Word Meaning and Similarity

Word Senses and Word Relations

Reminder: lemma and wordform

- ## A **lemma** or **citation form**
  - Same stem, part of speech, rough semantics
- ## A **wordform**
  - The "inflected" word as it appears in text

Wordform	Lemma
banks	bank
sung	sing
duermes	dormir

Lemmas have senses

- One lemma "bank" can have many meanings:

Sense 1:
- …a **bank** can hold the investments in a custodial account$_1$…

Sense 2:
- "…as agriculture burgeons on the east **bank**$_2$ the river will shrink even more"

- **Sense** (or **word sense**)
  - A discrete representation

    of an aspect of a word's meaning.

- The lemma **bank** here has two senses

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Homonymy

Homonyms: words that share a form but have unrelated, distinct meanings:

- $bank_1$: financial institution, $bank_2$: sloping land
- bat_1: club for hitting a ball, bat_2: nocturnal flying mammal

1. Homographs (bank/bank, bat/bat)
2. Homophones:
   1. Write and right
   2. Piece and peace

Homonymy causes problems for NLP applications

- Information retrieval
  - "bat care"
- Machine Translation
  - bat: murciélago (animal) or bate (for baseball)
- Text-to-Speech
  - bass (stringed instrument) vs. bass (fish)

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Polysemy

- 1. The **bank** was constructed in 1875 out of local red brick.

- 2. I withdrew the money from the **bank**

- Are those the same sense?
  - Sense 2: "A financial institution"
  - Sense 1: "The building belonging to a financial institution"

- A **polysemous** word has **related** meanings
  - Most non-rare words have multiple meanings

Metonymy or Systematic Polysemy: A systematic relationship between senses

- Lots of types of polysemy are systematic
  - `School, university, hospital`
  - All can mean the institution or the building.

- A systematic relationship:
  - Building ⬌ Organization

- Other such kinds of systematic polysemy:

Author `(Jane Austen wrote Emma)`

⬌ Works of Author `(I love Jane Austen)`

Tree `(Plums have beautiful blossoms)`

⬌ Fruit `(I ate a preserved plum)`

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How do we know when a word has more than one sense?

- The "zeugma" test: Two senses of `serve`?
  - `Which flights **serve** breakfast?`
  - `Does Lufthansa **serve** Philadelphia?`
  - ?Does Lufthansa serve breakfast and San Jose?
- Since this conjunction sounds weird,
  - we say that these are **two different senses of "serve"**
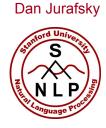
Synonyms

- Word that have the same meaning in some or all contexts.
  - filbert / hazelnut
  - couch / sofa
  - big / large
  - automobile / car
  - vomit / throw up
  - Water / H_2O

- Two lexemes are synonyms
  - if they can be substituted for each other in all situations
  - If so they have the same **propositional meaning**

Synonyms

- But there are few (or no) examples of perfect synonymy.
  - Even if many aspects of meaning are identical
  - Still may not preserve the acceptability based on notions of politeness, slang, register, genre, etc.
- Example:
  - Water/H_2O
  - Big/large
  - Brave/courageous

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Synonymy is a relation between senses rather than words

- Consider the words *big* and *large*

- Are they synonyms?
  - How **big** is that plane?
  - Would I be flying on a **large** or small plane?

- How about here:
  - Miss Nelson became a kind of **big** sister to Benjamin.
  - ?Miss Nelson became a kind of **large** sister to Benjamin.

- Why?
  - *big* has a sense that means being older, or grown up
  - *large* lacks this sense

Antonyms

- Senses that are opposites with respect to one feature of meaning

- Otherwise, they are very similar!

```
dark/light    short/long    fast/slow    rise/fall
hot/cold      up/down       in/out
```

- More formally: antonyms can
  - define a binary opposition
    or be at opposite ends of a scale
    - `long/short, fast/slow`
  - Be **reversives**:

Hyponymy and Hypernymy

- One sense is a **hyponym** of another if the first sense is more specific, denoting a subclass of the other
  - *car* is a hyponym of *vehicle*
  - *mango* is a hyponym of *fruit*
- Conversely **hypernym**/**superordinate** ("hyper is super")
  - *vehicle* is a **hypernym** of *car*
  - *fruit* is a hypernym of *mango*

Superordinate/hyper	vehicle	fruit	furniture
Subordinate/hyponym	car	mango	chair

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Hyponymy more formally

- Extensional:
  - The class denoted by the superordinate extensionally includes the class denoted by the hyponym

- Entailment:
  - A sense A is a hyponym of sense B if *being an A* entails *being a B*

- Hyponymy is usually transitive
  - (A hypo B and B hypo C entails A hypo C)

- Another name: the **IS-A hierarchy**
  - A IS-A B   (or A ISA B)
  - B **subsumes** A

Hyponyms and Instances

- WordNet has both **classes** and **instances**.
- An **instance** is an individual, a proper noun that is a unique entity
  - `San Francisco` is an **instance** of `city`
 - But `city` is a class
    - `city` is a **hyponym** of `municipality...location...`

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