SEMANATICS: (P)REVIEW
Strategies for excelling

• Do the readings (not just once!)
• At least take a stab at the exercises (even those not required)
• Do become familiar with the terminology.
• Don't get frustrated with:
  • contradictions
  • ambiguity
  • unsolved questions
• Try applying concepts to other language(s) you know
Semantic analysis skills (1)

1) Understanding the conceptual foundations of semantic theory, and the principles and formalisms of particular theories.

2) The skills of doing semantic analysis: experience at doing analysis, knowing what kinds of things to expect, and various rules of thumb, heuristics, and other tricks of the trade.
Semantic analysis skills (2)

3) The skills necessary for constructing arguments that support your analysis as opposed to other analyses.

4) The skills necessary for presenting your analysis, and the arguments for it, in the most transparent fashion possible, so that the reader will see immediately the structure of both without any need for exegesis, and with a minimum likelihood of misinterpretation.
What do semanticists do?

- Abstract theory: contrast, evaluate (top-down)
- Data analysis: collect, sift, categorize, contrast (bottom-up)
- Usually combined
- Hypothesis testing: facts $\rightarrow$ new sentences $\rightarrow$ informant
- Applications: AI, advertising, communications, knowledge engineering, web applications, robotics, machine reading, etc.
Example applications

• Anaphor
  • John walked the dog to a store. It barked.

• Lexical disambiguation
  • I saw a cat doze up the neighbor’s lot.

• Ellipsis recovery
  • John loves his mother and Jane does too.

• Modality interpretation
  • Fred may not come to my party.

• Coreference
  • He wants to win.
Sample job ad

Subject: English; Semantics; Syntax: Project Manager, Google, California, USA
University or Organization: Google
Job Location: California, USA
Job Title: Analytic Linguistic Project Manager [English] Job Rank: Manager

Specialty Areas: Semantics; Syntax

Required Language(s): English (eng)

Job description: The role of the Analytic Linguistic Project Manager is to consult with Natural Language Understanding Researchers on creating guidelines and setting standards for a variety of NLP projects as well as to manage the work of a team of junior linguists to achieve high quality data output.

Work will be done from Google’s office in Mountain View, CA.

The tasks include:
- Training, managing and overseeing the work of a team of junior linguists
- Creating guidelines for semantic, syntactic and morphological projects
- Evaluating and analyzing data quality
- Consulting with researchers and engineers on the development of linguistic databases

Job requirements:
- Native-level speaker of English
- Master's degree or higher in Linguistics or Computational Linguistics with experience in semantics and syntax
- Ability to quickly grasp technical concepts; should have an interest in natural language processing
- Excellent oral and written communication skills
- Good organizational skills
- Previous project management and people management experience
- Some programming language or previous experience working in a Linux environment is a plus

Project duration: 12 months (with potential for extension) This is a fixed-term contract, not a permanent position.
Basic premises

• Mind is innately structured
• Mind is modular: subparts, particular functions, domains
• Language module exists
• Lang acquisition is central puzzle (learnability, innateness, universal grammar)
• Knowledge of language is modular (phonology, morphology, syntax, semantics)
Basic assumptions

- Semantics is a formal system (isolatable, describable, autonomous)
- Syntax, semantics are different modules
- They are (somehow) related
  - Knowing about one helps knowing about another
  - Semantics is interpretable from syntax
- They involve divergent representations
- Both are necessary for a thorough treatment of language

- Other areas also have some bearing on semantics
  - Phonology, morphology, syntax, pragmatics
Philosophy and semantics

• Philosophical methods for describing entities, relations, events, tense, aspect

• Formal semantics: using tools (logic, inferencing) to prove meaning in a formalized, model-theoretic manner
  • Explores structural properties, compositionality, interfaces with other aspects of language
  • Derives from math, theorem proving, computation systems
  • Widely used in current semantics work
Morphology review

- Morphemes
- Morpheme types
- Morphemes and semantic functions
- Parts of speech
- (Mental) lexicon
Syntax review

- Phrases, phrase types
- Clauses, clause types
- Sentences, sentence types
- Constituency
- Heads
- Modification
- Morphosyntax
- X-bar structure
- Diagramming sentences
- Grammaticality
Clause types (cont.)

