The meanings of words

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Words carry different meanings: ***leave*** I

10070 *Nothing was left save a few acres of ground , and the two-hundred-year-old house , which is itself crushed under a heavy mortgage .*

10079 *The money which my mother had left was enough for all our wants , and there seemed to be no obstacle to our happiness . ”*

10085 *He had no friends at all save the wandering gipsies , and he would give these vagabonds leave to encamp upon the few acres of bramble- covered land which represent the family estate , and would accept in return the hospitality of their tents , wandering away with them sometimes for weeks on end .*

10107 *She left her room , therefore , and came into mine , where she sat for some time , chatting about her approaching wedding .*

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Words carry different meanings: ***leave*** II

10108 *At eleven o'clock she rose to leave me , but she paused at the door and looked back.*

10439 *" The rest you will leave in our hands . "*

10449 *And now , Miss Stoner , we must leave you for if Dr. Roylott returned and saw us our journey would be in vain .*

10526 *Then he turned down the lamp , and we were left in darkness .*

How many different meanings? ?

From the NTU Multilingual Corpus (*Adventure of the Speckled band*, concept lemma = *leave*)

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How can we represent the differences?

- Definitions
- Translations/paraphrases
- Semantic Relations
- Components
- Word Embeddings

Semantic Representations of Words

- Divide meaning into
  - **reference**: the relation to the world/mental space
  - **sense**: the rest of the meaning
    - **denotation** the part that distinguishes the meaning from other meanings
    - **connotation** cultural or emotional associations
- Introduce **concepts**
  - How can we represent concepts?
  - How do we learn them?
    - Typically children start off by **underextending** or **overextending** concepts
- Example: *That dog*
  - reference — the animal over there
  - sense — canine quadruped domesticated by man
  - connotation — faithful, friendly (or dirty)

Definitional Semantics

- Standard lexicographic approach to lexical semantics:

  semantics = *the study of language meaning*

  tailor = *a person whose occupation is making and altering garments*

- Definitions are conventionally made up of;
  - genus: what class the lexical item belongs to
  - differentiae: what attributes distinguish it from other members of that class
- Often hard to understand if you don't already know the meaning!

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Definitional Semantics: pros and cons

- Pros:
  - familiarity (we are taught to use dictionaries)
- Cons:
  - subjectivity in sense granularity (splitters vs. lumpers) and definition specificity
  - circularity in definitions
  - consistency, reproducibility, …
  - often focus on diachronic (historical) rather than synchronic (current) semantics

Entries for ***leave*** I

02015598-v (72) V1, V2 ***get out, go out, leave, exit*** "move out of or depart from"

02356230-v (8) V3 ***leave, entrust*** "put into the care or protection of someone"

02009433-v (149) V1 ***leave, go away, go forth*** "go away from a place"

02229055-v (7) V3 ***leave, will, bequeath*** "leave or give by will after one's death"

02729414-v (56) V2 ***leave*** "act or be so as to become in a specified state"

02730135-v (5) V2 ***leave*** "have left or have as a remainder"

06690114-n (1) ***leave*** "permission to do something"

Not to be confused with *left hand* and *the leaves fell*, ...

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Paraphrases and translation

- Saying the same thing in different words
  - Same language = **paraphrase**
  - Different language = **translation**
- We showed some paraphrases in the entries given above
- If you speak another language, then you can use that to disambiguate may things.
  - ***leave, entrust*** = 預ける *azukeru*
  - ***get out, go out, leave, exit*** = 去る *saru*
  - ***leave, will, bequeath*** = 遺す *nokosu*

Can you explain the ambiguity in *The money which my mother had left was enough for all our wants*?

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Lexical Semantics

- Lexical semantics is concerned with the identification and representation of the semantics of lexical items
- But a given word can have multiple interpretations
  - **Polysemy**: having multiple meanings
  - **Monosemy**: having only one meaning
- **Homonyms** are words with two unrelated meanings:
  - **homographs**: same spelling
    bow vs *bow*; *keep* vs *keep*
  - **homophones**: same pronunciation
    right vs *write*; *keep* vs *keep*

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Distinguishing Polysemes

- **Antagonism**: can the word be used in a sentence with multiple competing interpretations that are incompatible?

