses to daily care is not routinely captured in a standardised way, preventing learning about treatment effectiveness from such a record. The long-term and overarching aim of the CONSULT project is address these issues.

Our approach is founded on the use of *computational argumentation* to model relationships between elements of information, represented as logic predicates, and the sources of that information, tracked using *data provenance*. Argumentation [5, 14] is a well-founded formal methodology with roots in philosophy and has been applied in *artificial intelligence (AI)* and *multi-agent systems (MAS)* as a structured technique for reasoning where conclusions are drawn by analysing evidence that supports (or refutes) the conclusions. Different from model-driven and other formal systems, argumentation-based systems have the ability to explain why a decision was made in a particular context. Further, argumentation-based systems can incorporate models of *trust* [15], *data provenance* [4] and user preferences to modulate reasoning.

2 THE CONSULT SYSTEM

Our computational argumentation engine is combined with a number of other components in order to form the CONSULT system, shown in Figure 1. We aim to realise each of these components as self-contained *RESTful microservices* [6, 11], providing advantages with respect to scalability, resilience and composability. These components (services) interact in order to support patients using the CONSULT system. To illustrate the role of each of these components, and the way in which they interact, we consider the following support scenario.

Running Example. Joy is a 54-year old female who has suffered a stroke; she is prescribed *angiotensin-converting enzyme (ACE) inhibitor* [13]. Joy started taking *ibuprofen* after experiencing back pain. After a few days, the CONSULT system detects that this has caused an increase in her blood pressure. Can the CONSULT system help Joy to choose a different treatment?

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