An Automated Planning Approach for Generating Argument Dialogue Strategies

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Overview

1. Background
   - Persuasion Dialogues
   - Classical Planning
   - Planning a Dialogue
   - Policies

2. Planning Argument Strategies
   - Simple Strategies vs Policies
   - Generating a Policy from Simple Strategies

3. Future Work

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Persuasion Dialogues

- Agents have conflicting views on a topic
- Proponent’s goal: convince opponent to accept the topic
- Dialogue terminates when the opponent accepts the topic or when neither agent asserts any more arguments
Argument Strategies

Existing work

- AI Planning approach for *simple persuasion dialogues* [Black et al., 2014]
- Mixed Observable Markov Decision Processes, assumes probabilistic knowledge of opponent strategy [Hadoux et al., 2015]
- Minimax algorithm [Rienstra et al., 2013]
Classical Planning

A classical planning problem consists of

- a set of state variables
- a set of actions defined by preconditions and effects
- a start state
- a goal state
Persuasion Dialogues as Planning Problems

[Black et al., 2014]

- a set of state variables
  - different dialogue states
- a set of actions defined by preconditions and effects
  - asserting arguments
- a start state
  - initial knowledge of proponent and opponent
- a goal state
  - topic is acceptable to the opponent
Opponent models

\[ M_0 = \{ B \} \]
\[ M_1 = \{ C \} \]
\[ M_2 = \{ B, C \} \]

Simple strategy

\[ \{ A, D \}, \{ E \} \]
Policies

A policy is a set of state-action-pairs that determines which action should be performed in which state.
Simple Strategies vs Policies

Opponent models

\[
\begin{align*}
M_0 &= \{B_0\} : 0.3 \\
M_1 &= \{B_1\} : 0.5 \\
M_2 &= \{B_2\} : 0.2
\end{align*}
\]

Simple strategy

\[
\begin{align*}
\{A, C_1\}, \{C_0\} \\
p &= 0.8
\end{align*}
\]
Simple Strategies vs Policies

Opponent models

\[ M_0 = \{ B_0 \} : 0.3 \]
\[ M_1 = \{ B_1 \} : 0.5 \]
\[ M_2 = \{ B_2 \} : 0.2 \]

Policy

\[ (s_0, a_A) \]
\[ (s_{B_0}, a_{C_0}) \]
\[ (s_{B_1}, a_{C_1}) \]
\[ (s_{B_2}, a_{C_2}) \]
\[ p = 1 \]
Generating a Policy from Simple Strategies
Finding a Simple Strategy

Opponent models

\[ M_0 = \{ B_0, B_2 \} : 1/3 \]
\[ M_1 = \{ B_2, B_4 \} : 1/3 \]
\[ M_2 = \{ B_1, B_3 \} : 1/3 \]

Simple strategy \( \pi_0 \)

\[ \{ A, C_0, C_2 \}, \{ C_4 \} \]
\[ p = 2/3 \]
Generating a Policy

Opponent models

\[ M_0 = \{ B_0, B_2 \} \]
\[ M_1 = \{ B_2, B_4 \} \]
\[ M_2 = \{ B_1, B_3 \} \]
Replanning for Failed Cases

Opponent models

\[ M_0 = \{ B_0, B_2 \} : 1/3 \]
\[ M_1 = \{ B_2, B_4 \} : 1/3 \]
\[ M_2 = \{ B_1, B_3 \} : 1 \]

Simple strategy \( \pi_1 \)

\( \{ A, C_1, C_3 \} \)

\( p = 1 \)

- Merge simple strategies into policy
Merging Simple Strategies into a Policy

Opponent models

\[ M_0 = \{ B_0, B_2 \} \quad \pi_0 = \{ A, C_0, C_2 \}, \{ C_4 \} \]
\[ M_1 = \{ B_2, B_4 \} \quad \pi_1 = \{ A, C_1, C_3 \} \]
\[ M_2 = \{ B_1, B_3 \} \]

Policy

\[ p = 1 \]
Generating a Policy from Simple Strategies
Finding a Simple Strategy

Opponent models

\[ M_0 = \{B_0, B_2\} : 0.25 \]
\[ M_1 = \{B_0, B_1\} : 0.25 \]
\[ M_2 = \{B_1, B_2\} : 0.25 \]
\[ M_3 = \{B_1, B_3\} : 0.25 \]

Simple strategy \( \pi_0 \)

\( \{A, C_0, C_2\}, \{C_1\} \)
\( p = 0.75 \)
Generating a Policy

Opponent models

\[ M_0 = \{ B_0, B_2 \} \]
\[ M_1 = \{ B_0, B_1 \} \]
\[ M_2 = \{ B_1, B_2 \} \]
\[ M_3 = \{ B_1, B_3 \} \]
Finding more Simple Strategies

Opponent models

\[ M_0 = \{B_0, B_2\} : 0.25 \]
\[ M_1 = \{B_0, B_1\} : 1/3 \]
\[ M_2 = \{B_1, B_2\} : 1/3 \]
\[ M_3 = \{B_1, B_3\} : 1/3 \]

Simple strategy \( \pi_0 \)

\( \{A, C_0, C_2\}, \{C_1\} \)

\( p = 2/3 \)
Finding more Simple Strategies

Opponent models

\[ M_0 = \{B_0, B_2\} : 0.25 \]
\[ M_1 = \{B_0, B_1\} : 1/3 \]
\[ M_2 = \{B_1, B_2\} : 1/3 \]
\[ M_3 = \{B_1, B_3\} : 1 \]

Simple strategy \( \pi_1 \)

\( \{A, C_1, C_3\} \)
\( p = 1 \)
Merging Simple Strategies into a Policy

Opponent models

\[ M_0 = \{B_0, B_2\} \]
\[ M_1 = \{B_0, B_1\} \]
\[ M_2 = \{B_1, B_2\} \]
\[ M_3 = \{B_1, B_3\} \]

\[ \pi_0 = \{A, C_0, C_2\}, \{C_1\} \]
\[ \pi_1 = \{A, C_1, C_3\} \]
Merging Simple Strategies into a Policy

Opponent models

\[ M_1 = \{B_0, B_1\} \quad \{C_0, C_2\} \]

\[ M_2 = \{B_1, B_2\} \quad \{C_2\} \]

\[ M_3 = \{B_1, B_3\} \quad \{C_1, C_3\} \]
Future Work

- Implement this approach and perform experiments to determine both its scalability and the quality of the policies compared to the optimal.
- How can we identify problems where a policy would perform better than a simple strategy?
- What is the best simple strategy to start with?
- How can we deal with more complex dialogue scenarios and opponent strategies?
References

E. Black, A. Coles, S. Bernardini (2014)
Automated planning of simple persuasion dialogues
*Computational Logic in Multi-Agent Systems*, LNCS vol. 8624, Springer, 87 - 104.

Optimization of probabilistic argumentation with Markov decision models.

Opponent models with uncertainty for strategic argumentation.