  Kim can't bear children
  - Cannot have children
  - Doesn't like children

- **Zeugma**: can the word be used in a context where multiple competing interpretations are simultaneously evoked?

  Kim and her visa expired
  - died
  - ran out

  Hitmen were quite expensive, so she decided to take out a loan and her husband. ?

- **Paraphrase/Translation**: Is there more than one (clearly different) way to paraphrase/translate the word.

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Necessary and Sufficient Conditions

- Can we define words in terms of **conditions**?
  - ***zebra***
    - quadruped
    - animal **redundant**
    - black and white striped
    - herbivore
- These are **intrinsic**, **generic** properties
  - An albino zebra with three legs is still a zebra
- Can we use words even if we don't know their properties?
  - ***Kway Teow***
- We seem to be ok with fairly vague definitions

  - What is a ***dog-cart***?
  - What is a ***grass snake***?
  - What is a ***swamp adder***?

Words/Concepts are related in many ways

We can also look at words (or more properly senses) in terms of their relations to other words.

- **Hyponymy/Hypernymy**
- **Synonymy**
- **Antonymy** (Opposites)
- **Meronymy**
  - **Member-Collection**
  - **Portion-Mass**
  - **Element-Substance**
- **Domain** (lexical field)

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Hypernymy and Hyponymy

- **Hyponymy**: X is a hyponym
  of Y iff $f(X)$ entails $f(Y)$ but $f(Y)$ does not entail $f(X)$ (for all or most f):
  Kim has a pet dog $\models$ *Kim has a pet animal*
  Kim has a pet animal $\not\models$ *Kim has a pet dog*

  N.B. complications with universal quantifiers and negation:
  Kim likes all animals $\models$ *Kim likes all dogs*
  Kim likes all dogs $\not\models$ *Kim likes all animals*

- **Hypernymy**: Y is a hypernym of X iff X is a hyponym of Y
- Can a word have multiple hypernyms?

  (1) ***tank***$_1$ $\subset$ ***military_vehicle***$_1$; $\subset$ ***tracked_vehicle***$_1$; $\subset$ ***armored_vehicle***$_1$; ? $\subset$ ***weapon***$_1$

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What is **entailment**

Entailment *(⊨): A sentence p entails a sentence q when the truth of the first (p) guarantees the truth of the second (q), and the falsity of the second (q) guarantees the falsity of the first (p).*

Properties of hypernymy/hyponymy

- Asymmetric; applies at the sense level
- applies only to lexical items of the same word class
- Transitive: ***dog***$_1$ $\subset$ ***mammal***$_1$ $\subset$ ***animal***$_1$

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Not everything is lexicalized

Lexicalization is the process by which new words, having gained widespread usage, enter the lexicon.

neutral (Hyper)	male	female	child
sheep	***ram***	***ewe***	***lamb***
cow	***bull***	***cow***	***calf***
goose	***gander***	***goose***	***gosling***
horse	***stallion***	***mare***	***foal:colt/filly***
dog	***dog***	***bitch***	***puppy***
snake			

snake is not ambiguous it is **vague**: the meaning is underspecified.

Can you do this for ***pig***, ***cat*** or ***chicken***?

Can you give an example of this in another language?

Language Change and Auto-hyponyms I

- The meanings of words change over time
  - ***guitar*** — “a stringed instrument usually having six strings”: originally these all used the body to make sound
  - We then get ***electric guitar*** — “a guitar with a built-in pickup or pickups which convert string vibrations into electrical signals for amplification”
  - To refer to non-electric guitars we get a new coining ***acoustic guitar*** – “a guitar that does not require electrical amplification”: which used to just be guitar
- ***guitar*** is now a hypernym of them both and can refer to either
- we can also refer to the prototypical guitar (acoustic) using reduplication
  What kind of guitar do you play? Guitar guitar

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Language Change and Auto-hyponyms II

- Sometimes this practice becomes politically charged, although linguistically it is unremarkable
  - ***woman*** “an adult female person”
  - ***trans woman*** “a person who identifies as a woman but was assigned male at birth”
  - ***cis woman*** “a person who identifies as a woman and was assigned female at birth”

Can you give other examples of this in English or other languages?

