

Plan for Today

Overview of the course:

- Discourse processing: motivation and background
- Discourse theories
- Applications

Administration:

- Requirements

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

Computational Models of Discourse: Overview

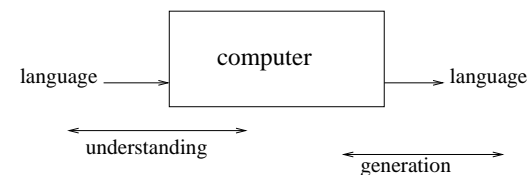
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Natural Language Processing

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

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: Text Generation

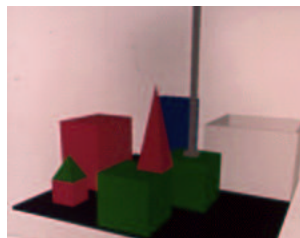
(Duboue&McKeown, 2003): verbalization of semantic data from movie databases

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.

Example: User Interfaces

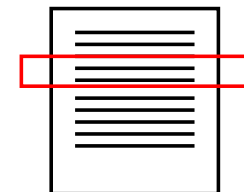
SHRDLU (Winograd, 1972): language interface for block manipulation

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



Example: Information Retrieval

Show me the proof of Cantor theorem



What is Discourse

Example by Charles Fillmore:

Please use the toilets, not the pool.

The pool for members only.

Inference in Discourse Processing

- There are several possible ways to to interpret an utterance in context
- We need to find the most likely interpretation
- Discourse model provides a computational framework for this search

Challenges

Sentences cannot be processed in isolation

- Coreference
- Ordering
- Segmentation

We need to model text and dialog structure

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

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

Cohesion

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

- Repetitions
- Synonyms
- Coreference

Discourse Exhibits Structure!

- Discourse can be partitioned 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

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.

Rhetorical Structure Theory

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

- Evidence: a claim \rightarrow information intended to increase the readers' belief in the claim
- ...

Text Grammars

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

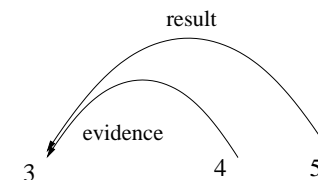
- Tale grammar (31 terminals) VPropp(1920s)
- Scientific articles: introduction, conclusions, ...

Cohesion

- | |
|--|
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Rhetorical Structure Theory

- | |
|---|
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| 4. It poured for two hours. |
| 5. I had a tent, but I got soaked anyway. |



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

Types of Discourse

- Monologue (narrative, lecture)
- Human-human dialog
- Human-machine dialogue

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

Applications

- Summarization
- Anaphora resolution
- Essay grading
- Segmentation
- Information ordering
- Dialog processing
- ...

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.

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!