Computational Semantics and Pragmatics
Autumn 2011

Raquel Fernández

Institute for Logic, Language & Computation
University of Amsterdam

Overview

Last week:

- Speech act theory (Austin, Searle)
- Interpretation of Speech Acts / Dialogue Acts:
  - Plan-based inference models (beliefs, desires, and intentions - BDI)
  - Cue-based probabilistic models

Plan for today:

- BDI approaches vs. ISU approaches
- Models of grounding

BDI Approaches

- Last week we looked at plan-based BDI approaches in the context of speech act interpretation, in particular indirect speech acts such as *'Can you pass me the salt?'*
- But the BDI approach is meant to be more than that: a general model of rational action that can be applied to conversation
- It proposes an axiomatization of belief, desire, and intention to account for:
  - ∗ what motivates our actions
  - ∗ how to understand actions by others

example of plan-inference rule (from Jurafsky 2004):

- <u>Action-Effect Rule</u>: For all agents S and H, if Y is an effect of action X and if H believes that S wants X to be done, then it is plausible that H believes that S wants Y to obtain.

BDI Approaches

For further details on the axiomatization and the plan-inference rules see Jurafsky (2004) for a short summary and the original papers by Allen et al.

Jurafsky (2004) Pragmatics and Computational Linguistics. *Handbook of Pragmatics*. Oxford: Blackwell.
Allen & Perrault (1980) Analyzing Intention in Utterances, *Artificial Intelligence* 15(3).
Perrault & Allen (1980 A Plan-based Analysis of Indirect Speech Acts, *Computational Linguistics* 6(3):167-182.

Main influences of these approaches:

- Austin's and Searle's characterisation of speech acts in terms of felicity conditions that appeal to the mental attitudes of speakers
- Hintikka's logic of belief

BDI Dialogue Systems

BDI approaches have been used as the basis to implement conversational agents in the TRAINS/TRIPS projects.

- see the project's website for access to a dialogue corpus collected to develop the system, movies of the system in action, and links to publications.

  http://www.cs.rochester.edu/research/trains/

Allen et al. (2001) Towards Conversational Human-Computer Interaction, *AI Magazine.*
Allen et al. (2001) An architecture for more realistic conversational systems, in *Proc. of Intelligent User Interfaces.*

Information State Update Approaches

The ISU approach is influenced by two main traditions:

- The work of philosophers such as Lewis and Stalnaker
  * focus on public/conventional aspects of dialogue (*common ground*).
  * the dynamics of dialogue can be modelled using a game metaphor: participants (players) make moves that update an evolving *conversational scoreboard* that represents the information that has become common as a result of the dialogue.

Lewis. 1979. Score keeping in a language game. *Journal of Philosophical Logic*.
Stalnaker. 1979. Assertion. In *Syntax and Semantics IX*. Academic Press.
Carlson. 1983. Dialogue Games. *Synthese Language Library*. D. Reidel.

- The work of conversational analysts (Schegloff et al.) and psycholinguists (Clark et al.)
  * focus on interaction management and meta-communication
  * *grounding*

Allwood (1995) An activity-based approach to pragmatics. *Göteborg Papers of Theoretical Linguistics*.
Clark & Schaefer (1989) Contributing to discourse, *Cognitive Science*.
Schegloff et al. (1977) The preference for self-correction in the organization of repair in conversation, *Language*.

Grounding Models

Conversation is a continuos process of establishing common ground between speaker and addressee $\Rightarrow$ grounding

Models of grounding need to explain:

- how DPs achieve shared understanding and contribute to their common ground, and
- the possibility of misunderstanding and the strategies used by the DPs to recover from communication problems.

Levels of Communication

Ladder of actions at different levels of communication performed by speakers and addressee with each utterance (Clark / Allwood)

Level	Actions
1 contact:	A and B pay attention to each other
2 perception:	B perceives the signal produced by A
3 understanding:	A understands what B intends to convey
4 uptake:	B accepts / reacts to A's proposal

In contrast to Austin's distinction between locutionary, illocutionary, and perlocutionary acts, the emphasis here is in the joint character of the actions performed with/by utterances

$\Rightarrow$ effective utterances in dialogue are joint actions.

Grounding Criterion

Level	Actions
1 contact:	A and B pay attention to each other
2 perception:	B perceives the signal produced by A
3 understanding:	A understands what B intends to convey
4 uptake:	B accepts / reacts to A's proposal

Lack of understanding may occur at any level of action

- we may not realised we are being addressed
- we may not hear our interlocutor properly
- we may not know the meaning of a word the speaker uses
- we may fail to recognise the relevance of what is said

To achieve grounding, dialogue participants must understand each other at all levels of communication up to the *grounding criterion*: $\Rightarrow$ the appropriate degree of understanding given the communicative situation at hand.