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Synonymy

- **Propositional synonymy**: X is a propositional synonym of Y if
  - (i) X and Y are syntactically identical,
  - (ii) substitution of Y for X in a declarative sentence doesn't change its truth conditions

  e.g., ***violin*** and ***fiddle***
- Why propositional synonymy is over-restrictive:
  - syntactic identity (cf. ***eat*** and ***devour***)
  - collocations (cf. ***cemetery*** and ***graveyard***)
  - gradability (cf. ***sofa***/***settee*** vs. ***boundary/frontier***)

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Near Synonymy

- Near synonyms are substitutable in **some/most** rather than **all** contexts
- Synonymy via semantics: synonyms share "common traits" or attributional overlap, walking the fine line between "necessary resemblances" and "permissible differences":

  grain *vs.* ***granule***; ***green*** *vs.* ***purple***; ***alsation*** *vs.* ***spaniel***

- Permissible differentiation via **clarification**.

  Here is a grain, or granule, of the substance.

  ** The cover is green, {or, that is to say} purple.*

  ** He likes alsations, in other words, spaniels*

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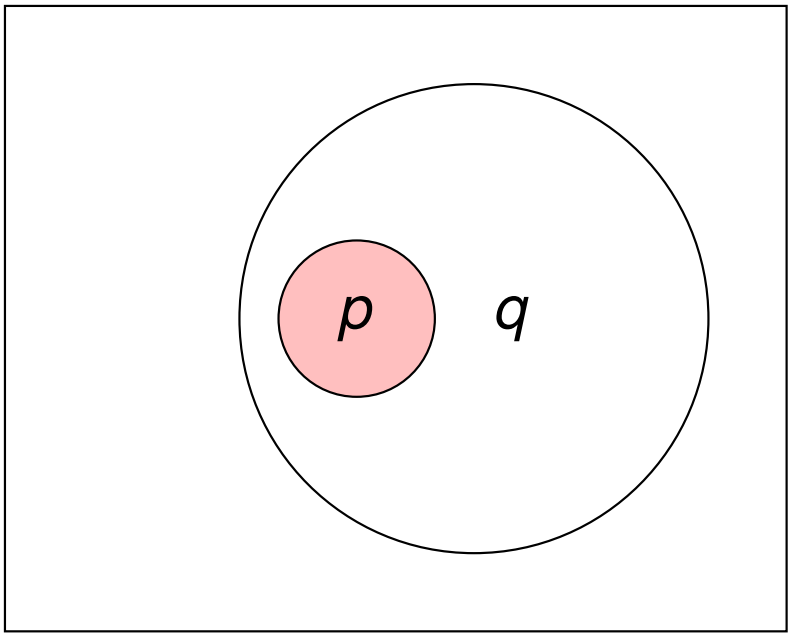
Properties of synonymy

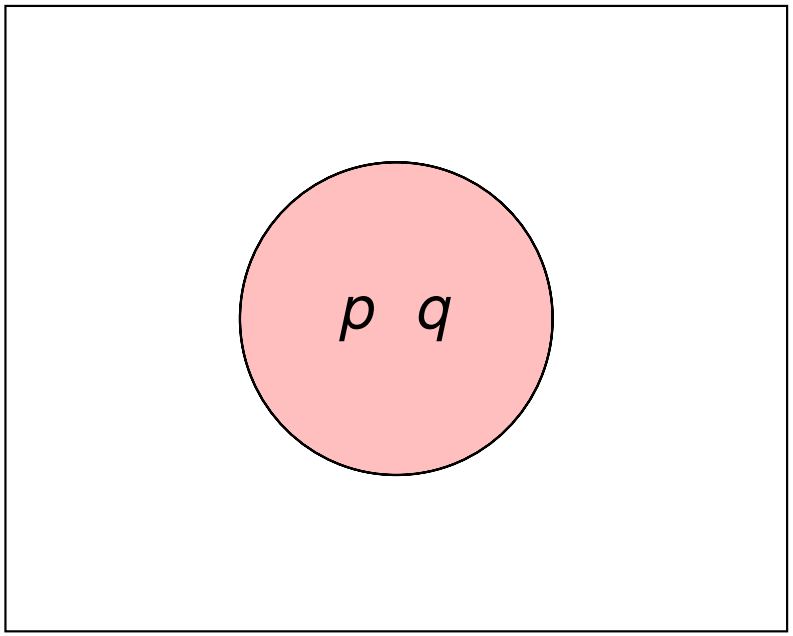
- Symmetric
- traditionally applies only to lexical items of the same word class but pairs like ***can*** vs ***be able to*** suggest otherwise
- applied at the sense level
- $\approx$ converse of polysemy

Semantic Relations as Sets ($p \subset q$ and $p \sim q$)

$p \subset q$ **hypernym**



$p \sim q$ **synonym**



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Antonymy (opposites) I

- **Simple antonyms**: the negative of one implies the positive of the other.

