A Persuasive Dialogue Game for Coalition Formation

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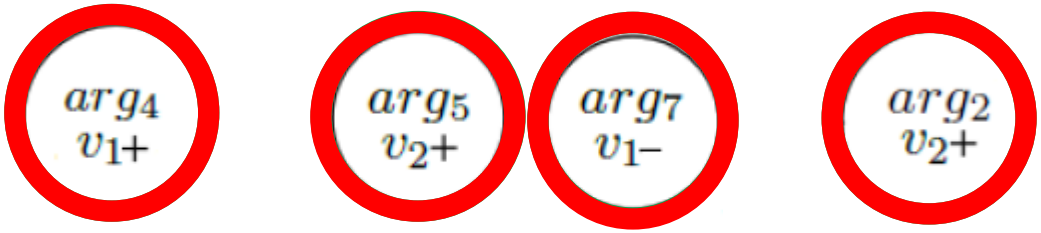
Introduction

- In **multi-agents systems** there are many proposed way to form **coalitions**, each with different properties.
- **Dialogue games** allow for flexible communication.
- **Argumentation** is a process where agents can reason about different beliefs to come to some logical conclusions.
- The aim of the dialogue game is to find the best **coalition structure** for the system.

Argumentation Framework (AF)

- AFs are comprised of nodes (**arguments**) and directed edges (**attacks**)
- Attacks **defeat** a node if certain conditions are met.
- There are various extensions to AFs such as VAF, BAF, PAF, EAF
- E.g. A small VAF:



Argumentation Scheme

- So far the arguments have been **abstract**
- To form coalitions agents need more info:

$$R \xrightarrow{C,\, J} S \uparrow v$$

- Agents will **instantiate** this scheme and broadcast it, allowing other agents to **evaluate** the scheme.
- If agents spot flaws in an instantiated scheme they can challenge it with **critical questions**…

Critical Questions (CQ)

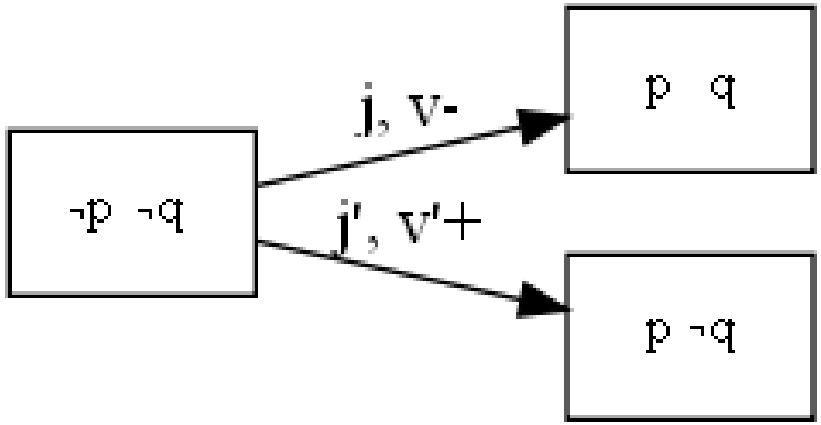
- The CQs can challenge premises or the conclusion of the argumentation scheme
- If a CQ is left **unanswered** then the instantiation of the argumentation scheme it attacks is **defeated**.
- here the CQs identify **non-optimal coalitions** which the system will then **not** recommend.
- Some example CQs:
  - does doing the joint action have a side effect which demotes another value?
  - Has a coalition member previously been shown to be unable to carry out its designated action?

Using values

- Values can break up potential cycles in a AF
- Can describe a social interest the agents have
- Sometimes agents don't want to satisfy propositions (goals), the inclusion of values will show **why**
- Goals are **situation dependent**, values are **individual dependent**…
- In general an ordering over values will change less than an ordering over goals

Environmental inferences

- The argumentation scheme shows that arguments are made connected to the agent's **environment**.
- Throughout execution the agents will be able to **add** and **change** their knowledge bases.
- The **environment** is described in the form of a **VATS** (extended from AATS and ATL), e.g.:



Dialogue Framework

- **Persuasion** – identified by Dignum et al [1] as the key dialogue type for team formation.
- Agents move in the dialogue using utterances according to the theory of speech acts [2]
- The different moves: **open**, **propose**, **assert**, **object** and **close** are available.
- Agents choose the most appropriate according to their **internal state** and **external environment**.

[1] F. Dignum et al.,Agent theory for team formation by dialogue, 2000
[2] Searle & Vanderveken, Foundations of Illocutionary Logic, 1985

Dialogue Framework

- Agents proposals, assertions and objections are stored in a **commitment store**
- The **VAF** includes all agents assertions and objections.
- Dialogue ends when every agent performs a close move in a row.
- After completion an overall system **value order** needs to be found.
- A **borda count** is used to find an overall ordering.

Example Application Areas

- Example possible application areas:
  - E-business –
    - Different values present: profit, fair-trade, customer satisfaction,…
    - Coalitions made of different companies.
  - Smart grid –
    - Different values present: profit, green energy, stock reserves,…
    - Coalitions made of different energy providers.

Future work

- It has been shown all voting mechanisms have flaws[3].
  - There will always be some dissatisfied agents.
  - Voting method requires some additional centralization
- To overcome this issue, I will look into a self interested multi-agent design and game theory concepts such as stability

[3] M. Wooldridge, An Introduction to MultiAgent Systems Second Edition, Chpt 12