April 12, 2004

Semantics

Overview

- Leftovers: Redundancies
- Semantic representation
- Semantic composition

Apparent redundancies

- lexical item designators and orthographies
- ARG-S and SPR/SUBJ/COMPS
- *head* types and *lex-item* types
- SPEC and SPR

Lexical item designators and orthographies

```
cat := noun-lex &
 [ STEM < "cat" > ].

cat := noun-lex &
 [ STEM < "cat" >,
   SYNSEM.LKEYS.KEYREL _cat_n_rel ].
```

- What does each instance of the string `cat` in that code do?
- Which could be spelled differently without loss of functionality, and why?

ARG-S and SUBJ/COMPS/SPR (1/2)

```
noun-lex := basic-noun-lex & basic-one-arg &
  [ SYNSEM.LOCAL [ CAT [ HEAD noun,
                         VAL [ SPR < #spr >,
                               COMPS < >,
                               SUBJ < >,
                               SPEC < > ]],
                   ARG-S < #spr > ]].
```

- ARG-S gives all the arguments of a head.
- ARG-S is a locus of (cross-linguistic) statements of syntactic and semantic linking.

ARG-S and SUBJ/COMPS/SPR (2/2)

```
noun-lex := basic-noun-lex & basic-one-arg &
  [ SYNSEM.LOCAL [ CAT [ HEAD noun,
                         VAL [ SPR < #spr >,
                               COMPS < >,
                               SUBJ < >,
                               SPEC < > ]],
                   ARG-S < #spr > ]].
```

- (In the HPSG literature, ARG-S is also the locus of the binding theory.)
- The valence features specify the particular grammatical function associated with each argument.

head types and lex-item types

- The subtypes of *head* (values of HEAD) give part-of-speech information.
- They are the 'X' in X-bar theory, the information that mothers share with head-daughters.
- The subtypes of *lex-item* (*basic-noun-lex*, etc) are classes of lexical items.
- Subtypes of *lex-item* express generalizations about the syntax and semantics of word classes.
- Do we expect to have more subtypes of *head* or of *lex-item* in a large grammar? Why?

SPEC and SPR

- Heads select for subjects, complements and specifiers.
- Subject and complements do not also select for heads.
- Specifiers do (for semantic reasons).
- A subject is a distinguished argument which is not the semantic head of its phrase.
- A specifier is a distinguished argument which is the head of its phrase.
- Subjects canonically are linked to a semantic role of the selecting head.
- Specifiers canonically are not.

Summary: Apparent redundancies

- lexical item designators and orthographies
- ARG-S and SPR/SUBJ/COMPS
- *head* types and *lex-item* types
- SPEC and SPR

Semantic representations, or the meaning of life is life′

- *The cat chased the dog*
- the(x) $\wedge$ cat(x) $\wedge$ the(y) $\wedge$ dog(y) $\wedge$ chase(e,x,y) $\wedge$ past(e)
- What's the point?
- $\rightarrow$ linguistically
- $\rightarrow$ computationally

Minimal Recursion Semantics

- A semantic formalism designed for CL applications (including MT)
- Fully specified representations are equivalent to first-order predicate logic with generalized quantifiers
- Designed for: expressivity, scalability, computational tractability, underspecification
- Guiding principle: The semantic representations produced should include all grammatically relevant distinctions, while remaining as concise as possible.
- Expressed in feature structures (how convenient!)

MRS example

$$\left[\begin{array}{ll}
\text{RELS} & \left\langle !\left[\begin{array}{ll}\text{PRED} & \textbf{_def_q_rel}\\ \text{LBL} & h3\\ \text{ARG0} & x4\\ \text{BODY} & h6\\ \text{RSTR} & h5\end{array}\right], \left[\begin{array}{ll}\text{PRED} & \textbf{_cat_n_rel}\\ \text{LBL} & h7\\ \text{ARG0} & x4\end{array}\right], \right.\\
 & \left[\begin{array}{ll}\text{PRED} & \textbf{_chase_v_rel}\\ \text{LBL} & h8\\ \text{ARG0} & e9\\ \text{ARG1} & x4\\ \text{ARG2} & x10\end{array}\right], \left[\begin{array}{ll}\text{PRED} & \textbf{_def_q_rel}\\ \text{LBL} & h11\\ \text{ARG0} & x10\\ \text{BODY} & h13\\ \text{RSTR} & h12\end{array}\right], \left.\left[\begin{array}{ll}\text{PRED} & \textbf{_dog_n_rel}\\ \text{LBL} & h14\\ \text{ARG0} & x10\end{array}\right]!\right\rangle\\
\text{HCONS} & \left\langle !\left[\begin{array}{ll}\textit{qeq} & \\ \text{HARG} & h5\\ \text{LARG} & h7\end{array}\right], \left[\begin{array}{ll}\textit{qeq} & \\ \text{HARG} & h12\\ \text{HARG} & h14\end{array}\right]!\right\rangle
\end{array}\right]$$

Semantic compositionality

- Each word specifies the relation(s) it contributes, and how its syntactic arguments relate to those relations.
- Each word or phrase ‘exposes’ just enough information for further composition (the rels and h-cons collected so far, plus the HOOK: a local top handle, and 1-2 indices).
- The phrase structure rules ensure:
  - The CONT value of the mother is built up appropriately from the CONT values of the daughters.
  - The HOOK value of the selected daughter is made available to the selecting daughter.

Example: The cat slept

- *basic-verb-lex*: the single relation is an *event-rel*, and its handle (LBL) and event variable (INDEX) should be exposed for further composition.
- *transitive-lex-item*: identifies the INDEX of the single item on ARG-S with the ARG1 role of the key relation.
- *intrans-verb-lex*: the single element of ARG-S is identified with the single element of SUBJ.
- *basic-head-subj-phrase*: identifies non-head daughter's SYNSEM with the synsem on the SUBJ list of the head daughter. Appends the RELS and HCONS values of the two daughters to give the RELS and HCONS value of the mother. INDEX and LTOP come from the head daughter.

So what's left for you to do? (Lab 2)

- Add predicate names for each relation (PRED values)
- Make sure that quantifier relations are being introduced properly (either by overt determiners or by a non-branching rule for determinerless NPs)
- Try parsing sentences and then generating back from the semantic representations.
- Prune any overgeneration that that exercise turns up.
- Add vocabulary
- Check the web page for the prep instructions (posted by noon tomorrow).

Overview

- Leftovers: Redundancies
- Semantic representation
- Semantic composition