  (2) *dead/alive*

  (3) *pass/fail*

- **Gradable Antonyms**: points along a scale

  (4) *boiling/hot/warm/tepid/cool/cold/freezing*

  (5) *fascinating/interesting/dull/boring*

- **Reverses**: reverse the direction of a motion

  (6) *ascend/descend*

  (7) *up/down; right/left*

Antonymy (opposites) II

- **Converses**: the same act from different points of view

  (8) *above/below; right/left*

  (9) *employer/employee*

  (Slightly non-standard usage by Saeed)

- **Taxonomic Sisters**: children of the same (grand)parent

  (10) *Monday/Tuesday/…/Sunday*
  in WordNet: ***day of the week*** $\supset$ ***weekday***, ***weekend***

  (11) *LMS/English/Chinese/…*
  Context dependent

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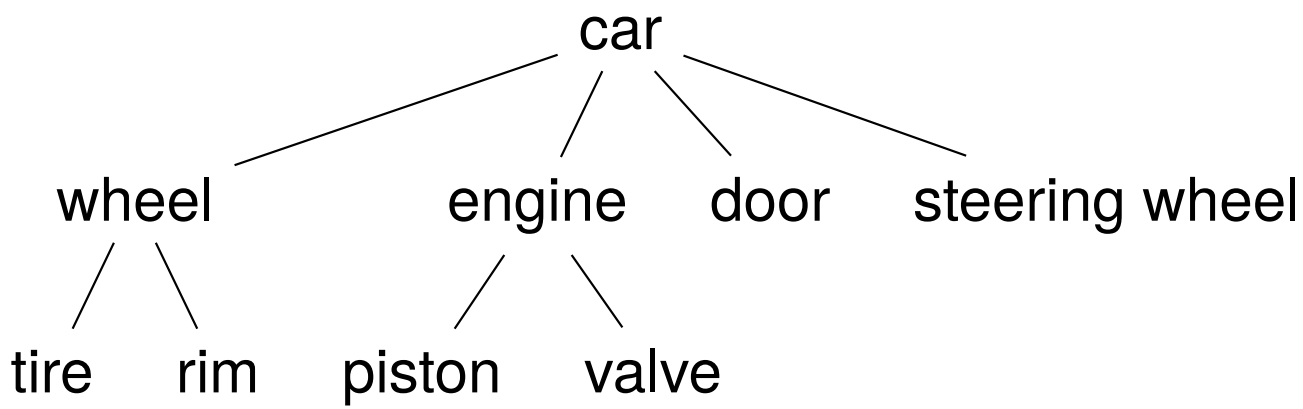
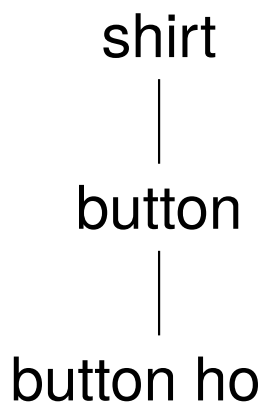
Meronymy

- **Meronomy** refers to the part-whole relation
  - **meronym** is the part
  - **holonym** is the whole



- It is not always transitive:



We don't normally say that a ***button hole*** is part of a ***shirt***.

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Member-Collection

- The relation between a collection and one of the units that makes it up

(12) *tree–forest*

(13) *sheep–flock*

(14) *fish–school*

(15) *book–library*

(16) *member–band*

(17) *musician–orchestra*

(18) *student–class*

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Portion-Mass

- The relation between a mass noun and a typical unit of measurement

  (19) *drop–liquid*

  (20) *grain–sand/salt/truth*

  (21) *sheet/ream–paper*

  (22) *lump–coal (or just about anything)*

  (23) *strand–hair*

  (24) *rasher–bacon*

- Similar to classifiers in many ways, e.g. in Malay

  (25) *ekor* “tail”–*animal*

  (26) *orang* “human”–*person*

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Domain (lexical field)

The domain in which a word is typically used with this meaning.