- Tensed: has a tensed verb
  - *The dog barked.*
- Untensed: doesn’t have a tensed verb (i.e. it has instead a participle or an infinitive)
  - *Being a farmer,* he has to get up early.
  - *Using a big axe,* he cleared the underbrush.
  - He stared at his feet, *too ashamed to reply.*
Relative clauses

- **Subject**: a relative clause that modifies a subject
  - The child who ___ lost the scooter was sad.
  - The dog I heard ___ ___ barking ran away.
  - Anyone who ___ bets on horses deserves to lose money.
- **Object relative**: a relative clause that modifies an object
  - Direct object:
    - I sold *the book [that you gave me ___].*
  - Indirect object:
    - I told *the man [who ___ laughed at you] to stop.*
- **Restrictive**: BYU students who study hard succeed.
- **Nonrestrictive**: BYU students, who study hard, succeed.
Subcategorization

- What types of complements a word requires/allows/forbids
  - vanish: \( \varnothing \)  The book vanished ____.
  - prove: NP  He proved the theorem.
  - spare: NP NP
  - send: NP PP
  - proof: CP
  - curious: PP or CP
  - toward: NP

- Valence, arity, argument structure, frame, adicity
Indices for coreference

• John$_i$ saw him$_j$.
• John$_i$ saw himself$_i$.

• John$_i$ saw him$^*_i/j$.

• John$_i$’s father$_j$ saw him$_i$. 
Semantics review

- Lexical semantics, relations
- Thematicity
- Semantic constituency (entities, properties, predicates, valence)
- Semantic types/features
- Semantic relations (implication, entailment, presupposition, modality, etc.)
- Ambiguity
Argument structure

• How many arguments a given predicate takes/requires
• Zero-place predicates: rains, thundered, snowing
• One-place predicates: intransitives
  • One external argument
• Two-place predicates: transitives
  • One external argument, one internal argument
• Three-place predicates: ditransitives
  • One external argument, two internal arguments
Basic theta-role concepts

• Theta criterion
• Relationship with grammar
  • The syntax/semantics interface (mapping)
  • Often direct, sometimes more transparent
• Ambiguity
  • The witch made the prince a frog.
  • The ducks floated down the river.
  • The anthrax was found by the robot.
  • I smelled the roses.
Sample event types

- Stative events: internally uniform, no internal dynamics (e.g. I am hungry.)
- Nonstatives (acts): heterogeneous, componential, dynamic (e.g. He ate potato chips.)
- Inchoatives: denote interval between two intervals (e.g. She became a lawyer.)
- Resultatives: complex event: act + change-of-state (e.g. They got married last week.)
- Ambiguities
  - This shrimp digests easily. (inchoative middle, resultative active)
Salient semantic features

- TAM
  - Tense
  - Aspect
  - Mood
- Modality
- Voice
- Transitivity
Meaning and literality

• Literal meaning
  • Representation of states of affairs in the world
  • Decontextualized as much as possible
  • Objective, focused, structured

• Implicational meaning
  • What the speaker intended or what the hearer’s expected response is
  • Context is crucial to interpretation
  • Negotiable, subjective, variable
Non-literal meaning

• Hyperbole/litotes
• Idioms
• Metaphor
• Pervarication

• Connotation
• Emotion
What type of meaning?

- I am firm.
  You are obstinate.
  He is a pig-headed fool.
- This piece of chalk is white.
- My opinion is that he should resign.
- You are full of baloney.
Selectional restrictions

• Close synonymy
  • Small/little
    I have little/*small money.
    This is Fred, my big/*large brother.

