COMBINATORIAL DIALOGUE
GAMES IN STRATEGIC ARGUMENTATION

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- Playing with dialectical games
- Enabling agents to engage in argumentative dialogues (games as interaction protocols)
  - Heterogeneous agent communities
  - Wide range of games available

- Need a mechanism to enable an agent to play a game (but identifying specific guidelines for every game doesn’t feel right)
• Dialectical Games
• Unifying Dialectical Games
• Deciding what to say
• Combinatorial Dialogue Games
DIALECTICAL GAMES

- [hamblin, 1970]
  - Interaction protocols
  - Multiplayer (but usually 2)
  - Games (turns, moves, rules (tokens, boards))
  - Players take turns to make moves according to the rules of the game
  - Moves in the game correspond to utterances (speech act + locutional content)
• Dialogue Game Description Language [wells,2012]

• DSL for describing syntactically correct descriptions of the rules of dialogue games/dialectical games

• Underpinned by an EBNF grammar

• Supports interpretations of many extant games:
  • Hamblin, Mackenzie, Woods & Walton, Walton & Krabbe, Girle, Mcburney & Parsons, Bench-Capon, Lorenzen,...
  • & newer games
    • MAgtALO protocol, Argument Blogging protocol,....

• Supports: Shifts & Embeddings [wells, 2006]

• Supports: Schemes [wells, 2014]

• Tooling: verifier, Game engine, library of games
• Composition:
  • Game Components, e.g.
    • participants,
    • commitment stores,
    • &c.

• Rules:
  • Regulations that indirectly manipulate components

• Interactions:
  • Regulations for direct (by players) manipulation of components
Simple{
  {turns,magnitude:single,ordering:strict}
  {players,min:2,max:2}
  {player,id:Player1}
  {player,id:Player2}
  {store,id:CStore,owner:Player1}
  {store,id:CStore,owner:Player2}
  {Assert,{p},"I assert that",{store(add, {p}, CStore, Speaker),store(add, {p}, CStore, Listener)}}
}
DECIDING WHAT TO SAY

• Can define many different dialectical games (with varying features & characteristics)

• Many games are amenable to computational implementation and often to automated play by software agents

• Can identify the set of legal utterances....
  
  • ....but selecting the best utterance.... (ignoring optimal (& pessimal utterances for now))
  
  • ... depends upon goals, strategy, tactics, heuristics (& probably many other features)
STRATEGY, TACTICS, & HEURISTICS

Take a von Clausewitz style hierarchical approach:

**Strategy** - High-level approach to achieving a goal rendered in more general or abstract terms

**Tactics** - Specific coordinated movements, the “disposition of forces”, aiming to practically achieve the strategic objectives

(in parallel) **Heuristics** - General rules or principles associated with good (or bad) play (can be related to norms for reasonableness)
STRATEGIES

• Start with dialogue type ([walton,1995] style), e.g.

• Critical Discussion
  • Start from conflicting points of view
  • Overall goal: verbal resolution of the conflict
  • Individual goal: persuade others

• What constitutes a strategy in this context?
  • Formulated in terms of goal:
    • Defend own position,
    • Attack opponents position,
    • Get Socratic
TACTICS

• Select a dialectical game

• Generate a dialectical tree/sequences of locutions (speech act+content) for that game

• Identify winning sequences

• e.g. [yuan, 2007] - assigns probabilities to locutions to indicate the “chance of winning” if you play that locution

• NB. Yuan also proposes a second strategy:
  • 1. Generate all legal moves from current state
  • 2. Randomly select a move

• Others: Black, Rahwan,
HEURISTICS

• Dialectical Rules for explicit discussions [krabbe, 2001]:
  • DR1 - Comply with the rules
  • DR2 - Try to win

• “Loose lips sink ships” [oren, 2006]
  • Don’t say more than you have to
    • Possibly related to “when in a hole stop digging”

• & many more (NB. Grice, Gilbert, Pragma-Dialectics,....)
SOME HITCHES

• Much of the current work deals either with:
  • specific games (much of the tactical work)
  • non-computational/human-level interaction (heuristics/maxims)

• Might have many different games available (& shifts/embeddings between them at run-time) - providing playbooks for each potential game seems like a lot of effort (& DGDL admits a large space of possible games)
COMBINATORIAL GAMES

• Branch of Mathematics concerned with games of pure strategy

• Perfect information, no chance

• Players take turns to move alternately until there are no moves left available to either or both players

• Conway defined a set of axioms for what constitutes a pure combinatorial game

• But has proven useful to analyse play in games that violate conway’s axioms, e.g. Backgammon
Two players \{red, blue\}
Graph is multi-coloured and connected to the ground
Take turns to remove edges of own colour, discarding sub-graphs no longer connected to ground
Loser is first player who can no longer move
\textbf{Ignore locutions} - Exploit commitment state only

- Gives edges direction (to indicate which way a node acts)

\textbf{Edge Addition/Removal game}

- Incurring commitment adds node(s)/edge(s) to the CDG graph
- retracting commitment will remove node(s)/edge(s) from the CDG graph
• Combinatorial Games are generally studied as a single play, e.g. there is a single, static graph that forms the board upon which the game is played until a win/loss/draw state is reached.

• However, incurring commitment will add nodes/edges to the graph - I don’t know what my opponent knows, what their goals are, or what they will say so I don’t know how the CDG graph will update after my opponent’s turn.

• Whatever our approach - may have to re-evaluate the entire CDG graph frequently (possibly after each turn).

• NB. Can build hypothetical alternative CDG graphs (opponent models) based on knowledge of opponent (goals, knowledge).
WELL FORMED GAMES

• Additional constraints make formal dialectical games more ‘tractable’ when applied in a computational context

  • Opening phase is important - defines the motivation/goal for the dialogue (initial position or thesis)

  • Termination conditions -
    • help agents decide when to stop
    • can be defined in terms of elements established during the opening phase (e.g. the player who retracts commitment from their initial thesis loses and the other player wins)

• Commitment - Assume either an explicit commitment model, or that commitments can be ‘inferred’ from the rules of the dialectical game (worst case scenario: fall back on essential cumulativeness [wells, 2006] and a reasonable generic commitment model)
THERE & BACK AGAIN

• We threw away our locutions to work with pure commitment

• Need to reify our playbook in terms of locutions again (the things to say)

  • Search algorithm: Find a sequence of moves, having the requisite commitment effect, to bring the dialogue game state into alignment with the desired combinatorial game

  • Heuristics have a role here to further reduce the set of potential moves

  • Schemes play a role (Critical Questions can potentially restrict the set of available locutions related to the current state)
• A road ahead

• Mechanism for abstracting from specific dialectical games (if sufficiently well formed)
  
  • Ill-formed games may be amenable with certain assumptions

• Can work with current state: Based on current commitment state of the dialogue
  
  • Can simply extend the graph to include:
    
    • My knowledge - thinks I may or may not commit to in future
    
    • My knowledge about opponents knowledge - things not yet said in this dialogue but previously uttered by the opponent
    
    • Hypothetical/Inferred knowledge - things that I may ascribe to my opponent based upon stereotype
THANKS FOR YOUR ATTENTION