(27) ***driver***$_1$ — the operator of a motor vehicle

(28) ***driver***$_2$ — someone who drives animals that pull a vehicle

(29) ***driver***$_3$ — a golfer who hits the golf ball with a driver [**golf**]

(30) ***driver***$_4$ — ($\simeq$ device driver) a program that determines how a computer will communicate with a peripheral device [**computer science**]

(31) ***driver***$_5$ — ($\simeq$ number one wood) a golf club (a wood) with a near vertical face that is used for hitting long shots from the tee [**golf**]

Some **golf** terms: ***approach***$_9$, ***approach shot***$_1$, ***golf course***$_1$, ***links course***$_1$, ***wedge***$_5$, ***tee***$_1$, ***scratch***$_9$, ***putt***$_1$, ***slice***$_1$, ***hook***$_1$

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And More

- There are many, many more lexical relations advocated by various theories including:
  - Troponymy/hypernymy (cf. *walk* vs. *lollop*) “way of doing something”
  - Entailment (cf. *snore* vs. *sleep*) “if you do one thing, you must be doing the other”
  - Operator (cf. *question* vs. *ask*) “the thing you do by doing something”
  - Magnifier (cf. *wound* vs. *badly*) “intensifier, diminisher”
  - Usage (cf. *strong-willed* vs. *pig-headed* “stubborn”)
    pig-headed is **pejorative**

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Derivational Relations

- Often words are linked by more or less systematic relations, sometimes morphologically marked
  - ***beauty*/*beautiful*/*beautify***
  - ***cute*/*cuteness***

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Agentive Nouns

- An **agentive noun** is a word that is typically derived from another word denoting an action, and that identifies an entity that does that action.
  verb + ***-er, -or, -ant***

  (32) ***murderer, commentator, whaler, director, computer***

  (33) ?? ***undertaker, cooker, footballer*** (Saeed also includes these)

- Should ***murderer*** be listed separately from ***murder*** in the dictionary? Why or why not?
- Also **recipient noun**s that show the undergoer: **verb** + ***-ee***: ***employee***, ***trustee***

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Agentive Nouns in Other Languages

- Japanese (suffix distinguishes person/machine)
  - 運転する → 運転者 *unten-sha* “driver”
  - 計算する → 計算者 計算機 *keisan-sha/ki* “computer”
  - 研究する → 研究者 研究員 *kenkyuu-sha/in* “researcher”
  - 読む → 読み手 読者 *yomite/dokusha* “reader”
- Malay (prefix can convert any part of speech)
  - *bantu (v)* “help” → *pembantu* “assistant/helper”
  - *potong (v)* “cut” → *pemotong* “cutter (human/machine)”
  - *terbang (v)* “fly” → *penerbang* “pilot (not passenger)”

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WordNet

- WordNet is an open-source electronic lexical database of English, developed at Princeton University
  http://wordnet.princeton.edu/
- Made up of four separate semantic nets, for each of nouns, verbs, adjectives and adverbs
- WordNets exist for many languages, my group has worked on:
  - Japanese
  - Bahasa Malay/Indonesian
  - Chinese (Mandarin and Cantonese)
  - The shared open multi-lingual wordnet (150+ languages)
    https://omwn.org/
  - Kristang
  - Myanmar
  - Czech

Wordnet Structure

- Lexical items are categorised into ∼115K (and counting) glossed **synsets** (= synonym sets)
- Lexical relations at either the synset level or sense (= combination of lexical item and synset) level
- Strongly lexicalist (originally):
  - synsets only where words exist
  - but many multiword expressions ($\approx 50\%$)

