

Explainable Argumentation for Wellness Consultation

EXTRAAMAS19 Workshop

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- ▶ Introduction
- ▶ Background: Argumentation, Argumentation Schemes and Argumentation-based dialogues
- ▶ Proposed Method
- ▶ Case Study from CONSULT
- ▶ Future Work

Introduction

- ▶ explore the **types of interactions** involved in clinical consultations
- ▶ explore the application of **computational argumentation** and **argumentation-based dialogue** to the domain of clinical consultation, particularly focusing on patient self-management of chronic health conditions
- ▶ propose an agent-based system designed to support wellness consultation which leverages argumentation schemes, argument based dialogues and explanation templates

Patient - GP interactions

There are three types of interactions between GPs and Patient:

1. *information* - such as requesting information about their condition and/or symptoms
2. *recommendation* - asking for a recommendation in response to a specific situation
3. *explanation* - asking for clarification or explanation regarding the response given in the two above

The Consult project is focused on *recommendation*. Today's focus is towards *explanation*.

Different consultations

		<i>software agent</i>	
		<i>patient</i>	<i>GP</i>
<i>human user</i>	<i>patient</i>	self-care	consultation
	<i>GP</i>	training	second opinion

The different roles that a *human user* and *software agent* might play in an agent-based system designed to support self-management of chronic conditions.

Definition (Argument)

An argument, $Arg = \langle S, c \rangle$, consists of a set of premises, S , defined in some language, \mathcal{L} , which support the conclusion, c .

Example

$Arg_1 = \langle S = \{pain(joey)\}, c = consider(ibuprofen) \rangle$

Argumentation Scheme

- ▶ an *argument scheme* (AS) is a model for instantiating arguments within a specific context
- ▶ it is used to provide a formal basis for instantiating arguments and defining their internal structure
- ▶ An AS consists of a set of support premises (S), which support the conclusion premise, c . necessary for this derivation. [4, 5, 6, 8]

Formally:

Definition (Argument Scheme)

An argument scheme $AS = \langle S, c, \mathcal{V} \rangle$ consists of the set of premises, S , which support a conclusion, c , and are instantiated with the set of variables, $\mathcal{V} = S.V \cup c.V$.

An example of an argument scheme

AS for practical reasoning

premise - In the current circumstances R

premise - We should perform Action A

premise - Which will result in new circumstances S

premise - Which will realise goal G

premise - Which will promote some value V

therefore : Action A should be considered

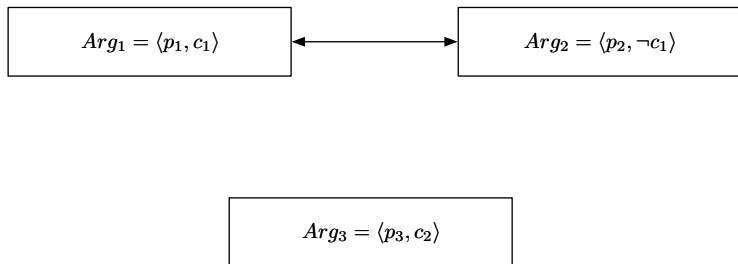
Argument scheme practical reasoning from [1]

Argumentation Framework

- ▶ an *Argumentation Framework (AF)* [2] represents a set of Arguments \mathcal{A} , and the relationships between the members of the set
- ▶ formally an *AF* is a pair $\langle \mathcal{A}, \mathcal{R} \rangle$, where \mathcal{A} is a set of arguments and \mathcal{R} is binary relation representing *attack* relationships between arguments

For example if $Arg_1 = \langle p_1, c_1 \rangle$ and $Arg_2 = \langle p_2, \neg c_1 \rangle$ then an attack relation exists between Arg_1 and Arg_2 since these arguments have conflicting conclusions (i.e. rebuttal attack).

An example of an Argumentation Framework



An example of an Argumentation Framework, with three arguments

Argumentation-based Dialogue

Argumentation-based Dialogue is a powerful methodology to support agents with one or more dialogue goals:

- ▶ Resolve conflict
- ▶ Reach agreement
- ▶ Convey explanation
- ▶ A number of **dialogue types** are defined:
 - ▶ **persuasion** — conflicting beliefs
 - ▶ **information-seeking** — lack of knowledge
 - ▶ **inquiry** — shared lack of knowledge
 - ▶ **deliberation** — shared decision making
- ▶ **Axiomatic semantics** define “moves” in a **dialogue game**:
 - ▶ Define what *type* of dialogue can be initiated
 - ▶ Define what *utterances* can be issued

Our Approach

1. defining an *argumentation scheme* specific to the provision of health related treatments or actions
2. identifying existing, and possibly defining new, *argumentation-based dialogues* that are appropriate for this domain
3. showing how these schemes in conjunction with the argumentation-based dialogues could be used by the agent to provide *explanation* to patients (human users)

Clinically Specialized Argument Scheme

The domain of relevance to this approach involves recommending a course of action in the clinical context, we therefore need to employ an argumentation scheme that is specialized to this domain. We propose to use the *Argumentation Scheme for proposed treatment (ASPT)* [3].

