Formalizing Practical Argumentation Lecture 5: Formalizing Adversarial Reasoning with Precedents

Henry Prakken
Department of Computer Science
Vrije Universiteit Amsterdam, The Netherlands

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Introduction

Prakken & Sartor (1998)

- *Aim:* formalize HYPO-style reasoning with the tools of argumentation systems.
- *Ideas:*
  - Model dialectical setting with dialectical proof theory
  - Regard analogy and distinguishing as heuristics for premise introduction
- Main difference with HYPO: 'normative' instead of 'descriptive' dialectics:

  Aim of game is testing a claim, not to produce realistic disputes.

  $\Longrightarrow$

  Dialectical asymmetry.
- Related work: Loui et al. (1993), Loui & Norman (1995, 1997)

Aspects:

1. Represent precedents as argument structures
2. Distinguish premises from ‘background’ information on precedents.
3. Define analogizing and distinguishing as premise-introducing dialogue moves
4. Define the notion of an actual dialogue
5. Define ‘winning’ relative to a stage in a dialogue.

1 Representing precedents

- Precedents in HYPO: factors pro and con a decision
- Formalization in Prakken & Sartor:

r_1: $PRO_1 \wedge \ldots PRO_n \Rightarrow DEC$
r_1: $CON_1 \wedge \ldots CON_m \Rightarrow \neg DEC$
p_1: $\Rightarrow r_2 \prec r_1$

- Problem: complex argumentation in precedents cannot be represented

  $\Longrightarrow$

- Generalization (Loui & Norman 1995): A dialectical sructure of arguments pro and con the decision (summarized by the premises used)

Example precedent:

r_7: *domestic-property* $\Rightarrow$ *domestic-company*,
$r_{10/12}$: $\neg$ *domestic-headquarters* $\wedge$ $\neg$ *domestic president* $\Rightarrow$ $\neg$ *domestic company*,
$r_{3/5/14}$: *domestic-company* $\wedge$ *short-duration* $\wedge$ *domestic-citizenship* $\Rightarrow$ $\neg$ *change*,
$r_{2/13}$: $\neg$ *kept-house* $\wedge$ $\neg$ *domestic-job-prospects* $\Rightarrow$ *change*,
p_1: $\Rightarrow r_{2/13} \prec r_{3/5/14}$,
p_2: $\Rightarrow r_{10/12} \prec r_7$,
f_2: $\neg$ *kept-house*, f_7: *domestic-property*, f_5: *short-duration*,
f_{10}: $\neg$ *domestic headquarters*, f_{12}: $\neg$ *domestic president*,
f_{13}: $\neg$ *domestic-job-prospects*, f_{14}: *domestic-citizenship*}

Intermediate decision:	$\neg$ *domestic-company*
Final decision:	*change*

2 Premises, background information

- A *Background Information theory (BI)* is a triple *(Cases,CFS,CSRules)*, where
  - *Cases* is a set of precedents;
  - *CFS* is a set of strict rules, the current fact situation;
  - *CSRules* is a set of rules, the 'common sense' knowledge.
- Any dialogue begins with
  $\Gamma_0 = CFS \cup CSRules$
- During a dialogue, new premises can be introduced when 'introducible' from BI.

3 Premise introduction

Rule: $r_{3/5/14}$: *domestic-company* $\wedge$ *short-duration* $\wedge$ *domestic-citizenship* $\Rightarrow \neg$ *change*

Broadening: $r_{3/5}$: *domestic-company* $\wedge$ *short-duration* $\Rightarrow \neg$ *change*

Distinction: $r_{d_{14}}$: $\sim \neg$ *domestic-citizenship* $\Rightarrow \neg$ *appl*$(r_{3/5})$

Introducible rules:

$Introducibles_{BI} \supseteq Broadenings_{BI} \cup Distinctions_{BI}$.

4 Actual dialogues

Definition 0.1 (*actual dialogues*) *For any BI an* actual dialogue *based on BI is a sequence of moves $move_i = (Player_i, Arg_i)$ $(i > 0)$, such that*

1. *Arg_i contains only rules from* CFS $\cup$ CSRules $\cup$ Introducibles$_{BI}$
2. *$Player_i = P$ iff i is odd; and $Player_i = O$ iff i is even;*
3. *If $Player_i = Player_j = P$ and $i \neq j$, then $Arg_i \neq Arg_j$;*
4. *If $i \neq 1$, then $move_i$ is for some $j < i$ a valid reply to $move_j$ in a priority dialogue.*

Remark: An actual dialogue is a tree of priority dialogues.

5 Winning an actual dialogue

- The premises at stage i, with tree T_i:
  $$\Gamma_i = \quad CFS \cup CSRules \cup (Introducibles_{BI} \cap Rules_{T_i})$$
- Branch B of actual dialogue T is a P-alternative to branch B' of T iff B and B' split at a move by O.

Definition 0.2 (*actually winning*) *$Player_i$ wins an actual dialogue T_i iff*

1. *$Player_{i+1}$ cannot move with arguments containing only rules from Γ_i;*
2. *If $Player = P$ then all branches of T won by O have a P-alternative won by P;*
3. *If $Player = O$ then not all branches of T won by O have a P-alternative won by P.*

Summary

- HYPO:
  - Reconstructed as normative dialectics
  - Extended with multi-step precedents and multiple priority sources
- Computational dialectics:
  - Actual dialogues, linked with argument-based semantics.