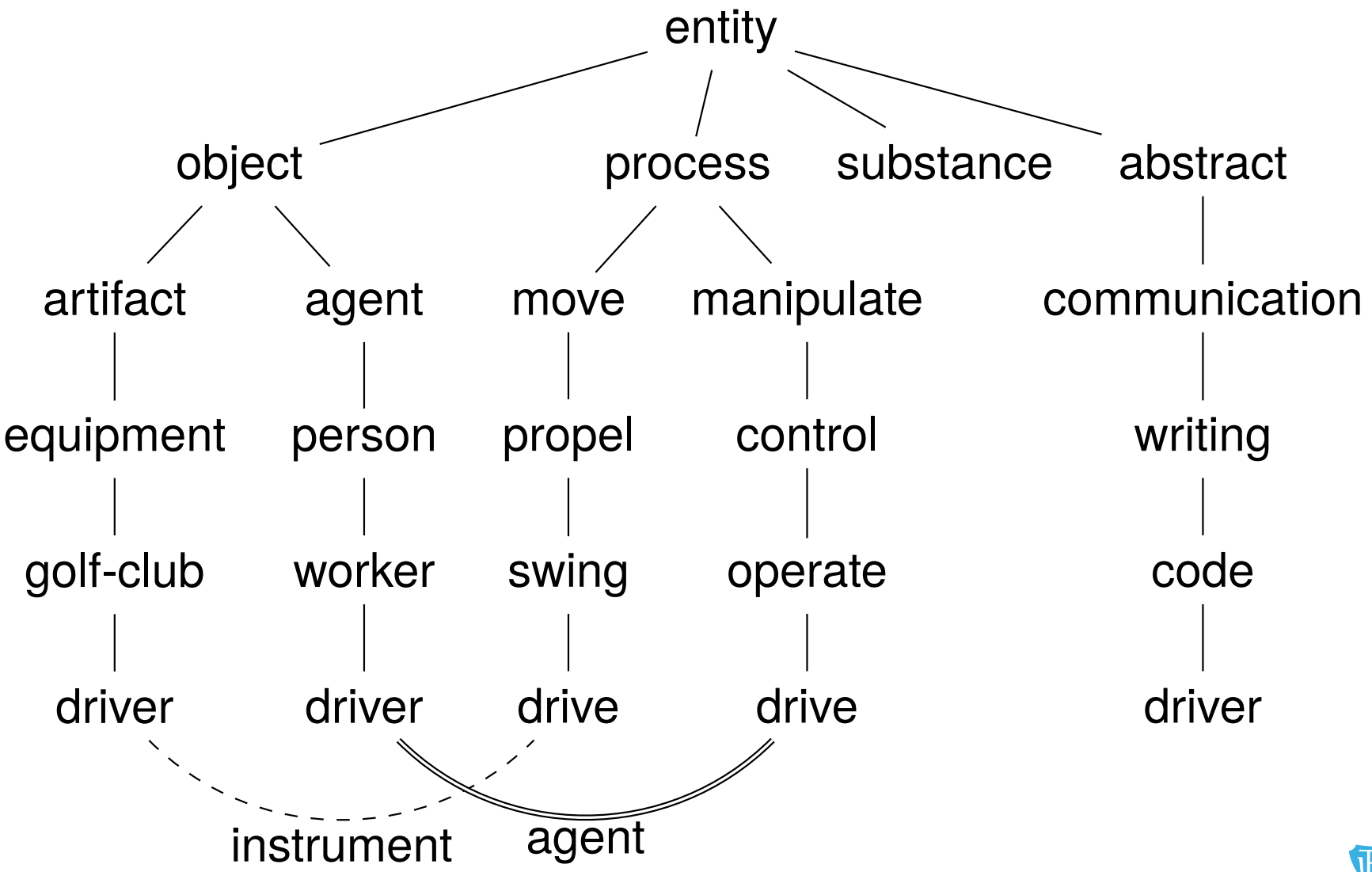
Psycholinguistic Foundations of WordNet

- Strong foundation on hypo/hypernymy (lexical inheritance) based on
  - response times to sentences such as:

    a canary {can sing/fly,has skin}
    a bird {can sing/fly,has skin}
    an animal {can sing/fly,has skin}
  - analysis of anaphora:

    I gave Kim a novel but the {book,?product,...} bored her
    Kim got a new car. It has shiny {wheels,?wheel nuts,...}
  - selectional restrictions
- Is now often used to calculate **semantic similarity**
  - The shorter the path between two synsets the more similar they are
  - Or the shorter the path to the nearest shared hypernym, …

