Syntax-Driven Semantic Frame Composition in Lexicalized Tree Adjoining Grammars

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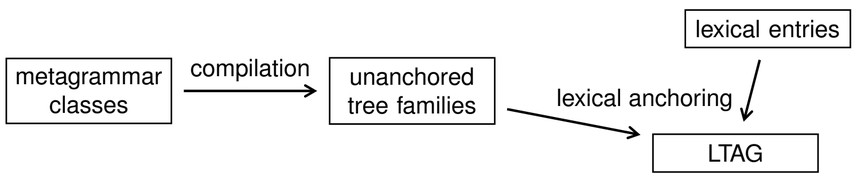
Project goals

- Development of a grammar engineering framework that integrates lexical and constructional semantics and allows a fine-grained factorization into syntactic and semantic components.
- Method: Combination of Lexical Tree Adjoining Grammar (LTAG) and decompositional frame semantics.

LTAG and grammatical factorization

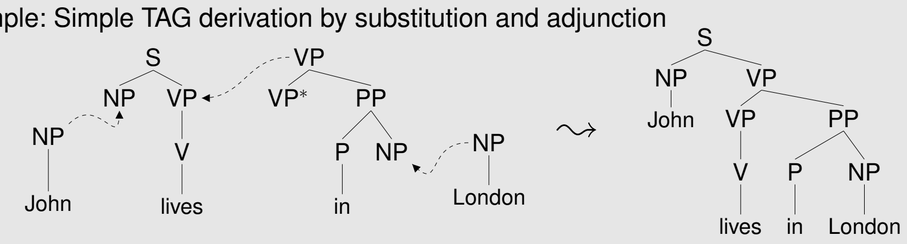
Overview



Lexicalized Tree Adjoining Grammar (LTAG) (Joshi & Schabes 1997)

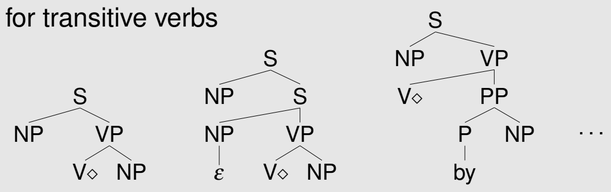
- Tree rewriting system (TAG) on *elementary trees* with two operations: *substitution* and *adjunction*.

Example: Simple TAG derivation by substitution and adjunction



- Elementary trees are lexically anchored and they can be arbitrarily large (*extended domain of locality*).
- Elementary trees can be split into *lexical anchors* and *unanchored trees*, which are organized in *tree families* that represent subcategorization frames.

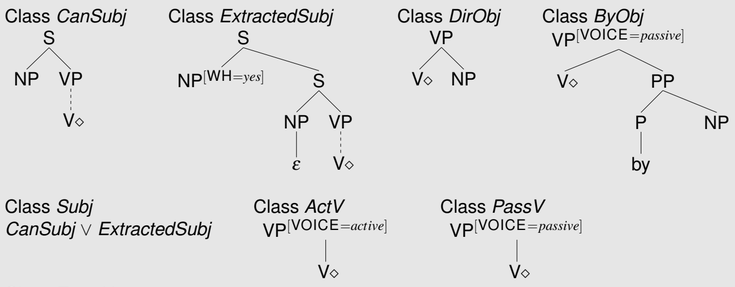
Example: Unanchored tree family for transitive verbs



Metagrammar (Candito 1999, Crabbe & Duchier 2005)

- Constraint-based, factorized description of unanchored elementary trees.

Example



Decompositional frame semantics

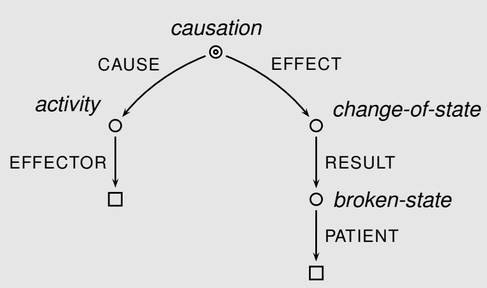
- Concept centered with inherent structural properties (vs. event logic).
- Much more flexible than traditional decompositional templates.

