Generating French with the LKB

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Outline

I. grammar overview

II. Matrix for French

III. grammar modifications

IV. demo
### Standard HPSG: ARG-ST and VALENCE

<table>
<thead>
<tr>
<th>ARG-ST</th>
<th>list(synsem) (&quot;initial subcategorization&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALENCE</td>
<td></td>
</tr>
<tr>
<td>SUBJECT</td>
<td>list(synsem)</td>
</tr>
<tr>
<td>SPECIFIER</td>
<td>list(synsem)</td>
</tr>
<tr>
<td>COMPLEMENTS</td>
<td>list(synsem)</td>
</tr>
</tbody>
</table>

- *synsem* = collection of syntactic and semantic properties (category, bar level, semantic index, predicate)

- three subtypes: *canonical* (ordinary syntactic realization), *gap* (extracted), *affix* (clitic)

- VALENCE lists (underespecified in lexical entries) instantiated by ARG-ST to VAL mapping constraints
Valence and syntactic combination

- **Head-Complements Schema**

  $\begin{bmatrix}
  \text{SUBJ} & 1 \\
  \text{COMPS} & \langle \rangle
  \end{bmatrix} \rightarrow 
  \begin{bmatrix}
  \text{SUBJ} & 1 \\
  \text{COMPS} & \langle 2, 3 \rangle
  \end{bmatrix} 
  \xrightarrow{\text{HD-DTR}} 
  \begin{bmatrix}
  \text{SYNSEM} & 2 \\
  \text{SYNSEM} & 3
  \end{bmatrix} 
  \xrightarrow{\text{NHD-DTR}} 
  \begin{bmatrix}
  \text{SYNSEM} & 1
  \end{bmatrix}$

- **Head-Subject Schema**

  $\begin{bmatrix}
  \text{SUBJ} & \langle \rangle \\
  \text{COMPS} & \langle \rangle
  \end{bmatrix} \rightarrow 
  \begin{bmatrix}
  \text{SYNSEM} & 1
  \end{bmatrix} 
  \xrightarrow{\text{NHD-DTR}} 
  \begin{bmatrix}
  \text{SUBJ} & \langle 1 \rangle \\
  \text{COMPS} & \langle \rangle
  \end{bmatrix} 
  \xrightarrow{\text{HD-DTR}} 
  \begin{bmatrix}
  \text{SYNSEM} & 1
  \end{bmatrix}$
Difficulties for implementation

- lack of “bottom-up” type inference and automatic type resolution
- no complex antecedents, disjunction, negation
- limited list manipulation functions (no generalized append, member, shuffle)

Theoretical approach can be approximated in implementation but highly inefficient

- multiplication of recursive lexical rules
- massive lexical ambiguity
Modified approach to VALENCE

\[
\begin{bmatrix}
\text{valence} \\
\text{SUBJ} & \text{list-of-synsems} \\
\text{SPR} & \text{list-of-synsems} \\
\text{VCOMPS} & \text{list-of-words} \\
\text{DO} & \text{list-of-synsems} \\
\text{A-OBJ} & \text{list-of-synsems} \\
\text{DE-OBJ} & \text{list-of-synsems} \\
\text{XCOMP} & \text{list-of-synsems}
\end{bmatrix}
\]

ARG-ST maintained for SLASH amalgamation, etc.
“Grammatical functions”

- **SUBJ, SPR:** no change
- **DO:** NP\[acc\] ou S[fin], typically corresponds to an accusative clitic (le, la, les) or partitive en
- **A-OBJ:** NP[dat] corresponding to dative clitic (lui, leur) or NP[loc] corresponding to “locative” y
- **DE-OBJ:** NP[de] (clitic en)
- **XCOMP:** VP[inf] (no corresponding clitic!) or predicative XP (sometimes le)
- **VCOMPS:** bare V in complex predicate constructions (argument inheritance with temporal and causative auxiliaries), “lite” complements (avoir faim, prendre froid)
Related changes

- head-comp-rule replaced by more specific rules
  \(\mapsto\) head-do, head-aobj-rule, head-xcomp-rule, ...

- flat structures (head-comp-rule, head-2comps-rule, head-3comps-rule, ...)
  \(\mapsto\) (mostly) binary structures

- preverbal clitics realized syntactically (no longer in morphology)

- \(\longrightarrow\) improved efficiency (many fewer edges)

- extraction, passive still analyzed by lexical rule
Aspects of the analysis

• free order among complements and adjuncts achieved with few rules, but...

• VCOMPS must be realized first
  Jean a parlé [de Marie]. (John has talked about Mary)
  *Jean a [de Marie] parlé.

• two items on one list ⇒ order fixed
  – VCOMPS: Jean [a fait couler] le navire. (John has made the ship sink)
    but *Jean [a couler fait] le navire.
  – DO: Jean informe Marie [que le navire va couler]. (John informs Mary that the ship is going to sink.)
    but *Jean informe [que le navire va couler] Marie.
Accommodating exceptions

- VPs generally cannot be pronominalized
  - Je promets [de faire qqch] (*I promise to do sth*)
    *J’en promets.
    Je le promets. (source: Je promets qqch. ‘*I promise sth’)

- Rare counterexamples
  - Je peux [faire qqch] (*I can do sth*)
    Je le peux. (but no nominal source: *Je peux qqch)
    ⇒ add frame with clitic in DO
  - Je l’empêche [de faire qqch] (*I keep her from doing sth*)
    Je l’ en empêche (but no nominal source:
    *Je l’empêche [de qqch]. ‘*I keep her from sth’)
    ⇒ add frame with clitic in DE-OBJ
Problems

- more lists will be needed (e.g., OBLIQUE)

- importing lexical information from external resource (e.g., SynLex)
  - predefined valence templates (intransitive, direct transitive, subject raising with bare VP, à-NP controlling de-VP, . . . ) and/or
  - predictable mapping from subcat frame elements to the appropriate valence list
Generation

- HPSG grammars are bidirectional.
- LKB grammars are (more or less) bidirectional.
- Generation is now possible with the LKB.
  - depends on a particular implementation of Minimal Recursion Semantics
  - poorly documented for the moment
The Grammar Matrix

http://www.delph-in.net/

- “universal type hierarchy” (with parameters)
- quick-start tool for new grammars
- questionnaire about simple syntactic properties of the language
  - Are there determiners? Optional or obligatory? Precede or follow N?
  - Yes/no questions: indicated by marking on V, word order, clausal marker?
  - Negation: expressed as a marking on V, modifier of VP, or operator on S?
- small number of lexical entries with semantic relations
Matrix for French

∼ tiny but fully-formed LKB grammar capable of analyzing and generating 3-4 sentences

• chien (dog), Paul, dort (sleeps), voit (sees), le (masc sing def art)

• accepts: Paul dort, Le chien voit Paul

• rejects: *Paul dort le chien, *Chien dort

• “overgeneration”:
  dort le chien, le Paul dort, voit Paul le chien

≈ 2000 lines (cf. ≈ 5000 lines in current French grammar)
MRS “extraction” and “importation”

100% non-automatic...

• all necessary type declarations to introduce appropriate attributes and values for semantic representation

• encoding semantics in lexical entries

• preserving/modifying semantics in lexical rules

• determining semantic composition in syntactic combinations

… and ongoing
Implications for development

- new constructions require both syntactic and semantic analysis
- grammar maintenance wrt both parsing and generation
- default unification: not bidirectional
- LKB morphological component *is* bidirectional
- semantically empty elements
  - huge strain on generator if unconstrained
  - solution: trigger rules licensing the hypothesis of a particular empty element
Demo

• ...

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