Language and Computation

week 12, Tuesday, April 15

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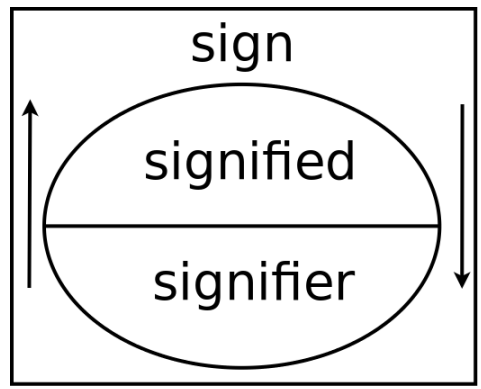
Today

- Discourse and dialogue systems
- Selected topics in computational semantics

Semantics

Semantics: the study of 'meaning'

F. de Saussure (1916): linguistic sign



signifier:	phonetics, phonology,	morphology, syntax
signified:	–	semantics

What is meaning?

- Lexical semantics: "atomic units"
- Compositional semantics:
  from atomic units to the meaning of phrases and sentences.

What is meaning?

- WE DO NOT KNOW IT!

- But let us handle it. . .
- How to do it?

Why handle meaning?

- Seemingly,
  most "ultimate" NLP tasks require access to meaning:

  machine translation, question answering, information extraction, dialogue systems, spell checking, etc.

  at least, when we think of the way humans solve these tasks.

- To improve quality of "lower level" NLP tasks:

  speech synthesis and recognition, part-of-speech tagging, morphological and syntactic parsing, etc.

How to handle meaning?

I made her duck. *Secretariat is expected to race tomorrow.*

He ate soup with a spoon / with a friend / with noodles.

- By tackling the problem:
  Create a computational model of the mental representation of the world. . . Hope to do so in the 60s, but then given up.

- By circumventing the problem:
  E.g., Probabilistic Grammars with corpus based frequencies.

- Intermediate solutions: computational semantics.

Topics in computational semantics

Lexical semantics: word sense

- Create a computational model of the mental representation of the world. . . Hope to do so in the 60s, but then given up.
- Word usage: contexts in which the word appears.
  For instance, using a feature vector $\vec{a}(w)$ for word w:
  $a_i(w)=$ whether/how often the word appears in context c_i.
- Heuristic: similar meaning if appearing in similar contexts.

Lexical semantics: word sense

Tasks related to word sense:

- WDS: **Word Sense Disambiguation**, a classic example of Machine Learning.
- WordNet: **Lexical Relations**

Lexical semantics: word sense

Bank: (1) financial institution; (2) river shore.

One lemma — two senses.

But also: (3) repository; (4) building.

- **Homonymy:** two signs (same form, different meaning).
- **Polysemy:** one sign with several, though related meanings.
- **Metonymy:** systematic relations between different aspects of a concept (e.g., building vs. organization).

Lexical semantics: word sense

- **Synonymy:** same meaning
- **Antonymy:** opposite meaning
- **Hyper[o]nymy:** superordinate meaning
- **Hyponymy:** is-a relation
- **Meronymy:** part-whole relation

WordNet: (`http://wordnet.princeton.edu/`)

Task: automatic detection of semantic relations from corpus.

Hamburger

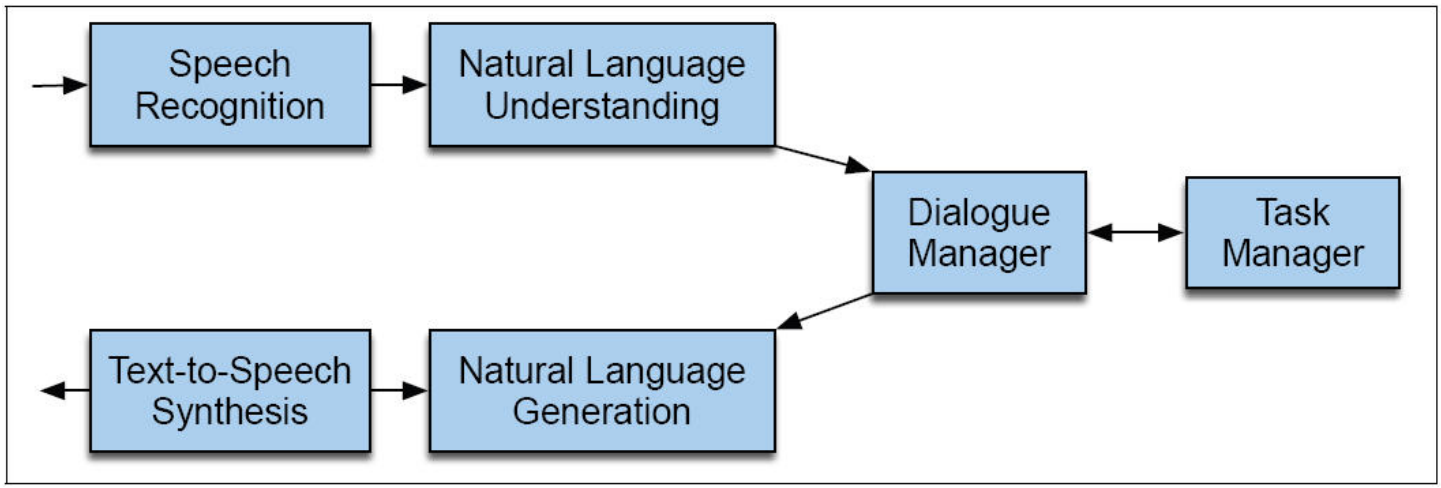
- Hamburger (an inhabitant of Hamburg)
  - direct hypernym:
    - German (a person of German nationality)
  - sister term
    - German (a person of German nationality)
      - East German (a native/inhabitant of the former GDR)
      - Bavarian (a native/inhabitant of Bavaria)
  - derivationally related form
    - Hamburg (a port city in northern Germany on the Elbe River that was founded by Chalemagne in the…)

```
dog, domestic dog, Canis familiaris
    => canine, canid
       => carnivore
          => placental, placental mammal, eutherian, euther
             => mammal
                => vertebrate, craniate
                   => chordate
                      => animal, animate being, beast, brute, c
                         => ...
```

