Computational Models of Discourse: Overview

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Plan for Today
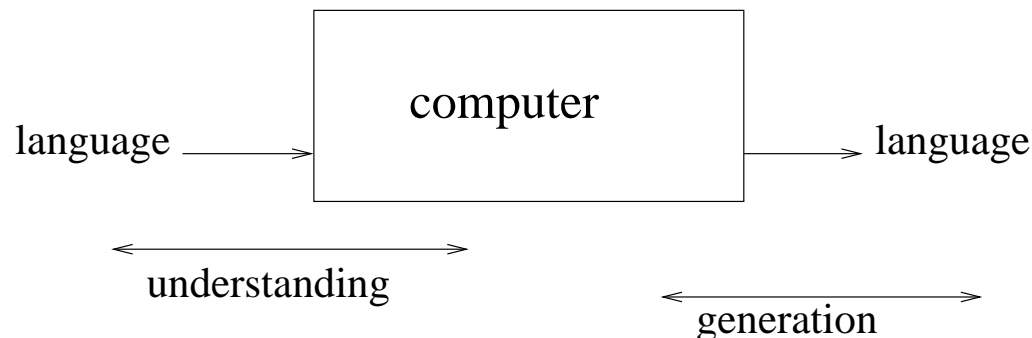
Overview of the course:

- Discourse processing: motivation and background

- Discourse theories

- Applications

Administration:

- Requirements

Natural Language Processing

Goal: Computers using natural language as input or output

NLU example: convert an utterance into a sequence of computer instructions

NLG example: produce a summary of a patient's record

Why NLP?

Lots of information is in natural language format

- Documents

- News broadcasts

- User Utterances
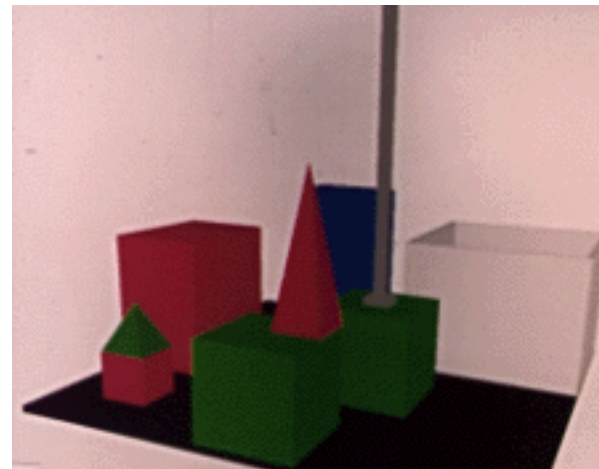
Lots of users want to communicate in natural language.

- "DO what I mean!"

"Now we are betting the company on these natural interface technologies" Bill Gates, 1997

Example: User Interfaces

SHRDLU (Winograd, 1972): language interface for block manipulation

Person: PICK UP A BIG RED BLOCK.
Computer: OK. (does it)
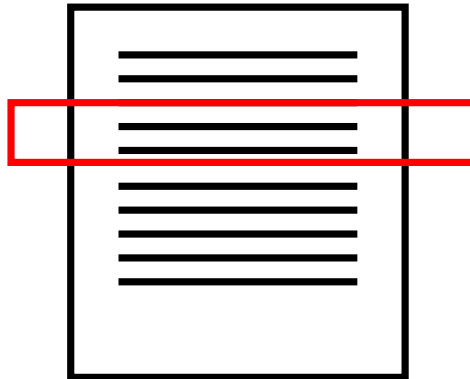Person: PUT IT NEAR THE PYRAMID.

Example: Question-Answering(1)

Q: Who is the president of First Union Corp?

> First Union Corp is continuing to wrestle with sever problems. According to industry insiders at Pine Webber, their president, John R. Georgius, is planning to retire soon.

Example: Information Retrieval

Show me the proof of Cantor theorem

Example: Text Generation

(Duboue&McKeown, 2003): verbalization of semantic data from movie databases

> Actor, born Thomas Connery on August 25, 1930, in Edinburgh, Scotland. He has a brother, Neil, born in 1938. Connery dropped out of school to join the British Navy. Connery is best known for his portrayal of the British spy, James Bond, in the 1960s.

Challenges

Sentences cannot be processed in isolation

- Coreference

- Ordering

- Segmentation

We need to model text and dialog structure

What is Discourse

Example by Charles Fillmore:

Please use the toilets, not the pool.
The pool for members only.

Discourse Phenomena

- a word, phrase, and utterance whose interpretation is shaped by the discourse or dialogue context

John arrived at an oasis. He saw the camels around the water hole ...
John arrived at an oasis. He left the camels around the water hole ...

