Tree Adjoining Grammar
TuLiPA and the lexion

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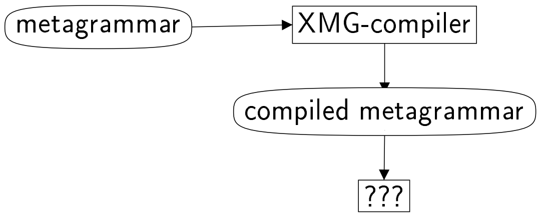
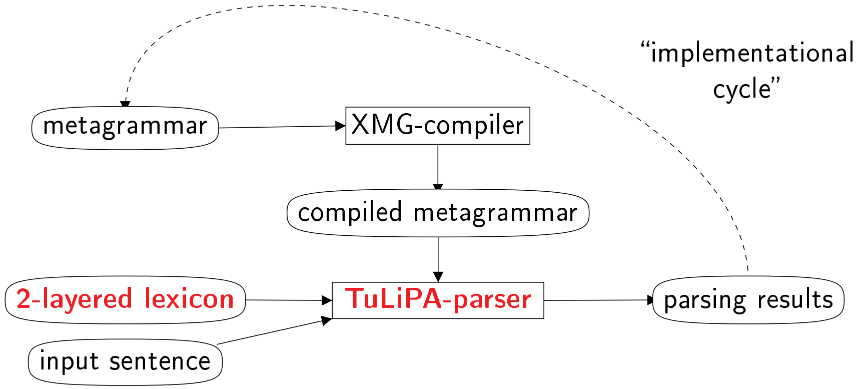
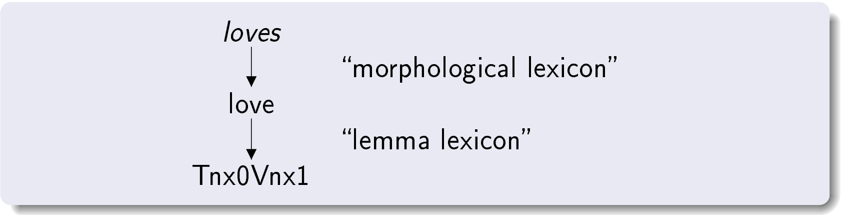
The situation



The missing pieces

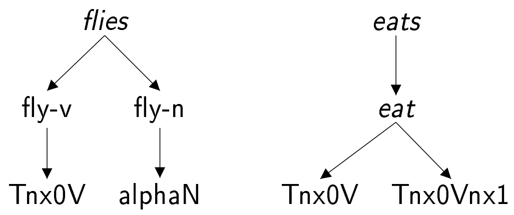


A 2-layered lexicon



The morphological lexicon and the lemma lexicon are compiled using `lexConverter` (as a part of LEX2ALL).

A 2-layered lexicon - 2 sources for ambiguity



A 2-layered lexicon

Morphological lexicon

maps an (inflected) token to some base form (= lemma), while preserving morphological information in a feature structure.

loves	love	[pos=v; num=sing; pers=3;]
Peter	Peter	[pos=n; num=sing; pers=3; case=nom|acc;]

Interface with tree templates:
Feature unification during lexical insertion

A 2-layered lexicon

Lemma lexicon

maps a lemma onto tree tuple families, while also containing selectional restrictions (e.g., case assignment).

```
*ENTRY: love
*CAT: v
*SEM:
*ACC: 1
*FAM: Tnx0Vnx1
*FILTERS: []
*EX:
*EQUATIONS:
NParg1 -> case = nom
NParg2 -> case = acc
*COANCHORS:
```

Interface with tree templates:
EQUATIONS → nodes of tree templates (via name property)
FILTERS → tree templates (via interface expressions)

Tübingen Linguistic Parsing Architecture (TuLiPA)

TuLiPA uses Range Concatenation Grammar (RCG) as a pivot formalism.

Components:

1. TAG-to-RCG converter (on-line)
2. RCG parser → RCG derivation forest → TAG derivation forest
3. Parse viewer (derived tree, derivation tree, dependency view, semantic representation)

Availability of TuLiPA:
written in Java and released under the GNU GPL
(`http://sourcesup.cru.fr/tulipa/`)

TuLiPA - Range Concatenation Grammars (RCG)

Range Concatenation Grammar (RCG)

$$A(X_1X_2, X_3) \rightarrow B(X_2)\ C(X_1, X_3)$$

A, B, C: predicates
X_1, X_2, X_3: range variables (instantiated with substrings of the string)

Example:
$\mathrm{S}(\mathrm{X}_1\mathrm{X}_2) \rightarrow \mathrm{NP}(\mathrm{X}_1)\ \mathrm{VP}(\mathrm{X}_2)$
$\mathrm{VP}(\mathrm{X}_3\mathrm{X}_4) \rightarrow \mathrm{V}(\mathrm{X}_3)\ \mathrm{NP}(\mathrm{X}_4)$
$\mathrm{NP}(\mathrm{Peter}) \rightarrow \epsilon$
$\mathrm{NP}(\mathrm{Susan}) \rightarrow \epsilon$
$\mathrm{V}(\mathrm{loves}) \rightarrow \epsilon$

TuLiPA - Range Concatenation Grammars (RCG)

Simple RCG

- **non-combinatorial:** each argument on the RHS of a clause consists of a unique variable!
  NOT: $A(XY, Z) \rightarrow B(Y)\ C(XZ)$
- **linear:** each variable appears at most once in the LHS or RHS of a clause!
  NOT: $A(XYX, Z) \rightarrow B(Y)\ C(X, Z)$
- **non-erasing:** every variable in the LHS of a clause is also in its RHS!
  NOT: $A(XY, Z) \rightarrow B(Y)\ C(X)$

TuLiPA - Why RCG?

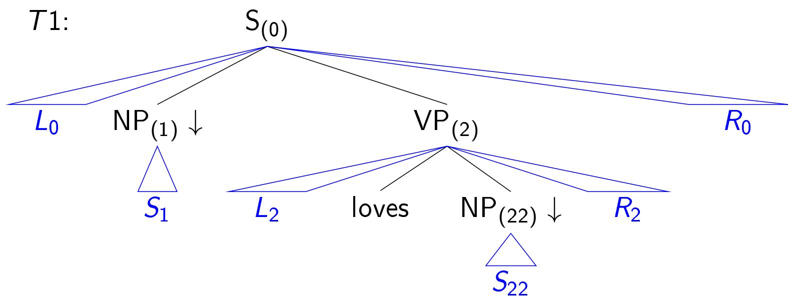
RCG is useful, because:

- it has attractive formal properties (polynomially parsable, full expressive power of MCS-languages);
- there exist parsing algorithms.

⇒ Parser can be reused for other mildly context-sensitive formalisms!

NB: RCG properly includes MCS. We use a restricted RCG, called *simple RCG*, that is included in MCS.

TuLiPA - From TAG to RCG



$T1(L_0\ S_1\ L_2\ \mathit{loves}\ S_{22}\ R_2\ R_0) \rightarrow$
$adj_{S_0}(L_0, R_0)\ \ sub_{NP_1}(S_1)\ \ adj_{VP_2}(L_2, R_2)\ \ sub_{NP_{22}}(S_{22})$

$adj_{S_0}(X, Y) \rightarrow T2(X, Y)$

...

The last slide

Adjacent topics:

- parsing techniques
- ways to extend grammars and lexica automatically
- coverage testing with testsuits (e.g. TSNLP)
- adding semantics
- ...