• Animacy
  • My neighbor admires my garden.
    *My car admires my garden.
  • Bill frightened his dog/*hacksaw.

• Implicit objects in English: I ate.
Basic referent categories

- Individuals, entities: NP’s, proper nouns
- Sets: groups, collections, kinds
- Properties: attributes, specificity, genericity
- Predicates: mechanism for describing properties, states, events
- Propositions: predicated assertions
Ambiguity

• Different types of lexical ambiguity
  • Polysemy: 2+ related senses (bright, deposit)
  • Homonymy: 2+ unrelated senses (bat, file)
• Won’t address other kinds today
• Lexical ambiguity is rampant in English
  • Average # senses: 4.74 for nouns, 8.63 for verbs
  • Many words overlap both categories
• Lexical ambiguity is: dangerous? helpful? immaterial?
  • Contributes to language processing difficulty, complexity
  • Contributes to vagueness, underspecification
Writing/editing headlines

• Iraqi head seeks arms
• William Kelly was fed secretary
• Police begin push to run down jaywalkers
• Dealers will hear car talk at noon
• Red tape holds up new bridges
• Kids make nutritious snacks
• Lansing residents can drop off trees
• Farmer Bill Dies in House
Humor

"FRESH GROUND THIS MORNING? NO WONDER IT TASTES LIKE MUD!"
Pragmatics review

- The real world
- Language use
- Conversation, discourse, narrative
- Speech acts
- Gricean maxims
- Deixis
WordNet: a valuable tool

• Large-scale English lexical database
  • Coverage: > 152,000 words
  • Many, many lexical relations (paradigmatic, syncategorematic, frequency-ranked)
  • Subcategorization information
  • Definitions, glosses, usage examples
• Machine-readable, widely used in various fields of linguistics
• Free, web-enabled, downloadable
• Developed by Princeton’s CogSci lab
### 45 WordNet semantic classes

#### 26 Noun classes
- (noun.Tops)
- noun.act
- noun.animal
- noun.artifact
- noun.attribute
- noun.body
- noun.cognition
- noun.communication
- noun.event
- noun.feeling
- noun.food
- noun.location
- noun.group
- noun.motive
- noun.object
- noun.person
- noun.phenomenon
- noun.plant
- noun.possession
- noun.process
- noun.quantity
- noun.relation
- noun.shape
- noun.state
- noun.substance
- noun.time

#### 15 Verb classes
- verb.body
- verb.change
- verb.cognition
- verb.communication
- verb.competition
- verb.consumption
- verb.contact
- verb.creation
- verb.emotion
- verb.motion
- verb.perception
- verb.possession
- verb.social
- verb.stative
- verb.weather
Semantic ambiguity

- More than one meaning possible for: word/phrase/clause/sentence/utterance
- Lexically, morphologically, syntactically invariant
- Everyone loves somebody.

A ➔ Mary
B ➔ Fred
C ➔ Mark
D ➔ Pat

A ➔ Fred
B ➔ Fred
C ➔ Fred
D ➔ Fred
E ➔ Fred
Sample WordNet output

- The noun "dog" has 6 senses in WordNet.
  1. dog, domestic dog, Canis familiaris that has been domesticated by man since prehistoric times;
  2. frump, dog — (a dull unattractive unpleasant girl or woman; "she got a reputation as a frump"; "she's a real dog")
  3. dog — (informal term for a man; "you lucky dog")
  4. cad, bounder, blackguard, dog, hound, heel — (someone who is morally reprehensible; "you dirty dog")
  5. pawl, detent, click, dog — (a hinged catch that fits into a notch of a ratchet to move a wheel forward or prevent it from moving backward)
  6. andiron, firedog, dog, dogiron — (metal supports for logs in a fireplace; "the andirons were too hot to touch")

