### Part 4

## **Synthesis Tasks**

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## Outline

### Part 4: Synthesis Tasks

4.1 Argumentation-oriented NLG

4.2 Argumentation-oriented Dialogue Systems

4.3 Debate Technologies

Why create arguments?

- To persuade
- To explain
- To summarise



#### Inventio – Dispositio – Elocutio – Memoria – Pronuntiatio



#### Inventio – Dispositio – Elocutio – Memoria – Pronuntiatio

Inventio

- Creating or identifying arguments
- Automated reasoning, Knowledge rep, nonclassical logics, ... Al
- IBM Debate Technologies

Dispositio

- Arrangement for effective persuasion, coherent explanation, salient summarisation
- Hovland and others in social psych (review in McGuire) primacy vs. recency effects on message design
- Persuasive Technology
- ... of which only some is linguistic see, e.g. Grasso
- ... of which only some is successful see, e.g. Reiter
- Coherence about structure graph traversals with irritatingly complex constraints (Reed, 1999)
- Salience about the focus of attention in argument presentation (Reed, 2002)

#### Elocutio

- Style and considering your audience
- Swathes of rhetoric (Perelman & Ohlbrechts Tyteca, 1969)
- Tailoring text to the audience PAULINE (Hovy); HealthDoc
- Bayesian modelling of audience NAG (Zukerman et al., 1999)

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-udwig Wittgenstein

Language Games



Formal Systems of Dialogue

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(also, Elsa Barthe, Jim Mackenzie, Erik Krabbe and many more)

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Formal dialogue systems – Key concepts

- Locutions & locution rules
- Structural rules
- Commitments & commitment rules
- Termination & outcome rules
- Types of commitment and the maieutic function
- Types of games and typologies
- Functional embeddings

A typology of formal dialogue systems

- Persuasion
- Negotiation
- Deliberation
- Information-seeking
- Inquiry
- Eristic

(Walton & Krabbe, 1995)

Zooming in to a typology of formal dialogue systems

- Persuasion
  - Rigorous Persuasion Dialogue
  - Permissive Persuasion Dialogue
  - Complex Persuasion Dialogue

etc.

(Walton & Krabbe, 1995)

Formalising formal dialogue systems

- Dealing with underspecification
- Dealing with correctness
- Change of focus and goal
- Widespread in AI, particularly MAS (Jennings, Prakken, McBurney, Parsons, Singh and many, many more)

Operationalising formal dialogue systems

- Three strategies:
  - Bespoke
    - Each new project, domain, application adopts a new, idiosyncratic approach
  - Lightweight generalised
    - An extension to logic programming
    - (Robertson, 2005)
  - Rich generalised
    - A programming language
    - (Bex et al., 2003)

**Dialogue Game Description Language** 

- A DSL
- Language constructs for
  - Locutions & locution rules
  - Structural rules
  - Commitments & commitment rules
  - Termination & outcome rules
  - Types of commitment and the maieutic function
  - Types of games and typologies
  - Functional embeddings
- Directly executable on Argument Web infrastructure...
- ... with AIF updates as side effects

CB{ % The file starts with Composition

```
{ turns, magnitude:single, ordering:strict, max:$UserDefined$ } ;
% Turns: single move per turn with strict turntaking (a-b-a-b-etc), Dialogue Rule R1. % Max turns is user defined (strategic rule i)
{ roles, speaker, listener, winner } ;
% Rolelist: there are 2 roles, speaker & listener
{ players, min:2, max:2 } ; % Participants
{ player, id:black } ; % Player
{ player, id:white } ; % Player
{ store, id:CS, owner:black, structure:set, visibility:public } ;
{ store, id:CS, owner:white, structure:set, visibility:public } ;
% commitment stores for both players
{ transforce, {<challenge, {p}>}, {<statement, {q}>}, arguing, {<q, p>, Inference Scheme} }
{ transforce, {<question, {p}>}, {<statement, {!p}>}, contradicting, {<!p, p>, Conflict Scheme} }
{ backtrack, off }
% In the next part the DGDL Rules are given, these are mostly CB's strategic rules
{ rule, StartingRule, scope:initial,
      { assign(black, speaker) & move(add, next, statement, {p}) & move(add, next, withdraw, {p}) & move(add, next, question, {p}) & move(add,
      next, challenge, {p}) & move(add, next, withdrawPlusChallenge, {p} } ;
{ rule, SpeakerWins1, scope:turnwise,
                { if { numturns(CB,max) & magnitude(CS, speaker, greater, CS, listener) }
                 then { status(terminate,CB) & assign(speaker, winner) } };
{ rule, ListenerWins1, scope:turnwise,
                { if { numturns(CB,max) & magnitude(CS, listener, greater, CS, speaker) }
                 then { status(terminate,CB) & assign(listener, winner) } };
% the above rules encode strategic rules ii and iv
{ rule, SpeakerWins2, scope:turnwise,
     { if { inspect(in, {p}, CS, speaker, initial) & inspect(in, {q}, CS, listener, current) & extCondition(ImmediateConsequence(q,p))}
                then { status(terminate,CB) & assign(speaker, winner) } } ;
{ rule, ListenerWins2, scope:turnwise,
     { if { inspect(in, {p}, CS, listener, initial) & inspect(in, {q}, CS, speaker, current) & extCondition(ImmediateConsequence(q,p))}
                then { status(terminate,CB) & assign(speaker, listener) } } ;
```