- a sequence of utterances whose interpretation is more than sum of its component parts

Inference in Discourse Processing

- There are several possible ways to interpret an utterance in context

- We need to find the most likely interpretation

- Discourse model provides a computational framework for this search

Discourse Exhibits Structure!

- Discourse can be partition into segments, which can be connected in a limited number of ways

- Speakers use linguistic devices to make this structure explicit
  cue phrases, intonation, gesture

- Listeners comprehend discourse by recognizing this structure

  - Kintsch, 1974: experiments with recall

  - Haviland&Clark, 1974: reading time for given/new information

Models of Discourse Structure

- Investigation of lexical connectivity patterns as the reflection of discourse structure

- Specification of a small set of rhetorical relation among discourse segments

- Adaption of the notion of grammar

- Examination of intentions and relations among them as the foundation of discourse structure

Example

1. A: I'm going camping next week. Do you have a two person tent I could borrow?
2. B: Sure. I have a two-person backpacking tent.

3. A: The last trip I was on there was a huge storm.
4. A: It poured for two hours.
5. A: I had a tent, but I got soaked anyway.
6. B: What kind of tent was it?
7. A: A tube tent.
8. B: Tube tents don't stand up well in a real storm.
9. A: True.

10.B: Where are you going on this trip?
11.A: Up in the Minarets.
12.B: Do you need any other equipment?
13.A: No.
14.B: Okay. I'll bring the tent tomorrow.

Cohesion

Assumption: Well-formed text exhibits strong lexical connectivity via use of:

- Repetitions

- Synonyms

- Coreference

Cohesion

1. A: I'm going camping next week. Do you have a two person tent I could borrow?
2. B: Sure. I have a two-person backpacking tent.

3. A: The last trip I was on there was a huge storm.
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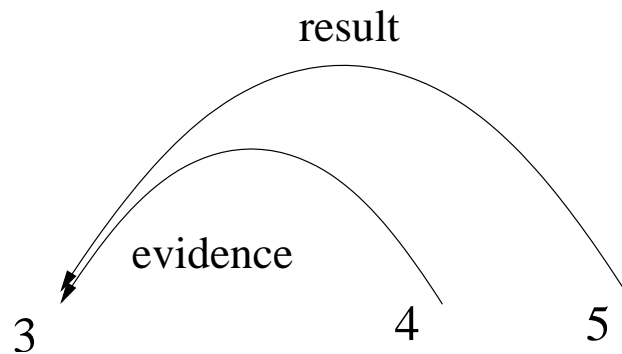14. B: Okay. I'll bring the tent tomorrow.

Rhetorical Structure Theory

Assumption: Clauses in well-formed text are related via predefined rhetorical relations

- Evidence: a claim → information intended to increase the readers' belief in the claim

- . . .

Rhetorical Structure Theory

3. The last trip I was on there was a huge storm.

4. It poured for two hours.

5. I had a tent, but I got soaked anyway.

Text Grammars

Assumption: existence of text grammar in limited domains (analogous to sentence grammar)

- Tale grammar (31 terminals) V.Propp(1920s)

- Scientific articles: introduction, conclusions, ….

Intention-based Approaches

Dialogue as collaborative activity:

- Intention of A: to get a tent

- To achieve this goal, A:
  - Requests a tent from B
  - Convinces B in the importance of this request

Computational Approaches

- Rule-based approaches: manually encode all the required domain and common knowledge

- Machine-learning approaches: learn all the required knowledge from a corpus

  - Supervised classification

  - Hidden-Markov Models

  - Clustering

  - Reinforcement learning

Applications

- Summarization

- Anaphora resolution

- Essay grading

- Segmentation

- Information ordering

- Dailog processing

- ...

Types of Discourse

- Monologue (narrative, lecture)

- Human-human dialog

- Human-machine dialogue

Does it work?

- Summarization: F-scores 70% (DUC 2003)

- Anaphora resolution: F-scores 60-70%
  (Ng&Cardie:2002)

- RST parsing: 47% (compare with th accuracy of
  syntactic parsers — high 80th!)

Discourse processing is hard!

Does it work?

A day after a suicide bomber killed 10 people in a terror attack on a Jerusalem bus, Israeli forces conducted operations Friday in the West Bank and Gaza, killing three Palestinians the Israeli army had identified as terrorists. The leader of Hamas said Friday that his group is making every effort to seize Israeli soldiers as bargaining chips for the release of Palestinians in Israeli jails. At least 45 people were wounded in the terror attack, which Israeli officials said proved the need for what Israel calls a security fence intended to block terrorists from entering the country.