COMBINATORIAL DIALOGUE GAMES IN STRATEGIC ARGUMENTATION

Simon Wells
Edinburgh Napier University, Scotland
s.wells@napier.ac.uk
http://www.simonwells.org

ECA, Lisbon, 11th June 2015

- 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)

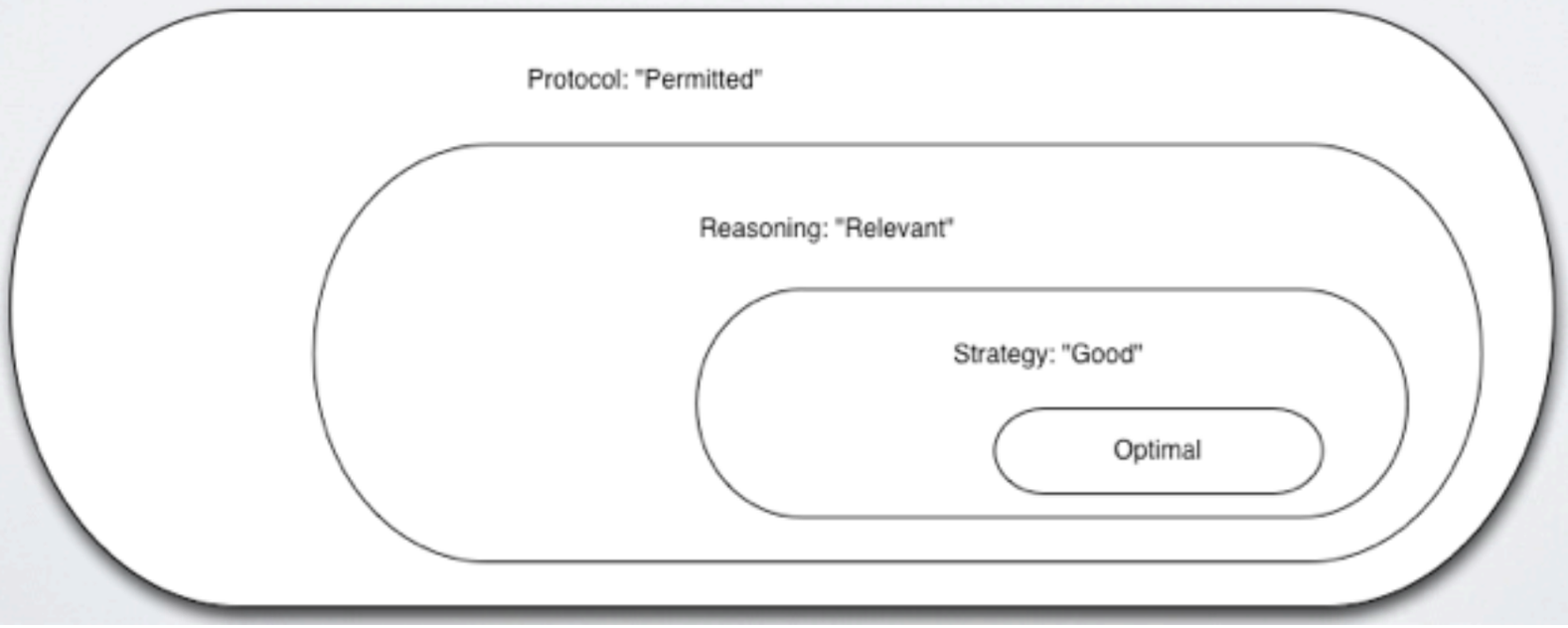
- Dialogue Game Description Language [wells,2012]
- DSL for describing syntactically correct descriptions of the rules of dialogue games/dialectical games
- Underpinned by an EBNF grammar
- Supports interpretations of many extant games:
  - Hamblin, Mackenzie, Woods & Walton, Walton & Krabbe, Girle, 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,....)