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% And the Interactions (locution rules and dialogue rules)

{ interaction, statement, asserting, {p}, "State",

{ if {extCondition(ImmediateConsequence, {q, p}) & inspect(in, {q}, CS, listener) }

- then { store(add, {p}, CS, listener) & store(add, {p}, CS, speaker) & move(add, next, statement, {r}) & move(add, next, withdraw, {r}) &
   move(add, next, question, {r}) & move(add, next, challenge, {r}) & move(add, next, withdrawPlusChallenge, {r})}
- else { store(add, {p}, CS, speaker) & move(add, next, statement, {r}) & move(add, next, withdraw, {r}) & move(add, next, question, {r}) &
   move(add, next, challenge, {r}) & move(add, next, withdrawPlusChallenge, {r}) } ;
- % This defines a statement (assertion) speech act. Basically, when a statement is made, it is checked whether the statement is the immediate consequence of something in the listener's commitment store. If this is the case, the statement is added to both speaker's and listener's commitment stores. Otherwise, only the speaker becomes committed.

{ interaction, withdraw, withdrawing, {p}, "No commitment",

{ if {extCondition(ImmediateConsequence, {{q}, {p}}) & inspect(!in, {q}, CS, speaker)}

{ interaction, question, questioning, {p}, "?",

{ interaction, challenge, challenging, {p}, "Why?",

{ store(add, {p}, CS, listener) & { move(add, next, withdraw, {p}) & move(add, next, statement, {q}, extCondition(Consequence, {{q},{p}})}; % A challenge adds something to the listener's CS and mandates that he reply by either withdrawing the challenged proposition or state something that provides a reason for p. Consequence(p, q) calls some theorem prover that determines whether p is a consequence of q (i.e., whether, p can be derived from q in a finite number of steps)

{ interaction, WithdrawPlusChallenge, withdrawing, {p}, challenging, {p}, "No commitment, why?",
 { store(remove, {p}, CS, speaker) & store(add, {p}, CS, listener) & { move(add, next, withdraw, {p}) & move(add, next, statement, {q},
 extCondition(Consequence, {{q},{p}})) } };



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## Outline

### Part 4: Synthesis Tasks

- 4.1 Argumentation-oriented NLG
- 4.2 Argumentation-oriented Dialogue Systems

4.3 Debate Technologies

## **Debate Technologies - outline**

- Definition
- Why it is interesting
- Example: Open domain argument synthesis









# **Debate Technologies - definition**

Debate Technologies: Computational technologies developed directly to enhance, support, and engage with human debating.

Our main focus – textual data

But other modalities can also be considered –

- Expressive Text To Speech
- Image / Video analysis to model and understand beyond-textual persuasiveness
- Physiological measures?
- More...?



- Around ~100 high quality debates, with the associated transcripts, audio, and video recordings
- See 'Conversational flow in Oxford-style debates', Zhang et al, NAACL-16

# Why it is interesting?

Debate is an important and common form of argumentation

• Debating involves a wide range of cognitive capabilities and activities, suggesting a more holistic analysis and modeling

Modeling and enhancing debates calls for -

- Argument Synthesis (Construction), as oppose to Argument Analysis (e.g., Mining)
- Going beyond single arguments towards a whole debate analysis?
- From static offline analysis, to **interactive** systems that support human debating...?
- Some debate formats are quite structured and have an associated "outcome"
- Debate practices include effective heuristics that we can model and learn from

Bottom line: Debate can serve as a lab to investigate and develop intriguing Computational Argumentation technologies, giving rise to new types of applications

# **Example: Towards open-domain argument synthesis**

#### Problem statement -

Given a short controversial topic, automatically construct relevant arguments.

