Computational Lexical Semantics

Lecture 8: Selectional Restrictions

Linguistic Institute 2005 University of Chicago

Selectional Restrictions

Introduction





Selectional Restrictions

Consider the two interpretations of:

I want to eat someplace nearby.

a) sensible:

Eat is intransitive and "someplace nearby" is a location adjunct

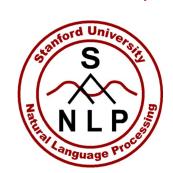
b) Speaker is Godzilla

Eat is transitive and "someplace nearby" is a direct object

How do we know speaker didn't mean b)?

Because the THEME of eating tends to be something edible





Selectional restrictions are associated with senses

- The restaurant serves green-lipped mussels.
 - THEME is some kind of food
- Which airlines serve Denver?
 - THEME is an appropriate location





Selectional restrictions vary in specificity

I often ask the musicians to imagine a tennis game.

To diagonalize a matrix is to find its eigenvalues.

Radon is an odorless gas that can't be detected by human senses.





Representing selectional restrictions

Instead of representing "eat" as:

 $\exists e, x, y \ Eating(e) \land Agent(e, x) \land Theme(e, y)$

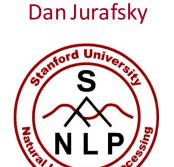
Just add:

 $\exists e, x, y \ Eating(e) \land Agent(e, x) \land Theme(e, y) \land EdibleThing(y)$

And "eat a hamburger" becomes

 $\exists e, x, y \ Eating(e) \land Eater(e, x) \land Theme(e, y) \land EdibleThing(y) \land Hamburger(y)$

But this assumes we have a large knowledge base of facts about edible things and hamburgers and whatnot.



Let's use WordNet synsets to specify selectional restrictions

- The THEME of eat must be WordNet synset {food, nutrient} "any substance that can be metabolized by an animal to give energy and build tissue"
- Similarly

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THEME of imagine: synset {entity}

THEME of lift: synset {physical entity}

THEME of diagonalize: synset {matrix}
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- This allows
 imagine a hamburger and lift a hamburger,
- Correctly rules out
- ⁷ diagonalize a hamburger.

Selectional Restrictions

Selectional Preferences





Selectional Preferences

- In early implementations, selectional restrictions were strict constraints (Katz and Fodor 1963)
 - Eat [+FOOD]
- But it was quickly realized selectional constraints are really preferences (Wilks 1975)
 - But it fell apart in 1931, perhaps because people realized you can't eat gold for lunch if you're hungry.
 - In his two championship trials, Mr. Kulkarni ate glass on an empty stomach, accompanied only by water and tea.





Selectional Association (Resnik 1993)

- Selectional preference strength: amount of information that a predicate tells us about the semantic class of its arguments.
 - eat tells us a lot about the semantic class of its direct objects
 - be doesn't tell us much
- The selectional preference strength
 - difference in information between two distributions:
 - P(c) the distribution of expected semantic classes for any direct object
 - P(c|v) the distribution of expected semantic classes for this verb
 - The greater the difference, the more the verb is constraining its object



Selectional preference strength

 Relative entropy, or the Kullback-Leibler divergence is the difference between two distributions

$$D(P||Q) = \sum_{x} P(x) \log \frac{P(x)}{Q(x)}$$

 Selectional preference: How much information (in bits) the verb expresses about the semantic class of its argument

$$S_R(v) = D(P(c|v)||P(c))$$

$$= \sum_{c} P(c|v) \log \frac{P(c|v)}{P(c)}$$

 Selectional Association of a verb with a class: The relative contribution of the class to the general preference of the verb

$$A_R(v,c) = \frac{1}{S_R(v)} P(c|v) \log \frac{P(c|v)}{P(c)}$$





Computing Selectional Association

- A probabilistic measure of the strength of association between a predicate and a semantic class of its argument
 - Parse a corpus
 - Count all the times each predicate appears with each argument word
 - Assume each word is a partial observation of all the WordNet concepts associated with that word
 - Some high and low associations:

	Direct Object		Direct Object	
Verb	Semantic Class	Assoc	Semantic Class	Assoc
read	WRITING	6.80	ACTIVITY	20
write	WRITING	7.26	COMMERCE	0
see	FNTITY	5 79	METHOD	-0.01



Results from similar models

Ó Séaghdha and Korhonen (2012)

eat
drink
appoint
publish

food#n#1, aliment#n#1, entity#n#1, solid#n#1, food#n#2 fluid#n#1, liquid#n#1, entity#n#1, alcohol#n#1, beverage#n#1 individual#n#1, entity#n#1, chief#n#1, being#n#2, expert#n#1 abstract_entity#n#1, piece_of_writing#n#1, communication#n#2, publication#n#1





Instead of using classes, a simpler model of selectional association

- Model just the association of predicate v with a noun n
 (one noun, as opposed to the whole semantic class in WordNet)
 - Parse a huge corpus
 - Count how often a noun n occurs in relation r with verb v:

$$\log \operatorname{count}(n, v, r)$$

Or the probability:

$$P(n|v,r) = \begin{cases} \frac{C(n,v,r)}{C(v,r)} & \text{if } C(n,v,r) > 0\\ 0 & \text{otherwise} \end{cases}$$



Evaluation from Bergsma, Lin, Goebel

Verb	Plaus./Implaus.		
see	friend/method		
read	article/fashion		
find	label/fever		
hear	story/issue		
write	letter/market		
urge	daughter/contrast		
warn	driver/engine		
judge	contest/climate		
teach	language/distance		
show	sample/travel		
expect	visit/mouth		
answer	request/tragedy		
recognize	author/pocket		
repeat	comment/journal		
understand	concept/session		
remember	reply/smoke		

Selectional Restrictions

Conclusion





Summary: Selectional Restrictions

Two classes of models of the semantic type constraint that a predicate places on its argument:

- Represent the constraint between predicate and WordNet class
- Represent the constraint between predicate and a word
- One fun recent use case: detecting metonomy (type coercion)
 - Coherent with selectional restrictions:

Pustejovsky et al (2010)

The spokesman denied the statement (PROPOSITION).

The child threw the stone (PHYSICAL OBJECT)

• Coercion:

The president denied the attack (EVENT \rightarrow PROPOSITION).

The White House (LOCATION \rightarrow HUMAN) denied the statement.