6.863J Natural Language Processing Lecture 15: Word semantics – Working with Wordnet

Robert C. Berwick berwick@ai.mit.edu

The Menu Bar

Administrivia:

- Lab 4 due April 9 (Weds.);
 - Start w/ final projects, unless there are objections
- Agenda:
- Working with Wordnet
 - What's Wordnet
 - What can we do with it?
 - Solving *some* reasoning problems:
 - Mending a torn dress
 - Enjoying a movie; What's a shelf?
 - Implementing EVCA and Wordnet together

Wordnet motivation
But people have persistent problem. When they look up a word, especially a commonly used word, they often find a dozen or more different meanings. What the dictionary does not make clear are the contexts in which each of these different meanings would be understood. So we know what kind of information is required, but we have not yet learned how to provide it to a computer.(G. Miller, U.S./Japan Joint Workshop on Electronic Dictionaries and Language Technologies January 2325, 1993.)











Basic stats						
 POS Noun Verb Adjective Adverb Totals 	Unique Strings 109195 11088 21460 4607 146350	Synsets 75804 13214 18576 3629 111223	Word-Sense Pairs 134716 24169 31184 5748 195817			
	6.863J/9.611J Le	cture 15 Sp03				









X hyp Y	Y hypernym of X	x-repair, y-improve
X ent Y	X entails Y	x-breathe, y-inhale
X sim Y	(adj) Y similar X	x-achromatic, y-white
X cs Y	Y is a cause of X	x-anesthetize, y-sleep
X vgp Y	(verbs) Y similar X	x-behave, y-pretend
X ant Y	X, Y antonyms	x-present, y-absent
X sa Y	X, see also Y	x-breathe, y-breathe out
X ppl Y	X participle of Y	x-applied, y,apply
X per y	X pertains to Y	x-abaxial, y-axial

Noun relations

Relation Hypernym Hyponym Has-Member Member-Of Has-Part Part-Of Antonym

Definition From concepts to superordinates From concepts to subtypes From groups to their members From members to their groups From wholes to parts From parts to wholes Opposites Example

 $breakfast \rightarrow meal$ $meal \rightarrow lunch$ $faculty \rightarrow professor$ $copilot \rightarrow crew$ $table \rightarrow leg$ $course \rightarrow meal$ $leader \rightarrow follower$



























ir	Chain len	Semantic opposition	Search size
nend-tear	5	Yes	1261
nend-red	-	No	11974
ix-leaky	5	Yes	12167
ix-blue	11	No	14553
ix-flat	-	No	12288
nix-powdered	6	Yes	11931
comfort-crying	9	Yes	11359
olue-white	-	No	24431
escue-drowning	13	Yes	9142
lean-dirty	1	Yes	61
ill-empty	1	Yes	48







Application 2: logical metonomy: telic (functional/purposive) roles distinguished

- What's that?
 - a. John began the novel (*reading/writing*)
 b. The author began the unfinished novel back in 1962 (*writing*)
- Begin can have Agent role, for the writer, or it can be a Telic role (function), for the reader
- Problem is how to define 'context' here $_{\scriptscriptstyle 6.863J/9.611J \text{ Lecture 15 Sp03}}$















Check	
Mary enjoyed the cigarette (smoking)	
Given the hypernym hierarchy in (13 <i>smoke</i> (PRO, <i>cigarette</i>) is the strongly preferred interpretation since the concept <i>smoke</i> is highly specific small) and distant from general concepts <i>artifact</i> as <i>physical object</i> (<i>m</i> large).	3), er- (<i>l</i> nd
6.863J/9.611J Lecture 15 Sp03	







Specifically, a door can function both as an entrance (enter) and a barrier (block) to an enclosure. However, the telic verb *block* has form *block(door*,ENCLOSURE), which is incompatible with the prototype V(PRO,door), thus ruling out *block*. Similar reasoning applies to *enter*(PRO,ENCLOSURE). At the other end of the hierarchy, the canonical events associated with *physical object* are predicted to be implausible (*l* large, *m* small).















Bleaching – noun meaning bleached

- a. John boxed the present
- b. John PUT the present IN a <BOX>
- c. John boxed the present in a gift box
- d. # John boxed the present in a brown paper bag
- a. Mary buttered the piece of toast
- b. Mary PUT <BUTTER> ON the piece of toast
- c. Mary buttered the toast with margarine/unsalted butter
- d. # Mary buttered the toast with marmalade/onions























2 Language Acquisition Problems: Lexicon vs Encyclopedia

ROOT	LEXICON ENTRIES		
/shelf/	n, =p =d V_{+cause}		
/butter/	n, = =d V_{+cause}		
/into/	=d +k p		
/with/	=d +k p		

LEXICON ACQUISITION:

How do LEXICAL roots get assigned to feature set?

ROOT	ENCYCLOPEDIA ENTRIES
/shelf/	n _{location} , =p _{location} =d V
/butter/	$n_{locatum}$, = $p_{locatum}$ =d V
/into/	=d +k p _{location}
/with/	=d +k p _{locatum}

ENCYCLOPEDIA ACQUISITION:

How do ENCYCLOPEDIA roots get assigned to feature set?







Machine Translation Lexical Choice- Word Sense Disambiguation

Iraq lost the battle. Ilakuka centwey ciessta. [Iraq] [battle] [lost].

John lost his computer. John-i computer-lul ilepelyessta. [John] [computer] [misplaced].

6.863J/9.611J Lecture 15 Sp03

Word sense disambiguation with Source Language Semantic Class Constraints (co-occurrence patterns)

lose1(Agent, Patient: competition) <=> ciessta

lose2 (Agent, Patient: physobj) <=> ilepelyessta





Another alternation example

- Another example: Causative/inchoative
- The window broke
- John broke the window
- · The rabbit suddenly appeared
- *The magician appeared the rabbit
- Benefactive:
- Sue carved a toy out of wood for Hansel
- · Sue carved hansel a toy out of wood
- Sue carved some wood into a toy for Hansel
- *Sue carved Hansel some wood into a toy
- Middle formation:
- The whale frightens easily
- *The whale sees easily

6.863J/9.611J Lecture 15 Sp03

Alternations..

- Sue broke the vase/ The vase broke (change-of-state)
- The vase broke easily
- Conative: *Sue broke at the vase
- Bill cut the bread/ *The bread cut (change-of-state, no "telic" endpoint)
- The bread cut easily
- Bill cut at the bread
- Mary touched the cat / *The cat touched
- *The cat touched easily (no change-of-state)
- *Mary touched at the cat
- Joe kicked the tire / *The tire kicked
- *The tire kicked easily
- Joe kicked at the tire
- Alternations can be lang-specific: "break" is a causative/inchoative in English, but not Italian.











































$Syntactic Theory:$ $H = \{H_1, H_0, H_*\}$ Prior $p(H_i)$ Likelihood $p(x/H_i)$ $Syntactic Theory:$ $H = \{H_1, H_0, H_*\}$ Prior $p(H_i)$ $Likelihood p(x/H_i)$						
	Acquired Syntactic Knowledge					
Lexicon:	Evidence X	$p(H_1 X)$	$p(H_0 X)$	$p(H_* X)$		
/glip/	F1	.633	.033	.333		
/gorp/	F1, F1	.781	.002	.217		
/seb/	F1, F0	.137	.137	.724		
/meef/	F1 ⁵ , F0	.712	5e-6	.288		
/foom/ 8 of 17	$F0^6_{_{6.863J/9.611J { m Le}}}$	2 <i>e-8</i> cture 15 Sp03	.979	.021		