### 💽 Example

- Input: 'We should become vegetarian'
- Corpus: Wikipedia, Newspapers, ...
- Output: Relevant Pro and Con arguments

### • An open-domain problem



 Notice the conciseness and simplicity of the input, vs. the complexity and richness expected in the output

# A simple argument model

### Topic

A short phrase that frames the discussion, defining the argument **context** The sale of violent video games to minors should be banned

### Claim (a.k.a. Conclusion)

A general, concise statement that directly supports/contests the given Topic Violent video games increase children's aggression

### lacksquare

#### **Evidence (a.k.a. Premise)**

A text segment that directly supports/contests the claim in the context of a given Topic A large scale meta-analysis, examining 130 studies with over 130,000 subjects worldwide, concluded that exposure to violent video games causes long term aggression in players.







### The individual problems are hard...

• Example – Context Dependent Claim Detection

(Levy et. el, COLING-14; and also Lippi & Toroni, IJCAI-15 for the context-independent task)

- ~500M Wikipedia sentences
- ~200 options to select claim boundaries
- ~100B candidates, of which typically only ~50 represent valid relevant claims

### Finding a needle in a haystack?



### No... It is worse...

### Identifying a claim involves quite subtle considerations

#### Topic: the sale of VVG to minors should be banned

- VVG should not be sold to children
- VVG are significantly associated with: increased aggressive behavior
- "Doom" has been blamed for school shooting
- Only children predisposed to aggression are affected by VVG
- TV shows just mirror the violence that goes on in the real world
- VG publishers unethically train children in the use of weapons
- VG addiction is excessive or compulsive use of VG that interferes with daily life

### Identifying a claim involves quite subtle considerations

#### Topic: the sale of VVG to minors should be banned

- VVG should not be sold to children (Repeats the Topic)
- VVG are significantly associated with increased aggressive behavior
- "Doom" has been blamed for school shooting (Too specific)
- Only children predisposed to aggression are affected by VVG (Ambivalent)
- TV shows just mirror the violence that goes on in the real world (Not relevant)
- VG publishers unethically train children in the use of weapons
- VG addiction is excessive or compulsive use of VG that interferes with daily life (Definition)

### Identifying a claim involves quite subtle considerations

#### Topic: the sale of VVG to minors should be banned

- VVG should not be sold to children
- VVG are significantly associated with increased aggressive behavior (Factual Claim)
- "Doom" has been blamed for school shooting
- Only children predisposed to aggression are affected by VVG
- TV shows just mirror the violence that goes on in the real world
- VG publishers unethically train children in the use of weapons (Opinion Claim)
- VG addiction is excessive or compulsive use of VG that interferes with daily life

### Factual vs. Opinion – The 'Big Bang Theory' view



Identifying claim boundaries is also far from trivial

Topic: the sale of VVG to minors should be banned

Because violence in video games is interactive and not passive, critics such as Dave Grossman and Jack Thompson argue that violence in games hardens children to unethical acts, calling firstperson shooter games "murder simulators", although no conclusive evidence has supported this belief. Identifying claim boundaries is also far from trivial

Topic: the sale of VVG to minors should be banned

Because violence in video games is interactive and not passive, critics such as Dave Grossman and Jack Thompson argue that violence in games hardens children to unethical acts, calling firstperson shooter games "murder simulators", although no conclusive evidence has supported this belief.

### **Open domain argument synthesis – points to notice**

Many components need to work in synchrony to obtain valuable results

If IR results drift from the original topic, the entire results are drifted

 How not to drift from a discussion about 'Marriage is outdated' to a discussion about 'same-sex marriage'?

• Identifying claim boundaries is important for downstream components

- Detecting the claim polarity
- Finding evidence to support/contest the claim
- Understanding claim relations claim equivalence, claim A subsumes claim B...

• A synthesized argument may include claim from one article and evidence instances from different articles, or even different corpora

Potential for generating "new" arguments and "new" persuasive content

### Another example: towards synthesis of (new?) claims

Bilu and Slonim, Claim Synthesis via Predicate Recycling, Wednesday, 3:30pm, Session 8C

- Extract predicates from labeled claims
- Extract topic from new motion
- Append topic to related predicates
- Classify candidates to determine which are good



### Examples

- Democratization contributes to stability.
- Graduated response lacks moral legitimacy.
- Truth and reconciliation commissions are a source of conflict.
- Hydroelectric dams are one of the most cost efficient sources of renewable energy.
- The free market increases aggregate demand for goods and services in the economy.
- > The ASEAN is both effective and necessary.
- Israel's 2008-2009 military operations violate multiple basic human rights.