Example: Decompositional representations of causative *break*

a. $[\,[x$ ACT$]$ CAUSE $[$BECOME $[y$ *BROKEN*$]\,]\,]$ (traditional decompositional template)

b.

$$\begin{bmatrix} \textit{causation} \\ \text{CAUSE} & \begin{bmatrix} \textit{activity} \\ \text{EFFECTOR } \boxed{1} \end{bmatrix} \\ \text{EFFECT} & \begin{bmatrix} \textit{change-of-state} \\ \text{RESULT} & \begin{bmatrix} \textit{broken-state} \\ \text{PATIENT } \boxed{2} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$



c. $\exists e \exists e' \exists e'' \exists s\,[$*causation*$(e) \wedge$ CAUSE$(e, e') \wedge$ EFFECT$(e, e'') \wedge$ *activity*$(e') \wedge$ EFFECTOR(e', x) $\wedge$ *change-of-state*(e'') $\wedge$ RESULT(e'', s) $\wedge$ *broken-state*(s) $\wedge$ PATIENT$(s, y)]$

Case study: the English dative alternation

(1) a. John sent Mary the book. (double object, DO)
b. John sent the book to Mary. (prepositional object, PO)

Traditional decompositional analysis:

(2) a. $[\,[x$ ACT$]$ CAUSE $[z$ HAVE $y]\,]$ (caused possession)
b. $[\,[x$ ACT$]$ CAUSE $[y$ GO TO $z]\,]$ (caused motion)

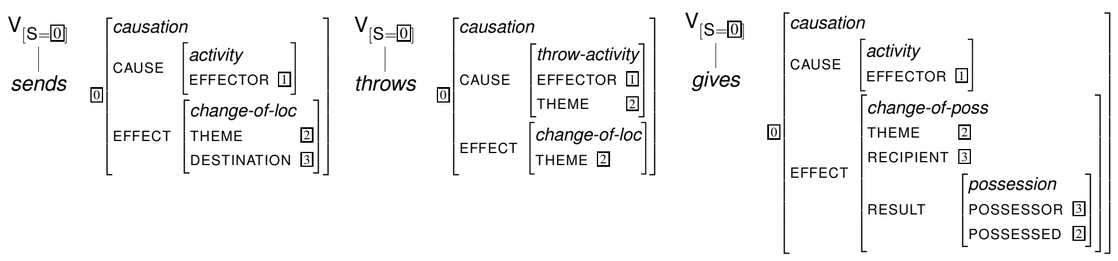
Observation (inter alia, Krifka 2004, Rappaport Hovav & Levin 2008):

- The interpretations of the DO and the PO constructions are sensitive to the lexical semantics of the verb.

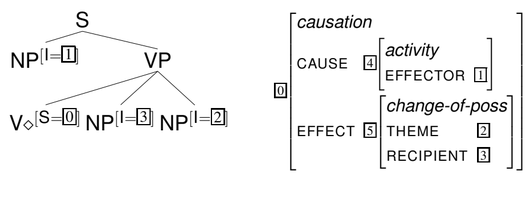
Partial semantic classification of alternating verbs (cf. Beavers 2011)

	lexical meaning					PO pattern	DO pattern
	#args	result	punct.	manner	motion	(◇arrive)	(◇receive)
give	3	receive	yes	no	no	receive	receive
hand	3	receive	yes	yes	yes	receive	receive
send	3	leave ◇arrive	yes	no	yes	◇arrive	◇receive
throw	2	leave	yes	yes	yes	◇arrive	◇receive
bring	3	arrive	no	no	yes	arrive	receive