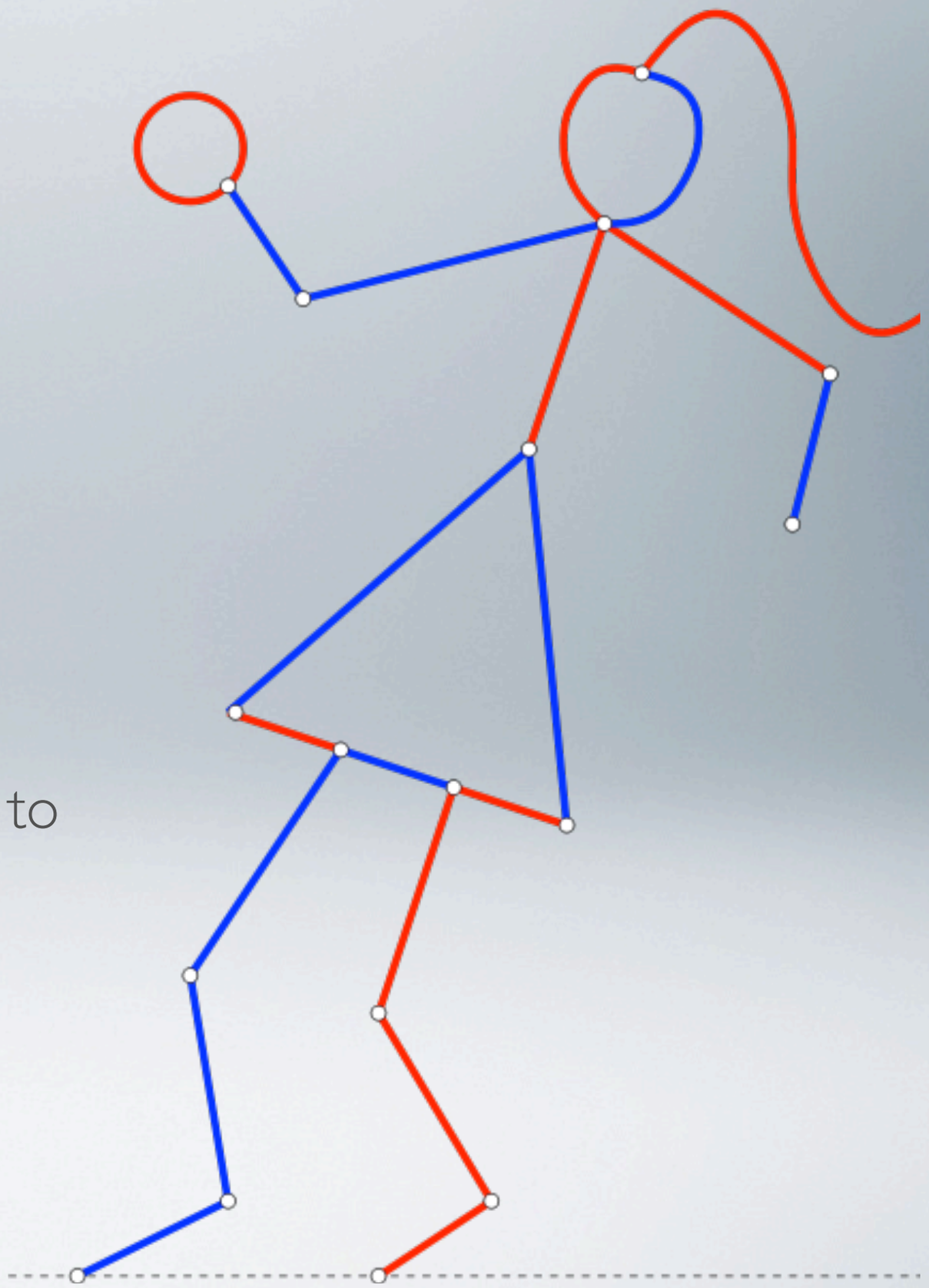
SOME HITCHES

- 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

EDGE REMOVAL GAMES



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

- ***Ignore locutions*** - Exploit commitment state only

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

- *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

- [hamblin, 1970] C. L. Hamblin (1970) "Fallacies", Methuen & Co. Ltd.
- [krabbe, 2001] E. C. W. Krabbe (2001) "Strategies in dialectic and rhetoric", OSSA'01
- [oren, 2006] N. Oren *et al.* (2006) "Strategies in dialectic and rhetoric" ARGMAS'06
- [yuan,2007] T. Yuan *et al.* (2007) "A Computer Game for Abstract Argumentation" CMNA'07
- [walton, 1995] D. Walton & E. C. W. Krabbe (1995) "Commitment in Dialogue" CUNY Press
- [wells, 2006] S. Wells & C. Reed (2006) "Knowing When to Bargain" COMMA'06
- [wells, 2006] S. Wells (2006) "Cumulativeness in Dialectical Games" ISSA'06
- [wells, 2012] S. Wells & C. Reed (2012) "A Domain Specific Language for Describing Diverse Systems of Dialogue" Journal of Applied Logic 10(4)
- [wells, 2014] S. Wells (2014) "Supporting Argumentation Schemes in Argumentative Dialogue Games" Studies in Logic, Grammar, & Rhetoric 36(1)