- The verb "dog" has 1 sense in WordNet.
  1. chase, chase after, trail, tail, tag, dog, go after, track — (go after with the intent to catch)
Hierarchical relationships

dog, domestic dog, Canis familiaris -- (a member of the genus Canis (probably descended from the common wolf) that has been domesticated by man since prehistoric times; occurs in many breeds; "the dog

=> canine, canid -- (any of various fissiped mammals with nonretractile claws and typically long muzzl

=> carnivore -- (terrestrial or aquatic flesh-eating mammal; terrestrial carnivores have four or five clawed digits on each limb)

=> placental, placental mammal, eutherian, eutherian mammal -- (mammals having a placenta; all mammals except monotremes and marsupials)

=> mammal -- (any warm-blooded vertebrate having the skin more or less covered with hair; young are born alive except for the small subclass of monotremes)

=> vertebrate, craniate -- (animals having a bony or cartilaginous skeleton with a segmented spinal column and a large brain enclosed in a skull or cranium)

=> chordate -- (any animal of the phylum Chordata having a notochord or spinal column)

=> animal, animate being, beast, brute, creature, fauna -- (a living organism characterized by voluntary movement)

=> organism, being -- (a living thing that has (or can develop) the ability to act or function independently)

=> living thing, animate thing -- (a living (or once living) entity)

=> object, physical object -- (a tangible and visible entity; an entity that can cast a shadow; "it was full of rackets, balls and other objects")

=> entity, physical thing -- (that which is perceived or known or inferred to have its own physical existence (living or nonliving)
Hierarchical relationships

Sense 4
cad, bounder, blackguard, dog, hound, heel -- (someone who is morally reprehensible)
  => villain, scoundrel -- (a wicked or evil person; someone who does evil deliberately)
  => unwelcome person, persona non grata -- (a person who for some reason is not wanted or welcome)
  => person, individual, someone, somebody, mortal, human, soul -- (a human being)
    => organism, being -- (a living thing that has (or can develop) the ability to act or function independently)
      => living thing, animate thing -- (a living (or once living) entity)
        => object, physical object -- (a tangible and visible entity; an entity that can cast a shadow)
          => entity -- (that which is perceived or known or inferred to have its own distinct existence (living or nonliving))
          => causal agent, cause, causal agency -- (any entity that causes events to happen)
            => entity -- (that which is perceived or known or inferred to have its own distinct existence (living or nonliving))

Sense 5
frank, frankfurter, hotdog, hot dog, dog, wiener, wienerwurst, weenie -- (a smooth-textured sausage of minced beef or pork usually smoked; often served on a bread roll)
  => sausage -- (highly seasoned minced meat stuffed in casings)
    => meat -- (the flesh of animals (including fishes and birds and snails) used as food)
      => food -- (any solid substance (as opposed to liquid) that is used as a source of nourishment)
        => solid -- (a substance that is solid at room temperature and pressure)
          => substance, matter -- (that which has mass and occupies space)
            => entity -- (that which is perceived or known or inferred to have its own distinct existence (living or nonliving))

Sense 6
pawl, detent, click, dog -- (a hinged catch that fits into a notch of a ratchet to move a wheel forward or prevent it from moving backward)
  => catch, stop -- (a restraint that checks the motion of something)
    => restraint, constraint -- (a device that retards something's motion)
      => device -- (an instrumentality invented for a particular purpose)
        => instrumentality, instrumentation -- (an artifact (or system of artifacts) that is instrumental in accomplishing some end)
          => artifact, artefact -- (a man-made object taken as a whole)
            => object, physical object -- (a tangible and visible entity; an entity that can cast a shadow)
              => entity -- (that which is perceived or known or inferred to have its own distinct existence (living or nonliving))
              => whole, whole thing, unit -- (an assemblage of parts that is regarded as a single entity)
                => object, physical object -- (a tangible and visible entity; an entity that can cast a shadow)
                  => entity -- (that which is perceived or known or inferred to have its own distinct existence (living or nonliving))
These are dogs too...