ASPT

$p1$ - Given the patient Facts F

$p2$ - In order to realise the goal G

$p3$ - Treatment T promotes the goal G

therefore : Treatment T should be considered

Argumentation scheme for a proposed treatment [3]

Clinically Specialized Argument Scheme - cqs

ASPT is subject to a set of critical questions (CQs), these can be the source of additional or counter-arguments to the arguments instantiated by this scheme. The list of critical questions outlined herein is not an exhaustive list, but makes use of three critical questions to illustrate our approach.

Critical Questions for ASPT

[CQ1] Has treatment T been unsuccessfully used on the patient in the past?

[CQ2] Has treatment T caused side effects on the patient?

[CQ3] Given patient facts F, are there any counter-indications to treatment T?

Critical question for ASPT [3]

An example

In a clinical scenario in the domain of hypertension:

- ▶ T could be ARB , where arb is a treatment for *high blood pressure* (hbp)
- ▶ G could be reducing blood pressure
- ▶ the claim of as argument generated from ASPT:
offer(arb, hbp)

Dialogue

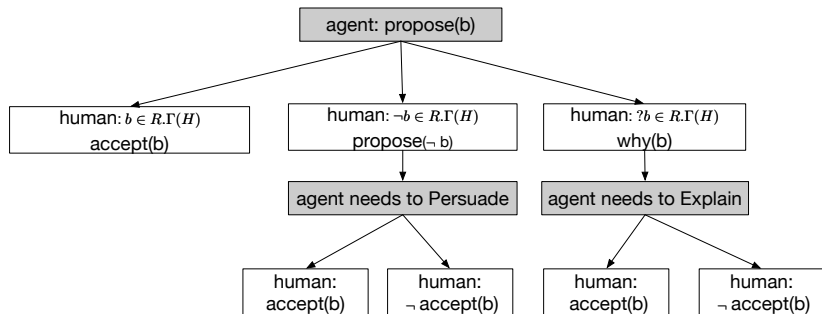
- ▶ The dialogue will be about a specific action b .
- ▶ The agent has a known set of beliefs $Ag.\Sigma$, and the human may also have a set of beliefs.
- ▶ $Ag.\Gamma(H)$ represents the agent's beliefs about the human's belief [7].
- ▶ b represents a belief about an action (from ASPT). For example $b = \mathbf{offer}(arb, hbp)$.
- ▶ $\neg b$ is a disbelief in that action,
- ▶ $?b$ is a situation where there is no belief about b .
- ▶ So what are the possible dialogues that should happen in each case?

Dialogue contd.

	$b \in Ag.\Gamma(H)$	$\neg b \in Ag.\Gamma(H)$	$?b \in Ag.\Gamma(H)$
$b \in Ag\Sigma$	case 1 agreement - (no dialogue)	case 2 disagreement - (persuasion)	case 3 agreement + explanation - (information seeking)
$\neg b \in Ag\Sigma$	case 4 disagreement - (persuasion → deliberation)	case 5 agreement - (deliberation)	case 6 (deliberation)
$?b \in Ag\Sigma$	case 7 (deliberation)	case 8 (deliberation)	case 9 (deliberation)

Agent, Ag , assumes the role of GP and the user, H , is the patient

Visualising the dialogue



The possible dialogue options matching the top row of the table in the previous slide

Explanation Template

AS or CQ	Explanation template
ASPT	Treatment T should be considered as it promotes goal G, given patient facts F
CQ1	Treatment T should not be considered as it was not effective for this patient in the past
CQ2	Treatment T should not be considered as it caused side effects for this patient in the past
CQ3	Treatment T should not be considered as patient fact $f_i \in F$ is a contra-indication to its use

Mapping of Argument Scheme and Critical question to an explanation template

consult

Introducing Consult

- ▶ In order to illustrate the approach proposed we use of an example interaction between the agent and the patient that arises in the context of the CONSULT project.
- ▶ The aim of the CONSULT project is to assess the feasibility of employing a collaborative mobile decision support system to help patients suffering from chronic diseases and multiple co-morbidities manage their treatment.
- ▶ The project integrates data from wellness sensors, electronic health records and relevant guidelines to support data-backed argumentation based decision support, which is accessible to the patient via a dashboard and a chat-bot.

