An Automated Planning Approach for Generating Argument Dialogue Strategies

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Overview

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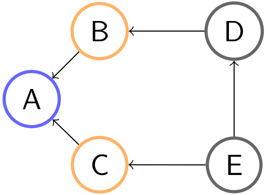
   - Persuasion Dialogues
   - Classical Planning
   - Planning a Dialogue
   - Policies
2. Planning Argument Strategies
   - Simple Strategies vs Policies
   - Generating a Policy from Simple Strategies
3. Future Work

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

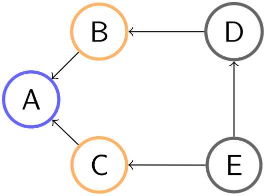
Planning a Dialogue

Opponent models

$M_0 = \{B\}$
$M_1 = \{C\}$
$M_2 = \{B, C\}$

Simple strategy

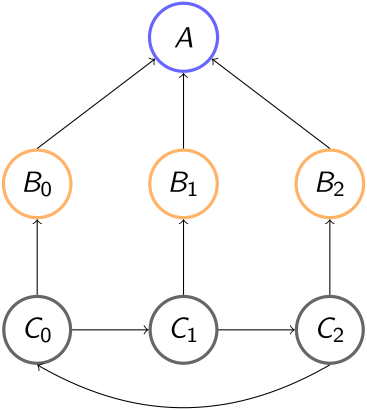
$\{A, D\}, \{E\}$



Policies

A policy is a set of state-action-pairs that determines which action should be performed in which state

Simple Strategies vs Policies



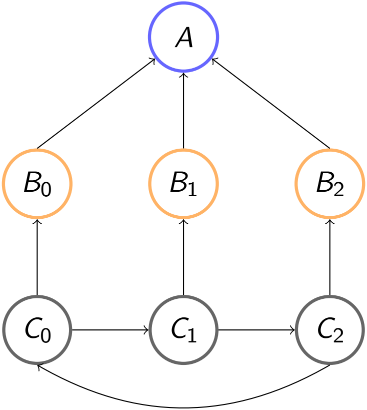
Opponent models

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

Simple strategy

$\{A, C_1\}, \{C_0\}$
$p = 0.8$

Simple Strategies vs Policies



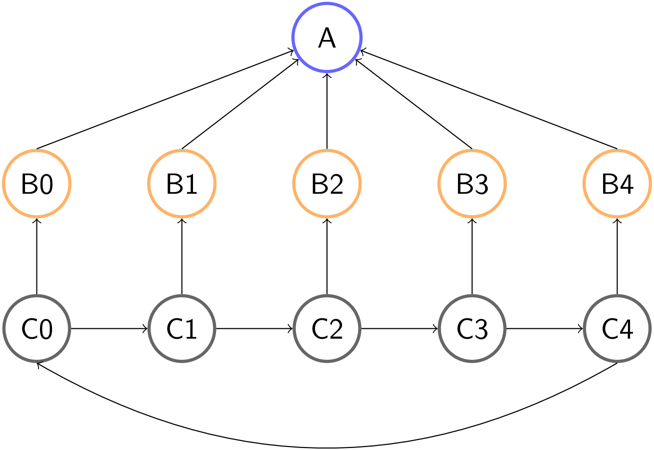
Opponent models

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

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



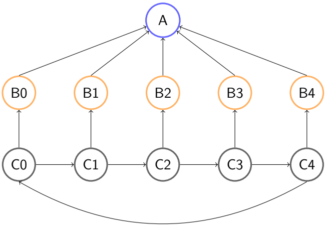
Finding a Simple Strategy

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 π_0

$\{A, C_0, C_2\}, \{C_4\}$
$p = 2/3$

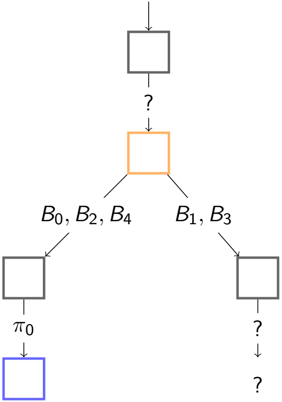


Generating a Policy

Opponent models

$$\left.\begin{array}{l} M_0 = \{B_0, B_2\} \\ M_1 = \{B_2, B_4\} \end{array}\right\} \pi_0$$

$$M_2 = \{B_1, B_3\} \quad \} \ ?$$



Replanning for Failed Cases

Opponent models

~~$M_0 = \{B_0, B_2\} : 1/3$~~

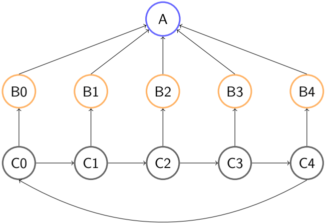
~~$M_1 = \{B_2, B_4\} : 1/3$~~

$M_2 = \{B_1, B_3\} : 1$

Simple strategy π_1

$\{A, C_1, C_3\}$

$p = 1$



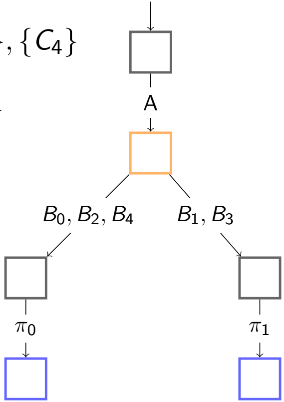
- Merge simple strategies into policy

Merging Simple Strategies into a Policy

Opponent models

$$\left.\begin{array}{l} M_0 = \{B_0, B_2\} \\ M_1 = \{B_2, B_4\} \end{array}\right\} \pi_0 = \{A, C_0, C_2\}, \{C_4\}$$

