
LECTURE 26: DIALOGUE

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Adapted from Julia Hockenmaier, NLP S2023 - course material
<https://courses.grainger.illinois.edu/cs447/sp2023/>



THE LINGUISTICS OF DIALOGUE

TODAY'S LECTURE

The linguistics of dialogue	What do we know about what happens when two or more people are having a conversation?
Dialogue Systems/ Conversational Agents	How can we design systems to have a conversation with a human user?
Chatbots	Mostly chitchat, although also some use in therapy
Task-based Dialogue Systems	Help human user to accomplish a task (e.g. book a ticket, get customer service, etc.)

RECAP: DISCOURSE



On Monday, John went to Einstein's. He wanted to buy lunch. But the cafe was closed. That made him angry, so the next day he went to Green Street instead.



'Discourse': Any linguistic unit that consists of multiple sentences



Speakers describe "some situation or state of the real or some hypothetical world" (Webber, 1983)



Speakers attempt to get the **listener** to construct a similar **model of the situation**.

A DIALOGUE BETWEEN A CUSTOMER (C) AND A TRAVEL AGENT (A)

C₁: ...I need to travel in May.
A₁: And, what day in May did you want to travel?
C₂: OK uh I need to be there for a meeting that's from the 12th to the 15th.
A₂: And you're flying into what city?
C₃: Seattle.
A₃: And what time would you like to leave Pittsburgh?
C₄: Uh hmm I don't think there's many options for non-stop.
A₄: Right. There's three non-stops today.
C₅: What are they?
A₅: The first one departs PGH at 10:00am arrives Seattle at 12:05 their time. The second flight departs PGH at 5:55pm, arrives Seattle at 8pm. And the last flight departs PGH at 8:15pm arrives Seattle at 10:28pm.
C₆: OK I'll take the 5ish flight on the night before on the 11th.
A₆: On the 11th? OK. Departing at 5:55pm arrives Seattle at 8pm, U.S. Air flight 115.
C₇: OK.
A₇: And you said returning on May 15th?
C₈: Uh, yeah, at the end of the day.
A₈: OK. There's #two non-stops . . . #
C₉: #Act. . . actually #, what day of the week is the 15th? A₉: It's a Friday.
C₁₀: Uh hmm. I would consider staying there an extra day til Sunday.
A₁₀: OK...OK. On Sunday I have ...

A DIALOGUE BETWEEN A CUSTOMER (C) AND A TRAVEL AGENT (A)

C₁: ...I need to travel in May.

A₁: And, what day in May did you want to travel?

C₂: OK uh I need to be there for a meeting that's from the 12th to the 15th.

A₂: And you're flying into what city?

C₃: Seattle.

A **dialogue** is a conversation between two speakers that consists of a sequence of **turns**

Turn = an **utterance** by one of the two speakers

Turn-taking requires the ability to detect when the other speaker has finished

Multiparty dialogue: A conversation among more than two speakers

FROM DISCOURSE TO DIALOGUE

Discourse:

- The **speaker** communicates to an **absent, passive listener** (or audience), and attempts to get them to construct a similar model of the state of affairs.
- The speaker does not receive any feedback from the audience.

Dialogue:

- Both parties are **present** and **active** participants. They each bring **their own mental model** of the state of affairs. Communication succeeds if both parties understand each other's mental models (and perhaps even get their models to agree).
- Both parties provide feedback to each other.

GROUNDING IN DIALOGUE

For communication to be successful, both parties have to know that they understand each other (or where they misunderstand each other)

— Both parties maintain (and communicate) *their own beliefs about the state of affairs* that they're talking about.

— Both parties also maintain *beliefs about the other party's beliefs about the state of affairs.*

— Both parties also maintain *beliefs about the other party's beliefs about their own beliefs,... etc.*



Common ground: The set of **mutually agreed beliefs** among the parties in a dialogue

GROUNDING IN DIALOGUE

John: *Dragons are scary!*

Common Ground: {*"John thinks dragons exist",*
"Mary knows that John thinks dragons exist",
"John finds dragons scary"
"Mary knows that John finds dragons scary",}

If Mary replies:

What dragons?