Sketch of lexical and constructional frames



DO construction



PO construction

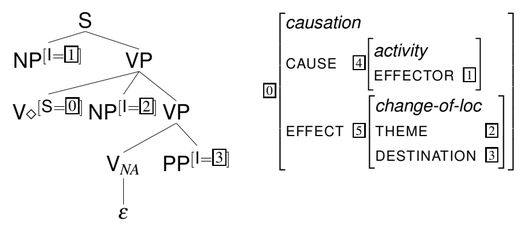
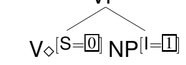


Illustration of metagrammatical factorization

Class *Transitive*
export: p, arg_1, arg_2
use classes $V_1 =$ InTransitive
$N_2 =$ DirObj
identities: $V_1.V = N_2.V$
$p = N_2.p$
$arg_1 = V_1.arg_1$
$arg_2 = N_2.x$

Class *IndirObj*
export: x, p
identities: $x = \boxed{1}$, $p = \boxed{0}$
syntactic dimension



V $\prec$ NP
semantic dimension

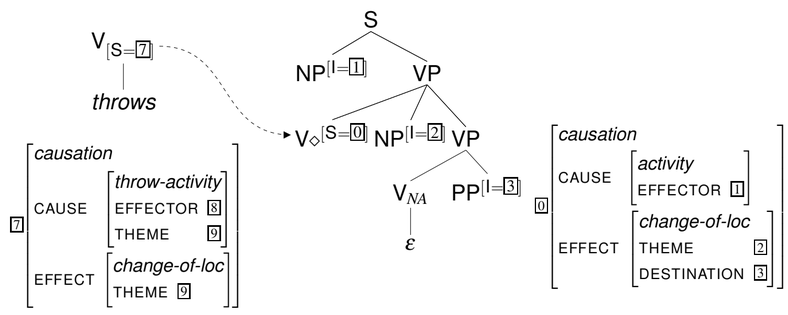
$$\boxed{0}\begin{bmatrix} \textit{causation} \\ \text{EFFECT} & \begin{bmatrix} \textit{change-of-poss} \\ \text{RECIPIENT } \boxed{1} \end{bmatrix} \end{bmatrix}$$

Class *DOConstr*
export: p
use classes $V_1 =$Transitive
$N_3 =$IndirObj
identities: $p = N_3.p$
semantic dimension

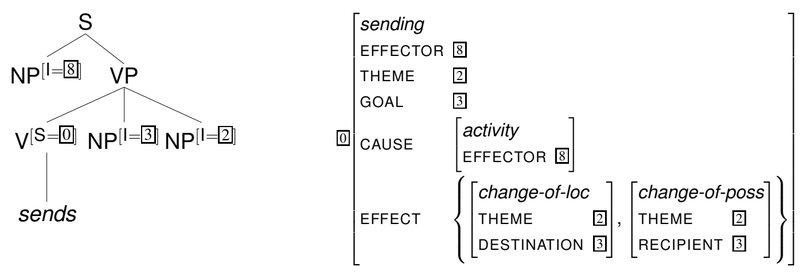
$$p\begin{bmatrix} \textit{causation} \\ \text{EFFECTOR} & V_1.arg_1 \\ \text{THEME} & V_1.arg_2 \\ \text{GOAL} & N_3.x \\ \text{CAUSE} & \begin{bmatrix} \textit{activity} \\ \text{EFFECTOR } V_1.arg_1 \end{bmatrix} \\ \text{EFFECT} & \begin{bmatrix} \textit{change-of-poss} \\ \text{THEME } V_1.arg_2 \end{bmatrix} \end{bmatrix}$$

Examples of lexical anchoring

- Process of anchoring the PO construction by *throws*:



- Result of anchoring the DO construction by *sends*:



Ongoing and future work

- Systematic definition of syntactic classes and generation of tree families.
- Larger coverage of constructions and more detailed semantic frames.
- Implementation by means of the XMG und TuLiPA tools.

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