
Foundations of Natural Language Processing

Lecture 20a

Lexical Semantics:

Word senses, relations, and classes

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Meaning and NLP: A Concrete Goal

- We would like to build
 - a machine that answers questions in natural language.
 - may have access to knowledge bases
 - may have access to vast quantities of English text
- Called **Question Answering**
aspire to an Alexa that works!

Why is **lexical semantics** important for building such a system?

- So far, **dog** is represented as *dog(x)*
Why is this inadequate?

Semantics

- Sentential semantics: how word meanings combine (studied earlier)
 - Who did what to whom; when, how, why. . .
 - Logical inference
- Lexical semantics: the meanings of individual words
 - How denotations of words relate to one another
 - Commonsense inference
- Consider some examples to highlight problems in lexical semantics

Example Question

- Question

When was Barack Obama born?

- Text available to the machine

Barack Obama was born on August 4, 1961

- This is easy.

- just phrase a Google query properly:

- "Barack Obama was born on *"

- syntactic rules that convert questions into statements are straight-forward

Example Question (2)

- Question

What plants are native to Scotland?

- Text available to the machine

A new chemical plant was opened in Scotland.

- What is hard?

- words may have different meanings (**senses**)
- we need to be able to disambiguate between them

Example Question (3)

- Question

Where did David Cameron go on vacation?

- Text available to the machine

David Cameron spent his holiday in Cornwall

- What is hard?

- words may have the same meaning (**synonyms**)
- we need to be able to match them

Example Question (4)

- Question

Which animals love to swim?

- Text available to the machine

Polar bears love to swim in the freezing waters of the Arctic.

- What is hard?

- words can refer to a subset (**hyponym**) or superset (**hypernym**) of the concept referred to by another word
- we need to have database of such **A is-a B** relationships, called an **ontology**

Example Question (5)

- Question

What is a good way to remove wine stains?

- Text available to the machine

Salt is a great way to eliminate wine stains

- What is hard?

- words may be related in other ways, including **similarity** and **gradation**
- we need to be able to recognize these to give appropriate responses

Example Question (6)

- Question

Did Poland reduce its carbon emissions since 1989?

- Text available to the machine

Due to the collapse of the industrial sector after the end of communism in 1989, all countries in Central Europe saw a fall in carbon emissions.

Poland is a country in Central Europe.

- What is hard?

- we need to do **inference**
- a problem for sentential, as well as lexical, semantics

Summary

- Compositional semantics yields LFs that capture **logical** forms of inference.
- But NL and its use relies on **commonsense** inference too.
- Lexical semantics: where language meets world knowledge.
- So word senses can be **related**:
 - Hyponym, hypernym, antonym, synonym, meronymand these relations influence NL understanding

Next time:

- Word meanings can be **productive** and (partly) **predictable**
- How do we represent that?