—> **Additions to Common Ground:**
{ "Mary doesn't think dragons exist",
"John knows that Mary doesn't think dragons exist", ...}

If Mary replies instead:

No, dragons are cute!

—> **Additions to Common Ground:**
{ "Mary and John both think dragons exist",
"Mary finds dragons cute."
"John knows that Mary finds dragons cute",
"Mary disagrees with John that dragons are scary",...}

CLARK AND SCHAEFER: GROUNDING

When two people communicate, they each contribute to the conversation by establishing and adding to the common ground.

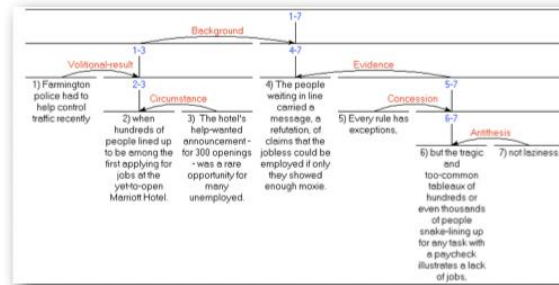
B needs to provide evidence of understanding what A meant by

- – **Continued attention:** B continues attending to A
- – **A relevant next contribution:** (“so, what shall we do now?”)
- – **Acknowledgement:** B nods, says (uh-huh, yeah), gives assessment (great!)
- – **Demonstration of understanding:** B paraphrases or reformulates A’s contribution, or completes A’s utterance
- – **Display:** B repeats verbatim all or part of A’s utterance

Without such evidence, A may not know if B understood what A meant to convey.

DISCOURSE HAS STRUCTURE

Rhetorical relations hold between parts of a discourse (e.g. as formulated in RST, or the PDTB):



Different parts of a discourse play **different functions** (e.g. as in Argumentative Zoning for scientific papers):

Category	Description	Example
AIM	Statement of specific research goal, or hypothesis of current paper	"The aim of this process is to examine the role that training plays in the tagging process"
OWN_METHOD	New Knowledge claim, own work: methods	"In order for it to be useful for our purposes, the following extensions must be made:"
OWN_RESULTS	Measurable/objective outcome of own work	"All the curves have a generally upward trend but always lie far below backoff (51% error rate)"

DIALOGUES HAVE STRUCTURE TOO

A0: Hello, how can I help you?	Greeting, Question
Co: Hi, thanks! I'd like to book a flight.	Greeting, Answer
C1: ...I need to travel in May.	Constraint
A1: And, what day in May did you want to travel?	
C2: OK uh I need to be there for a meeting that's from the 12th to the 15th.	
A2: And you're flying into what city?	
C3: Seattle.	
A3: And what time would you like to leave Pittsburgh?	
C4: Uh hmm I don't think there's many options for non-stop.	
A4: Right. There's three non-stops today.	
C5: What are they?	
A5: The first one departs PGH at 10:00am arrives Seattle at 12:05 their time. The second flight departs PGH at 5:55pm, arrives Seattle at 8pm. And the last flight departs PGH at 8:15pm arrives Seattle at 10:28pm.	
C6: OK I'll take the 5ish flight on the night before on the 11th.	
A6: On the 11th? OK. Departing at 5:55pm arrives Seattle at 8pm, U.S. Air flight 115.	
C7: OK.	
A7: And you said returning on May 15th?	
C8: Uh, yeah, at the end of the day.	
A8: OK. There's #two non-stops . . . #	
C9: #Act. . . actually #, what day of the week is the 15th? A9: It's a Friday.	