http://en.wikipedia.org/wiki/WordNet

Computational discourse

Dialogue and Conversational Agents

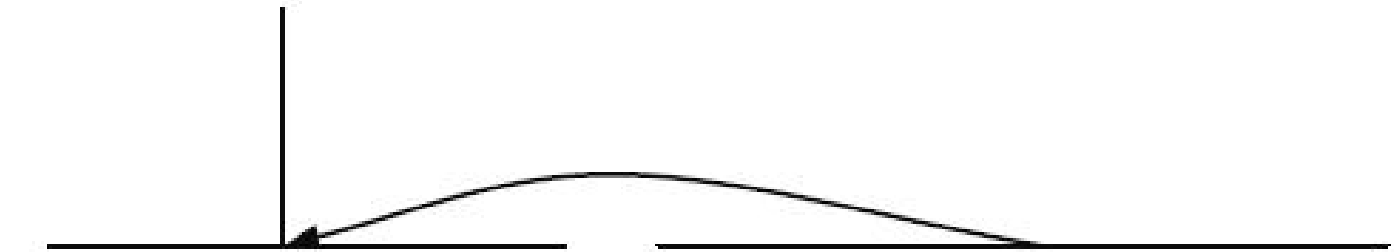


Challenges for computational discourse

Among many others. . .

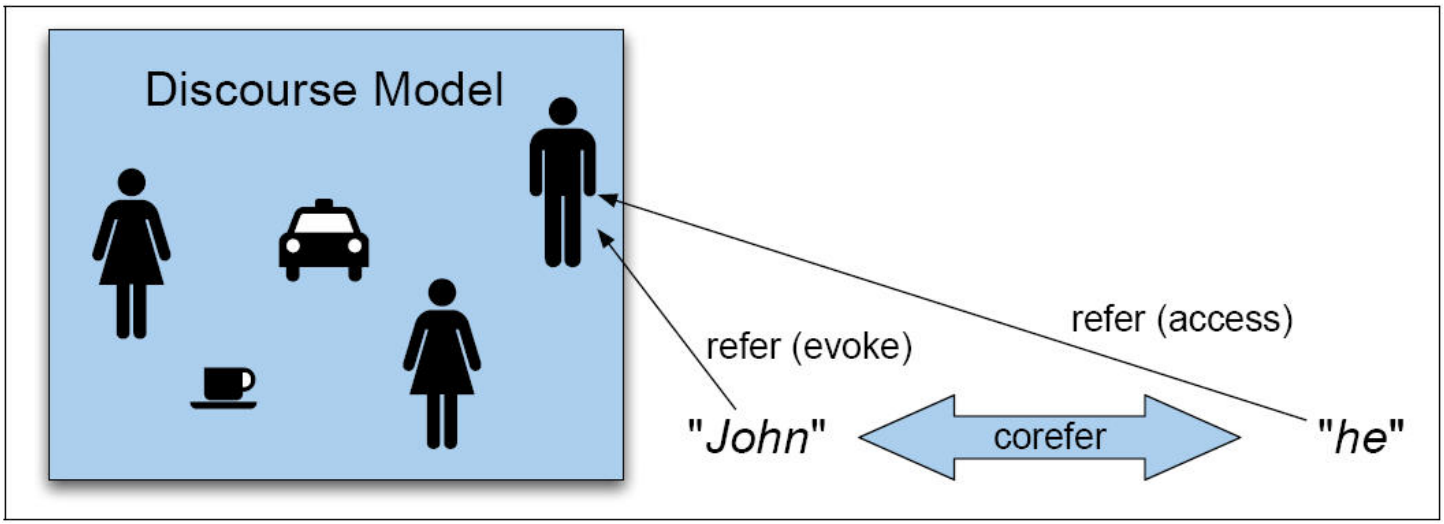
- Reference phenomena and anaphora (pronoun) resolution
- Turn-taking
- Error detection
- Detecting speech acts

Anaphora resolution



$John_i$ *is a good friend of* $Kevin_j$. $He_{i/j?}$ *loves Mary.*

Anaphora resolution



Speech acts

Locutionary act:	the utterance of a sentence with a particular meaning
Illocutionary act:	the act of asking, answering, promising, etc., in uttering a sentence
Perlocutionary act:	the (often intentional) production of certain effects upon the feelings, thoughts, or actions of the addressee in uttering a sentence

Performative sentences.

Illocutionary force: *You can't do that.*

Assertives:	committing the speaker to something's being the case (*suggesting*, *putting forward*, *swearing*, *boasting*, *concluding*)
Directives:	attempts by the speaker to get the addressee to do something (*asking*, *ordering*, *requesting*, *inviting*, *advising*, *begging*)
Commissives:	committing the speaker to some future course of action (*promising, planning, vowing, betting, opposing*)
Expressives:	expressing the psychological state of the speaker about a state of affairs (*thanking*, *apologizing*, *welcoming*, *deploring*)
Declarations:	bringing about a different state of the world by the utterance (including many of the performative examples above; *I resign*, *You're fired*)

See you on Thursday!