Word Meaning as a Graph



Wordnet in this course

- We will use wordnet to test our skills in determining word meaning
  - tag a short text from this year's story or stories
  - discuss differences with other annotators
- As well as a source of examples and inspiration
- my students have used wordnets for:
  - Japanese derivational relations (Bond and Wei, 2019)
  - pronoun representation for Japanese, Mandarin and English (Seah and Bond, 2014)
  - exclamatives and classifiers (Mok et al., 2012; Morgado da Costa and Bond, 2016)
  - sentiment analysis (Le et al., 2016; Bond et al., 2019)
  - cross-lingual sense annotation (Bonansinga and Bond, 2016)
  - multilingual crosswords (Tan, 2012)

  ...

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Close Reading

- Reading (and often re-reading) a text to uncover multiple aspects of meaning that lead you to understand a text better
- Looking at what the text actually says, as well as the inferences you make from reading it
- After a close reading you should be able to support your conclusions with specific examples from the text
- You can consider many aspects of the text, such as
  - The Title
  - Word Choice
  - The Tone and Style
  - Discerning Patterns
  - Point of View and Characterization
  - Symbolism

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Word Choice and Diction

- What word(s) stand out? Why? (typically vivid words, unusual choices, or a contrast to what a reader expects)
- How do particular words get us to look at characters or events in a particular way? Do they evoke an emotion?
- Did the author use nonstandard language or words in another language? Why? What is the effect?
- Are there any words that could have more than one meaning? Why might the author have played with language in this way?
- Do some words have extra connotations?

Word Sense Disambiguation

- Knowing what individual words mean is the first step towards understanding
- For the assignment, we will try to identify the **sense** of words
  - We use Wordnet (Fellbaum, 1998) as the sense inventory because it contains semantic relations as well as definitions and it is accessible: there are good interfaces to it
  - For every word we chose the most appropriate sense in wordnet or write a comment if we think there isn't one
  - Once we have identified a sense, it is then easy to look at synonyms and other closely related words
  - For Czech we use the Czech wordnet (Pala and Smrž, 2004)
  - Both wordnets have been extended as part of the the Natural Text Understanding — Multilingual Corpus (**ntu-mc**)

WSD: A challenging task! I

This is difficult for many reasons

- Meaning boundaries are not clear: the sense distinctions impose a structure on something that is actually fuzzy
- Dictionaries are imperfect
  - senses may be missing
  - senses may be too fine-grained
- Processing a text by computer is difficult
  - The computer may have misinterpreted
    - the part-of-speech
      Does that go “Female deer which go” “Is it the case that is goes?”
      The speckled band “the band that is speckled” “the band that someone speckled”
    - Or the sentence boundaries
    - Or the words boundaries
- People use language idiosyncratically
  - extending meanings metaphorically
  - sometimes so strangely that we might even say wrongly

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WSD: not impossible

- Typically people agree around 72.5% of the time (Snyder and Palmer, 2004).
  - Verbs are hardest (67.8%), then nouns (74.9%) and adjectives (78.5%)
  - Disagreements tend to cluster around a relatively small group of difficult words.
  - For example ***national***
    - In six out of seven instances one annotator chose “limited to or in the interests of a particular nation” and the other annotator chose “concerned with or applicable to or belonging to an entire nation or country”
    - They are hard to distinguish!

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Assignment I

1. Identify and annotate word meaning for your own passage of one of the stories using wordnet as the sense inventory: 2-4 people do the same set of sentences.
   - For every word that needs to be tagged, either
     - Chose a sense in wordnet
     - Identify it as a named entity
     - Identify a problem in the corpus or wordnet
       and leave a comment saying what the it should be
   - Do this on your own — the goal is to think about the words' meanings

Assignment II

2 Compare and contrast your annotations with other annotators; re-annotate based on your discussion and leave comments for at least five words.
   - We expect you to disagree 30-40% of the time (more often than experts)
   - Sometimes you will have made a careless mistake
   - Sometimes you will have interpreted wordnet differently
   - Sometimes you will have interpreted the passage differently
   - Discussing meaning deepens your understanding of it

Details online: I will give a demo

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Conclusions

- We learned a little about word meaning, wordnet, close reading and your assignment
- This is covered in more detail in Saeed (2009, Chapter 3) and Kroeger (2022, Chapter 6 and 7)

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