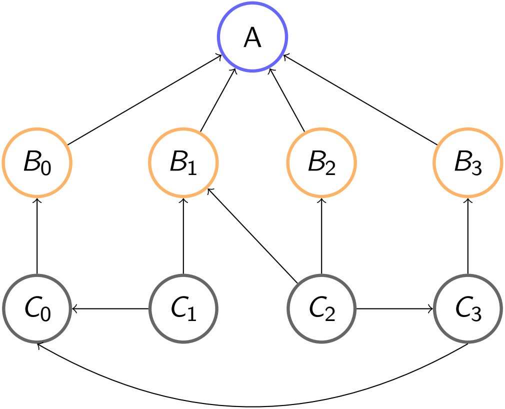
$$M_2 = \{B_1, B_3\} \quad \} \; \pi_1 = \{A, C_1, C_3\}$$



Policy

$(s_0, \{a_A\})$
(s_{B_0}, π_0)
(s_{B_1}, π_1)
(s_{B_2}, π_0)
(s_{B_3}, π_1)
(s_{B_4}, π_0)
$p = 1$

Generating a Policy from Simple Strategies



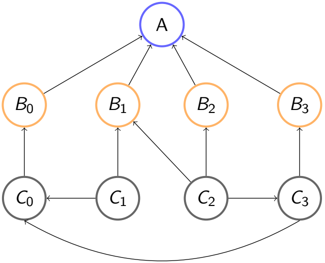
Finding a Simple Strategy

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 π_0

$\{A, C_0, C_2\}, \{C_1\}$
$p = 0.75$

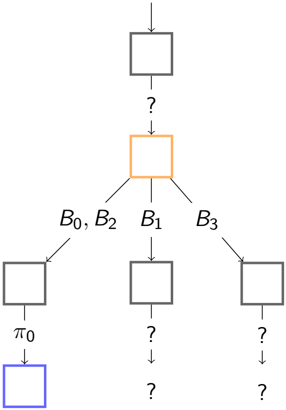


Generating a Policy

Opponent models

$$\left.\begin{aligned} M_0 &= \{B_0, B_2\} \\ M_1 &= \{B_0, B_1\} \\ M_2 &= \{B_1, B_2\} \end{aligned}\right\} \pi_0$$

$$M_3 = \{B_1, B_3\} \quad \} \; ?$$



Finding more Simple Strategies

Opponent models

~~$M_0 = \{B_0, B_2\} : 0.25$~~

$M_1 = \{B_0, B_1\} : 1/3$

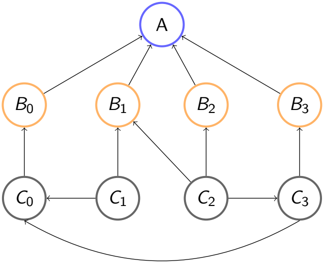
$M_2 = \{B_1, B_2\} : 1/3$

$M_3 = \{B_1, B_3\} : 1/3$

Simple strategy π_0

$\{A, C_0, C_2\}, \{C_1\}$

$p = 2/3$



Finding more Simple Strategies

Opponent models

$\cancel{M_0 = \{B_0, B_2\} : 0.25}$

$\cancel{M_1 = \{B_0, B_1\} : 1/3}$

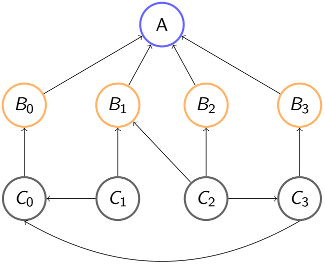
$\cancel{M_2 = \{B_1, B_2\} : 1/3}$

$M_3 = \{B_1, B_3\} : 1$

Simple strategy π_1

$\{A, C_1, C_3\}$

$p = 1$

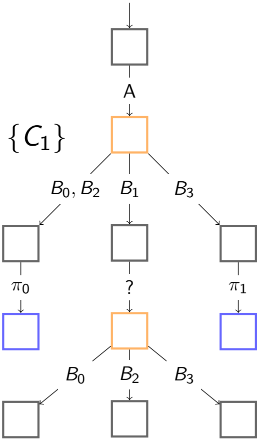


Merging Simple Strategies into a Policy

Opponent models

$$\left.\begin{aligned} M_0 &= \{B_0, B_2\} \\ M_1 &= \{B_0, B_1\} \\ M_2 &= \{B_1, B_2\} \end{aligned}\right\} \pi_0 = \{A, C_0, C_2\}, \{C_1\}$$

$$M_3 = \{B_1, B_3\} \quad \Big\} \; \pi_1 = \{A, C_1, C_3\}$$



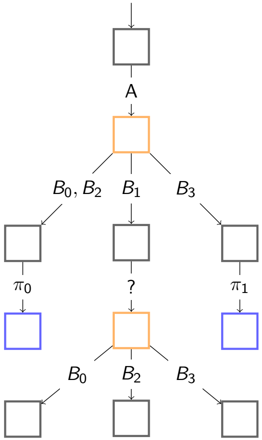
Merging Simple Strategies into a Policy

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?

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