Grounding Criterion

Level	Actions
1 contact:	A and B pay attention to each other
2 perception:	B perceives the signal produced by A
3 understanding:	A understands what B intends to convey
4 uptake:	B accepts / reacts to A's proposal

According to Clark, the levels of action are connected by two principles:

- Upward causality: actions at lower levels (completed successfully up to the grounding criterion) allow actions at higher levels.

- Downward evidence: evidence that a level has been achieved can be taken as evidence that the grounding criterion has been reached at all lower levels.

A: How would you like to be contacted?
B: By email, please. At john.smith@email.com
A: OK. Thank you very much and have a good day
B: Goodbye.

Feedback

- Addressees give constant feedback to the speaker regarding their level of understanding.
  * positive feedback: implicit or explicit acknowledgements
  * negative feedback: clarification requests

- Mechanisms to provide positive evidence of understanding:
  * acknowledgement
  * repetition
  * demonstration (paraphrase, reformulation, completion)
  * relevant next contribution

```
33 65.67 67.64 P: so (if y + if you) imagine the bottom right
34 67.64 68.79 P: you just got two spaces
35 68.82 69.06 E: | yah
36 68.85 71.32 P: (which . + which) is . sort of . horizontally
37 71.36 71.60 E: | mhm
38 72.06 75.81 P: uhm . you want . . the bottom bit of the l to go to the bottom
39 75.97 76.34 E: | okay
40 77.27 78.86 P: and what you want is (your + the) long ! end
41 78.87 79.21 E: | mhm
42 79.71 80.78 P: to be along the right
43 81.56 82.80 E: | to . be along the right
44 82.80 85.11 E: | okay so it's a reflection of an ordinary english L ?
45 85.26 85.64 P: yes
46 85.70 86.09 E: | okay
```

Feedback

Feedback mechanisms can be classified according to the level of communication at which the evidence of understanding is given.

A: I know a great tapas restaurant in Goldoni street.
B: Pardon? / A great what? / Goldoni street? / Should I consider this an invitation?

However, there is not a one-to-one correspondence between the form of feedback utterances and their function.

$$
\begin{array}{ll}
yeah & \rightsquigarrow \text{ level 1 / 2 /3 / 4 ?} \\
Goldoni\ street? & \rightsquigarrow \text{ level 2 / 3 / 4 ?}
\end{array}
$$

Note also that one single utterance can give positive and negative feedback simultaneously:

B: A tapas restaurant where?

A: ... I need to travel in May.
B: And, what day *in May* did you want to travel?
A: *OK* uh I need to be there from the 12th to the 15th.
B: And you're flying from what city?
A: I want to fly from Pittsburgh
B: *Mm hmm*
A: to Seattle.
B: *OK.*

A: Most machines don't record that slow.So I'd wanna, when I make a tape
B: *be able tuh speed it up.*
A: *Yeah.*

Least Collaborative Effort

Which feedback mechanism is appropriate in a given situation depends on several factors

- the degree of uncertainty regarding a possible misunderstanding
- the desire to be brief and efficient
- ...

Clark's principle of least collaborative effort: dialogue participants will try to invest the minimum amount of effort that allows them to reach the grounding criterion.

Here effort is *collaborative* (cf. Gricean quantity maxims)

Grounding and Metacommunication

- The primary function of feedback acts is to manage the grounding process

- They are *meta-communicative*: while other types of acts deal with the topic of the conversation, the subject matter of feedback utterances are the basic acts of communication.

Layer 1: basic communicative acts	Layer 2: meta-communicative acts
B: There is not one ticket left in the entire planet! So annoying!	
C:	Where for?
B:	Crowded House.
B: My brother is going and he doesn't even like them.	
A: Why doesn't he sell you his ticket?	*implicit positive evidence*
B: Cos he's going with his work. And Sharon.	*implicit positive evidence*
A:	Oh, his girlfriend?
B:	Yes.
B: They are gonna come and see me next week.	

Summing Up

- Main differences between BDI and ISU approaches:
  * BDI approaches are general models of rational action; they model actions in conversations by reasoning with the mental attitudes of the participants
  * ISU approach focuses on the public aspects of dialogue, on the common ground built by the participants during a conversation, and in how dialogue acts update the conversational scoreboard.

- Models of Grounding
  * Clark considers dialogue a joint action, requiring acts by both speaker and addressee.
  * grounding: the process whereby dialogue participants contribute to their common ground, giving feedback about their level of understanding.