Formalizing Construction Grammar in Tree Adjoining Grammar

Tatjana Scheffler and Joel C. Wallenberg

{tatjana,joelcw}@ling.upenn.edu

University of Pennsylvania

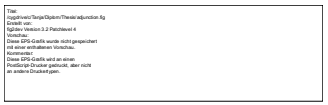
Overview

We envision a hybrid grammar that combines the advantages of Tree-Adjoining Grammar (TAG) and Zwickyan Construction Grammar (CG). A partial CG is formalized as a "metagrammar" for a TAG, defining the set of elementary trees anchored to lexical items and the all-important relationships between them. The TAG will then license sentences using its normal combinatorics of substitution and adjunction, which operate on the clause-sized elementary trees.

TAG & Metagrammar

TAG formalism

Adjunction:



Substitution:

TAG properties

- formal properties of TAG are well-known
- with just two operations, the formalism is very restricted, thus yielding insights into the formal theory of natural grammar
- extended domain of locality allows integration of "core" and "periphery" phenomena, a goal of CG
- linguistic relationships of lexical items (subcategorization, semantic roles of arguments, agreement, etc.) are stated locally
- captures recursivity without affecting local relationships: specification of all simple constructions in the language produces a description of the complex sentences as well
- a lexicalized elementary tree states the properties of one (simple or complex) lexical item within one structure – but relations between elementary trees are not specified

Metagrammar

- captures similarities between elementary trees
- set of partial tree descriptions that model constructions
- descriptions are conjunctions of propositions in a First Order Logic designed to state dominance and precedence relations
- superimposition of constructions is FOL conjunction
- tree descriptions license elementary trees:
  - combined tree description licenses those elementary trees that satisfy the description and have the minimal number of nodes
  - more than one elementary tree can be licensed by the same tree description

Notation

The logic for tree descriptions is adapted from Xia (2001:49) and Rogers & Vijay-Shanker (1994).

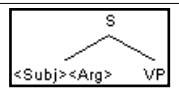
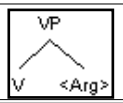
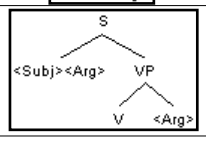
X ***DOM*** Y $=_{def}$ X immediately dominantes Y

X ***DOM**** Y $=_{def}$ X dominantes Y

X ***PR*** Y $=_{def}$ X precedes Y

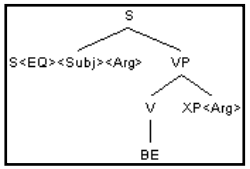
Examples

WH Cleft and Inverted WH Cleft constructions

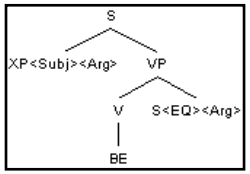
Name	Graphical notation	FOL notation
Subj		(S ***DOM*** <Subj><Arg>) **∧** (S ***PR*** VP) **∧** (<Subj><Arg> ***DOM*** VP)
VP		(VP ***DOM*** V) **∧** (VP ***DOM*** <Arg>) **∧** (V ***PR*** <Arg>)
SVP		Subj **∧** VP
WH Cleft (a valency set)	{BE, S<EQ><Arg>, XP<Arg>}	(V ***DOM*** BE) **∧** (S<EQ><Arg>) **∧** (XP<Arg>)
WH Cleft assembled by SVP		SVP **∧** WH Cleft

The last metarule licenses two elementary trees:

Regular WH Cleft:

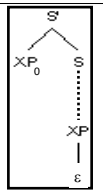
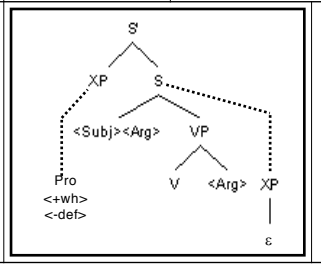


Inverted WH Cleft:



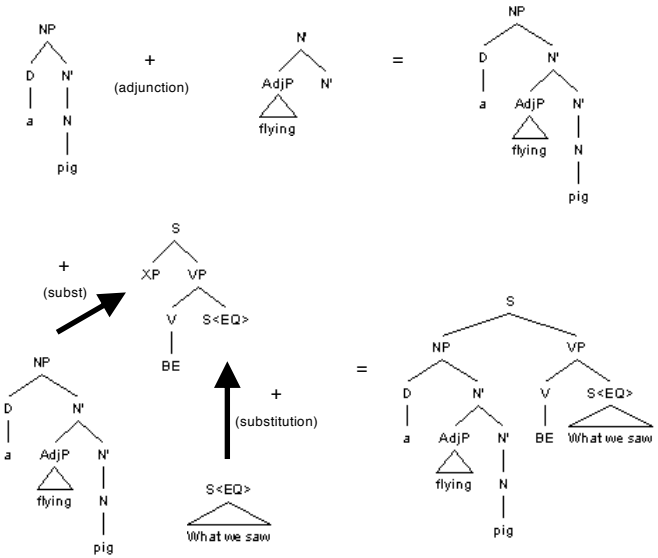
These two permutations (in terms of grammatical relations and structural positions) of the WH Cleft Valency Set in combination with SVP naturally result from the conjunction of the logical sentences stating their formal conditions. They constitute two lexicalized elementary trees on which a TAG may operate, and they instantiate the regular "WH Cleft" and "Inverted WH Cleft" when "assembled into a C[lause] by SVP" (Zwicky, 1994).

Constructing the Embedded Question (EQ) construction

Focus Fronting		(S' ***DOM*** XP_0) **∧** (S' ***DOM*** S) **∧** (XP_0 ***PR*** S) **∧** (S ***DOM**** XP) **∧** (XP ***DOM*** ε)
Interrogative Clause (IC)		FF **∧** (XP_0 ***DOM**** Pronoun<+wh><-definite>)
Embedded Question (EQ)		IC **∧** SVP

TAG derivation of a pseudocleft sentence

A flying pig is what we saw.



Selected References

Xia, Fei. 2001. *Automatic Grammar Generation From Two Different Perspectives*. Doctoral Dissertation, University of Pennsylvania.

Joshi, A. K., L. S. Levy and M. Takahashi. 1975. Tree Adjunct Grammars. *Journal of Computer and System Science*, 10:136–163.

Rogers, James and K. Vijay-Shanker. 1994. Obtaining trees from their descriptions: An application to Tree-Adjoining Grammars. *Computational Intelligence*, 10:401–421.

Zwicky, Arnold M. 1994. Dealing out meaning: Fundamentals of syntactic constructions. *BLS* 20:611–25