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Medical Case Study

In this example we assume that the agent is acting the role of the GP, and the human is the patient

Patient uses chatbot	Patient asks a question about symptom s_1 , what action to take?
	Agent maps s_1 to goal g
	Agent instantiates argumentation engine and $aspt(g,...)$
	Extension includes argument offer(b)
Agent uses chatbot	Agent proposes action b using chatbot

The steps to start the dialogue when a patient asks for advice

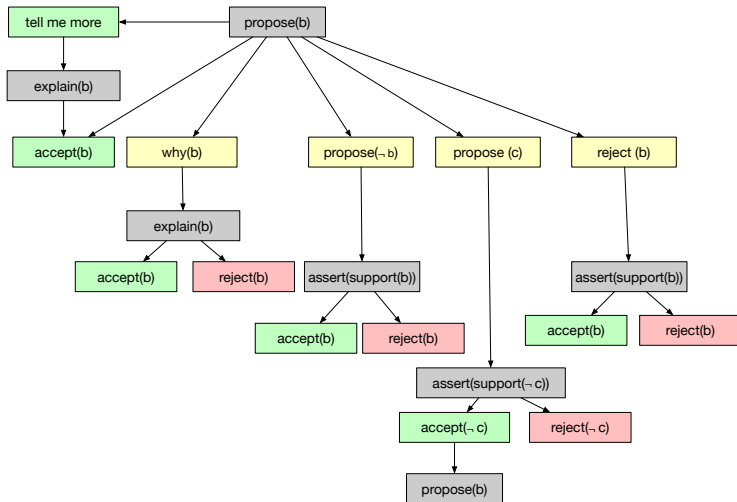
Medical Case Study - specific

Lets assume s_1 is backpain, g is pain reduction and b is Ibuprofen.

Patient uses chatbot	Patient asks a question about symptom s_1 , what action to take?
	Agent maps s_1 to goal g
	Agent instantiates argumentation engine and $aspt(g,...)$
	Extension includes argument offer(b)
Agent uses chatbot	Agent proposes action b using chatbot

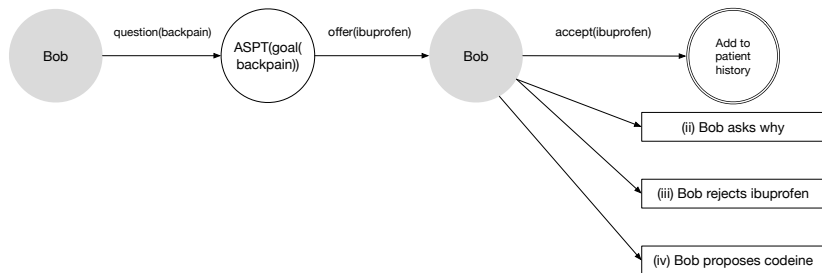
The steps to start the dialogue when a patient asks for advice

Medical Case Study Contd.



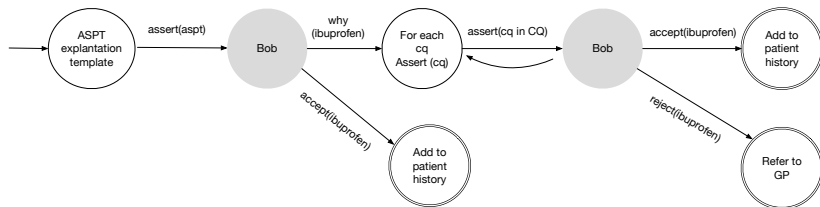
A possible patient asks for advice dialogue tree

Start of dialogue



Start of the Dialogue protocol using approach in [7]

(ii) Dialogue: why?



(ii) Explanation Dialogue: Why branch of Dialogue protocol using approach in [7]

(ii) Dialogue: Why?

An example explanation dialogue :

- ▶ *agent*: It is recommended that you take Ibuprofen
- ▶ *bob*: Why should I take Ibuprofen?
- ▶ *agent*: Ibuprofen (Treatment T) should be considered as it promotes back pain relief (goal G) given your clinical history (Bob Patient Facts F). [Here the agent is using the explanation template from Figure 7 that matches ASPT]

Bob would then be able to accept the recommendation, or probe further. In the latter case the critical questions would be employed in this dialogue in turn to further provide rationale for this recommendation.

(The elements in parenthesis are not part of the actual dialogue)

Future Work

- ▶ User study - as part of the CONSULT project we will be evaluating the chat-bot over the summer
- ▶ Formalise the approach
- ▶ Incorporate feedback from the user study

Acknowledgement

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CONSULT Demo

We have a *demo* of the CONSULT project this Wednesday 5:15pm - 6:15pm (D1 Session, in EV Atrium).

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