Critical Questions for Plan Proposals

Rolando Medellin-Gasque[1], Katie Atkinson[1], Peter McBurney[2], and Trevor Bench-Capon[1]

[1] University of Liverpool, Department of Computer Science, Liverpool UK
{medellin,katie,tbc}@liverpool.ac.uk
[2] King's College London, Department of Informatics, London UK
peter.mcburney@kcl.ac.uk

Abstract. In order to create a comprehensive dialogue game for autonomous agents to engage in rational debate over plans we present in this report a list of critical questions that match an argumentation scheme for plan proposals. Questions are grouped in six categories regarding the level of detail they focus. The critical questions are formalized in terms of AATS models where applicable.

Key words: plan proposal, argumentation schemes, critical questions.

1 Introduction

Argumentation schemes are stereotypical patterns of defeasible reasoning used in everyday argumentation and conversation. In an argumentation scheme, arguments are presented as general inference rules where under a given set of premises a conclusion can be presumptively drawn [**?**]. Artificial Intelligence has become increasingly interested in argumentation schemes due to their potential for making significant improvements in the reasoning capabilities of artificial agents [**?**] and for automation of agent interactions. In [**?**], Walton explains: "*...arguments need to be examined within the context of an ongoing investigation in dialogue in which questions are being asked and answered*". Critical questions are a way to examine the acceptability of arguments. Depending on the nature of the critical question, these questions can be used to evaluate several aspects of the argument. Usually, critical questions provide pointers which would make the argumentation scheme inapplicable or could lead to a valid way to attack the argument, either defeating the argument on one of its premises or on its presumptive conclusion. Depending on the nature of the dialogue game in which the critical questions are posed they could aim to search for further information or presenting source of disagreement from which an attack could be constructed for a persuasion or negotiation dialogue.

The remain of the report is structured as follows: Section **??** presents an argumentation scheme for plan proposals and section **??** present the critical questions associated to it. Section **??** concludes.

2 Argumentation scheme for a plan proposal

Our plan proposal is based on the proposal for actions in [**?**]. The action proposal presented in [**?**] is as follows: In the current circumstances R,we should perform action A to achieve new circumstances S which will realize some goal G which will promote some value v.

Our plan proposal ASP is as follows: Given a social context X [3] in the current circumstances q_0 holding preconditions $\pi(q_0)$, plan PL should be performed to achieve new circumstances q_x, that will hold postconditions $\pi(q_x)$ which will realize the plan-goal G which will promote value(s) V_G.

The valid instantiation of the scheme pre-supposes the existence of a regulatory environment or a social context X in which the proponent has some rights to engage in a dialogue with the co-operating agent. Current circumstances are represented by an initial state q_0. The agent acting as the proponent proposes plan PL as a finite set of linked action-combinations. I f executed successfully ,the plan leads to a state in which propositions $\pi(q_x)$ and the plan-goal G is achieved and a non-empty set of values associated with the plan is promoted. We use Action-based Alternating Transition Systems (AATS) as introduced in [**?**] as a basis for our formalism to represent action and plan proposals. AATS models define joint-actions that may be performed by agents in a state and the effects. In particular, an AATS model defines semantic structures useful to represent joint-actions for multiple agents, their preconditions and the states that will result from the transition. Table **??** presents the plan proposal and the AATS model for it.

Table 1. Plan Proposal Scheme ASP

Plan Proposal	**as an AATS model**
Given a social context X, in the current circumstances q_x holding preconditions $\pi(q_x)$ plan PL should be performed to achieve new circumstances q_y that will hold postconditions $\pi(q_y)$ which will realize the plan-goal G which will promote value(s) V_G.	Given context Δ , In the initial state $q_0 = q_x \in Q$, where $\pi(q_0)$, agents $i, j \in Ag$ should execute plan PL, where PL is a finite set of joint-actions j_n such that $PL = \{j_0, .., j_n\}$ and $\{j_0, .., j_n\} \in J_{Ag}$ and $j_n = \{\alpha_i, .., \alpha_j\}$ with transition given by $\tau(q_x, PL)$ is q_y , where $\tau(q_0, \{j_1, .., j_n\}) = \tau(\tau(q_0, j_1), (j_2, ..j_n))$ and $\tau(q_x, \{\}) = q_x$ such that $p_a \in \pi(q_x)$ and $p_a \notin \pi(q_y)$ where $G = p$ and ($V_G \subseteq V$ such that $v_1 \in V_G$ iff $\delta(q_x, q_y, v_1)$ is $+$) and $V_G \neq \emptyset$

[3] The social context was an extension to the argumentation scheme AS1 introduced in [**?**] for the purposes of specifying a multi-agent dialogue protocol for command dialogues.