DIALOGUES HAVE STRUCTURE TOO

- **Dialogues have (hierarchical) structure:**
 - “**Adjacency pairs**”: Some acts (first pair part) typically followed by (set up expectation for) another (second pair part):
 - Question → Answer,
 - Proposal → Acceptance/Rejection, etc.
- Sometimes, a **subdialogue** is required (e.g. for clarification questions):

A: I want to book a ticket for tomorrow

B: Sorry, I didn't catch where you want to go?

A: To Chicago

B: And where do you want to leave from?

...

B: Okay, I've got the following options: ...

SPEECH ACTS

Utterances correspond to **actions** by the speaker, e.g.

- — **Constative** (answer, claim, confirm, deny, disagree, state)
 - Speaker commits to something being the case
- — **Directive** (advise, ask, forbid, invite, order, request)
 - Speaker attempts to get the listener to do something
- — **Commissive** (promise, plan, bet, oppose)
 - Speaker commits to a future course of action
- — **Acknowledgment** (apologize, greet, thank, accept apology)
 - Speaker expresses an attitude re. listener with respect to a social action

In practice, much more fine-grained labels are often used, e.g:

- Yes-No Questions, Wh-Questions, Rhetorical Questions, Greetings, Thanks,
- Yes-Answers, No-Answers, Agreements, Disagreements, ...
- Statements, Opinions, Hedges, ...

INITIATIVE

Who controls the conversation?

- — Who asks questions?
- — Who introduces new topics?

Human-human dialogue is typically **mixed initiative** where both parties take initiative at different points

- (But it is difficult to design mixed initiative dialogue systems)

Systems often assume a **user-initiative strategy**

- (User asks questions, System responds)

or a **system-initiative strategy**

- (Only system can ask questions. System-initiative systems can be very frustrating to use)

INFERENCE AND IMPLICATURE



A1: And, what day in May did you want to travel?

C2: OK uh I need to be there for a meeting that's from the 12th to the 15th.



The customer (speaker) doesn't answer the question directly, but assumes the provided information allows the agent (hearer) to infer the requested information

(→ customer needs to travel on 11th/12th—15th/16th)



Hearers can draw these inferences (“conversational implicatures”) because they assume speakers are being cooperative



Gricean maxims: rules that govern (cooperative) human communication. Here: “Be relevant!”

CHATBOTS

CHATBOTS VS DIALOGUE SYSTEMS

Chatbots: Chitchat,
often used for
entertainment, originally
as testbed for clinical
therapy

Dialogue Systems:
Typically to perform
specific tasks (e.g.
customer service,
reservations, etc., smart
devices, cars, etc.)

A COMPUTER THERAPIST?

Computer: TELL ME MORE ABOUT YOUR FAMILY

Human: My mother takes care of me.

Computer: WHO ELSE IN YOUR FAMILY TAKES CARE OF YOU

Human: My father.

Computer: YOUR FATHER

Human: You are like my father in some ways.

Computer: WHAT RESEMBLANCE DO YOU SEE

Human: You are not very aggressive but I think you don't want me to notice that.

Computer: WHAT MAKES YOU THINK I AM NOT VERY AGGRESSIVE

Human: You don't argue with me.

Computer: WHY DO YOU THINK I DON'T ARGUE WITH YOU

Human: You are afraid of me. *Weizenbaum (1966), ELIZA.*

ELIZA AS A FST CASCADE

Human: You don't argue with me.

Computer: WHY DO YOU THINK I DON'T ARGUE WITH YOU

1. Replace **you** with *I* and *me* with *you*:

- *I don't argue with you.*

2. Replace <...> with *Why do you think* <...>:

- *Why do you think I don't argue with you.*

CURRENT CHATBOTS

Retrieval-based approaches:

- Mine large corpora of human-human dialogues
 - Given a user utterance, find an utterance in the corpus that is most similar to this utterance.
 - Return either this utterance itself, or the response to it

Neural approaches (seq2seq models)

- Trained on large corpora of human-human dialogues
 - May require beam search or other training objectives, and reinforcement learning or adversarial training to optimize for maintaining a longer conversation