Semantic Networks

Discourse referents are **states**: patterns of activation among cortical neurons. These referential states are connected by associative cues (relns in sem net). Comprehenders transition from state to state as they process sentences.

Can these semantic networks scale up from simple statements to other kinds?

Start with simple network representing ‘*Pat is eating corn*’:

- **p, c, e** discourse referents (states of thinking about ...)
- **(BeingPat p)** association of lemma ‘Pat’/‘Kim’ to *p*
- **(BeingCorn c)** association of lemma ‘corn’/‘maize’ to *c*
- **(e p c)** *e* is an eventuality involving *c* going into *p*’s mouth, *c* going into *p*’s stomach, ...
- **(BeingEating e)** association of lemma ‘eating’/‘biting’ to *e* (eventualities modeled same as other referents)
- **(IntersectsNow e)** *e* is happening during utterance (present tense)
Need to extend this with *sets*, in order to handle *quantifiers*.

To represent the knowledge *‘Half the kids like corn’*:

- \((\text{SetOfAll } sk' k')\)  
  - \(sk'\): set of all \(k'\)s (kids)
- \((\text{BeingAKid } k')\)  
  - association of lemma ‘kid’ to \(k\)
- \((\text{SetOfAll } sk k)\)  
  - \(sk\): set of all \(k\)s (those who like corn)
- \((h sk' sk)\)  
  - \(h\): relationship between \(sk'\) and \(sk\)
- \((\text{BeingHalf } h)\)  
  - association of lemma ‘half’ to \(h\)
- \((\text{BeingCorn } c)\)  
  - association of lemma ‘corn’ to \(c\)
- \((l k c)\)  
  - \(l\): eventuality involving ...
- \((\text{BeingLiking } l)\)  
  - association of lemma ‘liking’ to \(l\)
Quantifiers in Semantic Networks

Quantifiers can then have ambiguous *scope* — need extra scope parameter.

To represent the knowledge ‘Half the kids like two vegetables’:

- $(\text{SetOfAllFor } sk' k' - )$
- $(\text{BeingAKid } k')$
- $(\text{SetOfAllFor } skk - /v)$
- $(h sk' sk) (\text{BeingHalf } h)$
- $(\text{SetOfAllFor } sv' v' - )$
- $(\text{BeingAVegetable } v')$
- $(\text{SetOfAllFor } svv k/- )$
- $(t sv' sv) (\text{BeingTwo } t)$
- $(l k v) (\text{BeingLiking } l)$

Reading: two vegetables for each kid / half the kids for each vegetable
Quantifiers can also apply to eventualities.

To represent the knowledge ‘Pat once/twice/never ate corn’:

- (BeingPat \( p \))
- (BeingCorn \( c \))
- \((e \ p \ c) \) (BeingEating \( e \))
- (SetOfAllFor se e –)
- \((n \ se) \) (BeingOne/Two/None \( n \))
Negation also requires *scope* (= quantifier over eventualities).

To represent the knowledge *‘Pat does not eat corn’*:

- (BeingPat \(p\))
- (BeingCorn \(c\))
- \((e \, p \, c)\) (BeingEating \(e\))
- \((\text{SetOfAllFor} \, se \, e\, -)\)
- \((n \, se)\) (BeingNone \(n\))
Quantifiers in Semantic Networks

Two-place quantifiers over eventualities: ambiguity about restrictor

To represent the knowledge ‘Pat always ate corn’:

- \((e' \ p' \ c')\) (BeingEating \(e'\)) (BeingPat \(p'\)) (BeingCorn \(c'\))
- \((\text{SetOfAllFor } se' \ e' - )\)
- \((e \ p \ c)\) (BeingEating \(e\)) (BeingPat \(p\)) (BeingCorn \(c\))
- \((\text{SetOfAllFor } se \ e - )\)
- \((n \ se' \ se)\) (BeingAll \(n\))

Reading: Pat always eats corn (never peas/Kim/yells at/Kim ... peas).
Quantifiers in Semantic Networks

Since quantification, negation work, how about other logical connectives?

To represent the knowledge *‘Pat ate corn or danced’*:

- (BeingPat $p$)
- (BeingCorn $c$)
- ($e \ p \ c$) (BeingEating $e$)
- (SetOfAllFor $se \ e$)
- (SetOfAllFor $se \ e$)
- (Union $su \ se \ sd$)
- (n $su$) (BeingOne $n$)

Now it’s getting a bit questionable...
Other Interesting Research on Quantifiers

Scalar implicatures w.r.t. quantifiers:

Judith Degen and Michael Tanenhaus ’11:

- **stimuli**: visual ‘gumball machine’ scene and spoken description:
  - scene with 8 balls above, 5 below ‘You got some of the blue gumballs.’
  - followed by request to indicate whether description is correct
- **measure**: reaction time
- **results**: quantifier meaning depends on a variety of factors
  - Inhibition for ‘some’ if amount is all
  - Inhibition for ‘some’ if amount is subitizable: one/two/three
For next time... 

Read:

▶ Traxler ch 6