3 Critical Questions for plan proposals

A benefit of having critical questions associated with an argument scheme is that the questions enable dialogue participants to seek points of challenge in a debate or locate premises in an instantiation of the argument scheme that can be recognized as questionable. Most of the critical questions are created from argumentation schemes elements and represent a valid way to challenge arguments that could identify sources of disagreement about a particular element of the argumentation scheme. A question can be seen as an attack on a particular element of the argument scheme given different beliefs about the world of the agent posing the question. Critical questions then could be used to create Dialogue Games for agents where the participants put forward arguments instantiating the argumentation scheme and opponents to the argument challenge it through critical questions. Argumentation-based dialogues are used to formalize dialogues between autonomous agents based on theories of argument exchange. In [**?**] a classification is given based on the role the question plays in the context of the argumentation scheme. A question could either:

- Criticize a scheme premise. e.g. Are the current circumstances true?
- Point to exceptional situations in which the scheme should not be used. e.g. Has the action been performed? Are there any side effects if the action is executed?
- Set conditions for the proper use of the scheme, e.g. Could the actions be performed concurrently?
- Point to other arguments that might be used to attack the scheme, e.g. Are the preconditions as described as possible? or Does the action promotes some other value?

Our set of critical questions is based on the set of critical questions developed for action proposals in command dialogues presented in [**?**]. We classify our set of critical questions into six layers. Each layer groups questions according to the level of detail on which they focus. At the plan level, the critical questions are all those which are independent of the way in which actions are composed inside the plan i.e. the way in which actions are combined. This classification allows us to separate questions regarding the planning process, the proposal or the time in which they should be executed. This classification gives us elements to create a strategy to choose a critical question in a dialogue. An agent may want to start with elements that are not part of the view of his world and question that particular element to get more information about it. On another level an agent may want to deal with specific questions about the plan, given he accepts the proposal elements. A strategy on how to choose a particular question will be left for future work. The six layers are the following also presented in Figure **??**:

- Layer 1.- The action and its elements.
- Layer 2.- The timing of a particular action.
- Layer 3.- The way actions are combined.
- Layer 4.- The plan proposal overall.
- Layer 5.- The timing of the plan proposal.
- Layer 6.- Elements outside the scheme (alternative paths or consequences not foreseen).

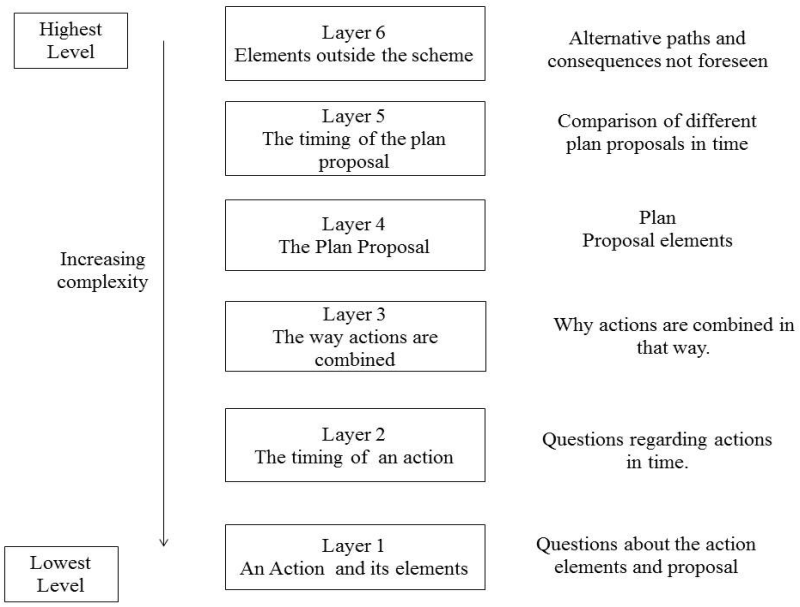

Fig. 1. Action Proposal Representation.

The complete list of critical questions presented in Tables 2-7. Where applicable questions are formalized in AATS terms. Elements such as start effects, invariant conditions and termination conditions are not yet defined for an AATS model.

Table 2. Layer 1. Critical Questions for the actions and its elements (9 questions).

Critical question	in AATS terms
CQA-01. Is the action α_i possible?	$j_n \notin J_{AG}$ where $j_n = \alpha_n^i$
CQA-02. Are the preconditions as stated by proponent?	
CQA-03. Are the preconditions as described as possible?	
CQA-04. Are the invariants conditions as stated by proponent?	
CQA-05. Are the invariants conditions as described as possible?	
CQA-06. Are the termination conditions as stated by proponent?	
CQA-07. Are the termination conditions as described as possible?	
CQA-08. Are the start effects described as possible?	
CQA-09. Are the end effects described as possible?	$\tau(q_x, j_n) \notin Q$

Table 3. Layer 2. Critical Questions for the timing of an action (10 questions).

Critical question
CQAT-01. Is the starting time point fixed for the action α? If not, what is the range allowed?
CQAT-02. Is the action α possible with the specified duration?
CQAT-03. Can the duration be less?
CQAT-04. Can the duration be longer?
CQAT-05. Is the action α possible at the specified time?
CQAT-06. What is the earliest time the action α can start?
CQAT-07. What is the latest time the action α can start?
CQAT-08. Is the action α possible to finish at the specified time?
CQAT-09. What is the earliest time the action α can end?
CQAT-10.What is the latest time the action α can end?

4 Conclusions

We believe this analysis enable plan proposals to be questioned in a comprehensive way in order to be justified. Critical questions could be used to create Dialogue Games for agents where the proponents may put forward arguments instantiating the argumentation scheme and opponents to the argument challenge it through critical questions. Argumentation-based dialogues are used to formalize dialogues between autonomous agents based on theories of argument exchange. Examples of argumentation-based dialogue protocols that use critical questions are presented in [**?**,**?**,**?**].

Table 4. Layer 3. Critical Questions for the way actions are combined (7 questions).

CQAC-01. (For sequential actions) Could actions α and β be performed concurrently?
CQAC-02. (For sequential actions) Can the order of the actions be changed?
CQAC-03. (For concurrent actions) Is there a conflict in any of the invariant conditions of the actions?
CQAC-04. (For concurrent actions) Is there a conflict in the start effects of the actions?
CQAC-05. (For concurrent actions)Is there a conflict in the end effects of the actions?
CQAC-06. (For concurrent actions) Is there a maximum duration for actions to perform concurrently?
CQAC-07. (For concurrent actions) Is there a minimum duration for actions to perform concurrently?

Table 5. Layer 4. Critical questions for the plan proposal overall (17 questions).

Critical question	
CQPP-01. Is the plan π possible?	
CQPP-02. Is the current social context Δ believed to be as stated by proponent?	
CQPP-03. Is the context Δ as described as possible?	
CQPP-04. Are the preconditions as stated by proponent?	$q_0 \neq q_x$ and $q_0 \in p(\alpha_i)$
CQPP-05. Are the preconditions described as possible?	$q_x \in Q$
CQPP-06. Are the plan invariant conditions as stated by proponent?	
CQPP-07. Are the plan invariant conditions as described as possible?	
CQPP-08. Are the start effects described as possible?	
CQPP-09. Are the termination conditions as described as possible?	
CQPP-10. Are the end effects as described possible?	$q_y \in Q$
CQPP-11. Does the new circumstances already pertain?	$q_x = q_y$
CQPP-12. Assuming believed preconditions are true, will the plan PL bring about the stated state ?	$\tau(q_x, PL)$ is not q_y
CQPP-13. Assuming all of these, will the plan PL bring about the desired goal G?	$G \notin \pi(q_y)$
CQPP-14. Can the desired goal G be realized?	$G \notin \pi(q_y)$ for any $q \in Q$
CQPP-15. Does the goal G promote the values intended V_G ?	$\delta(q_x, q_y, v)$ is not $+$
CQPP-16. Are the values in V_G indeed a legitimate value?	for some $v_n \in V_G$ there is a value v_n such that $v_n \notin V$
CQPP-17. Is the value v_n promoted by the execution of the plan PL?	$\delta(q_x, q_y, v)$ is not $+$
CQPP-18. Can the value v_n be promoted?	

Table 6. Layer 5. Critical Questions for the timing of the plan proposal (11 questions).

Critical question
CQPPT-01. Is the starting point for the plan PL fixed? If not, what is the range allowed?
CQPPT-02. Is the plan duration fixed? If not what is the range allowed?
CQPPT-03. Is the plan PL possible with the specified duration?
CQPPT-04. Can the duration be less?
CQPPT-05. Can the duration be longer?
CQPPT-06. Is the plan PL possible at the specified time?
CQPPT-07. What is the earliest time the plan PL can start?
CQPPT-08. What is the latest time the action PL can start?
CQPPT-09. Is the plan PL possible to finish at the specified time?
CQPPT-10. What is the earliest time the action PL can end?
CQPPT-11. What is the latest time the action PL can end?

Table 7. Layer 6. Critical questions for elements outside the scheme (11 questions).

CQOS-01. Does performing the plan PL have a side effect which demotes the value v_n ?	$\tau(q_x, PL)$ s.t. $p_b \in \pi(q_y)$ s. t. q_x, q_y, v_n is -.
CQOS-02. Does performing the plan PL have a side effect which demotes some other value v_n?	$\tau(q_x, PL)$ s.t. $p_b \in \pi(q_y)$ s. t. q_x, q_y, v_u is -.
CQOS-03. Is there an alternative plan PL_x to promote the same value v_n?	$\tau(q_x, PL_x)$ s.t. $\delta(q_x, q_y, v_n)$
CQOS-04. Is there an alternative plan PL_x to realize the same new circumstances?	$\tau(q_x, PL_x)$ is q_y
CQOS-05. Is there an alternative plan PL_x to realize the same goal G?	$\tau(q_x, PL_x)$ is q_y s.t. $G \in \pi(q_y)$
CQOS-06. Has the plan PL already been performed?	
CQOS-07. Does performing the plan PL promote some other value v_u?	$\delta(q_x, q_y, v_u)$ is $+$, where $v_u \neq v_n$
CQOS-08. Does performing the plan PL preclude doing some other action which would promote some other value v_u?	there is some other plan PL_x s.t. $\tau(q_x, PL_x)$ is q_z s.t. $\delta(q_x, q_z, v_u)$ is +, where $v_u \neq v_n$
CQOS-09. Is there another agent that could perform a particular action α?	$j_n = (\alpha_i, .., \alpha_k)$
CQOS-10. Is there another action that could be performed with the same result?	$\tau(q_x, PL_x)$ where $PL_x = \{j_0, ..j_m\}$
CQOS-11. Has the action α already been performed?	

References

1. K. Atkinson, T. Bench-Capon, and P. McBurney. A dialogue game protocol for multi-agent argument over proposals for action. *Autonomous Agents and Multi-Agent Systems*, 11(2):153–171, 2005.
2. K. Atkinson, R. Girle, P. McBurney, and S. Parsons. Command Dialogues. In I. Rahwan and P. Moraitis, editors, *Argumentation in Multi-Agent Systems*, Fifth International Workshop, pages 93–106, Berlin, Heidelberg, 2009. Springer-Verlag.
3. F. Bex, H. Prakken, C. Reed, and Douglas Walton. Towards a formal account of reasoning about evidence: argumentation schemes and generalisations. *Artificial Intelligence Law*, 11(2-3):125–165, 2003.
4. S. Heras, M. Rebollo, and V. Julián. A dialogue game protocol for recommendation in social networks. In Emilio Corchado, Ajith Abraham, and Witold Pedrycz, editors, *Hybrid Artificial Intelligence Systems*, volume 5271 of *Lecture Notes in Computer Science*, pages 515–522. Springer Berlin / Heidelberg, 2008. 10.1007/978-3-540-87656-4_64.
5. W. van der Hoek, M. Roberts, and M. Wooldridge. Social laws in alternating time: Effectiveness, feasibility, and synthesis. *Synthese*, 156:1–19, 2007.
6. B. Verheij. Dialectical argumentation with argumentation schemes: an approach to legal logic. *Artificial Intelligence and Law*, 11(2-3):167–195, 2003.
7. D. N. Walton. *Argumentation Schemes for Presumptive Reasoning*. Lawrence Erlbaum Associates, Mahwah, NJ, USA, 1996.
8. D. N. Walton. Justification of argumentation schemes. *Australasian Journal of Logic*, 3, 2005.