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Tree Adjoining Grammars
1st. International Workshop on TAGs:
Formal Theory and Applications

Dagstuhl-Seminar-Report; 2
15. - 17.8.1990 (9033)

ISSN 0940-1121

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**First International Workshop
on
Tree Adjoining Grammars:
Formal Theory and Applications**

organized by :

**Karin Harbusch (DFKI, FRG)
Wolfgang Wahlster (DFKI, FRG)**

Wednesday, August 15 - Friday, August 17
1990

Overview

Karin Harbusch, Wolfgang Wahlster

The topic of the workshop was a grammar formalism - the **Tree Adjoining Grammars (TAGs)** - which has interesting formal properties (e.g., mild context-sensitivity) as well as a wide range of application domains, especially in the field of natural language processing. Thus, it was very fruitful for the discussions to bring together researchers from both areas of interest in TAGs.

TAGs were introduced in 1975 by Joshi, Levy and Takahashi ([Joshi et al. 75]). To get a first intuition of the formalism - for a good introduction see [Joshi 85] - one can think of TAG rules as combined context-free rules building a context-free derivation tree. These trees are called *initial trees*. A second class of rules - the *auxiliary trees* - which are necessary for describing arbitrary large TAG-derivation trees - are characterized by a special nonterminal leaf - the *foot node* - in the context-free derivation tree which carries the same label as the root node. The *adjoining* operation replaces a nonterminal node in an initial tree (which can be modified by former adjoinings) by an auxiliary tree. This means that the incoming edge in the root node will end in the root node of the auxiliary tree and all outgoing edges of the eliminated node will start in the foot node of the auxiliary tree. Obviously a derivation tree results again.

To get an idea of such a grammar Figure 1 describes a fragment of a natural language grammar. The initial tree α can produce sentences like, e.g., "Children play" where "Children" is a lexical entry with the terminal category **N** and "play" is of category **V**. The auxiliary trees β_1 , β_2 and β_3 modify the NP node by a determiner, adjectives and relative clauses, respectively. The auxiliary trees β_4 and β_5 modify the verbal complex (VP) by a prepositional object (e.g., "with balls") or a direct or indirect object (e.g., "tennis").

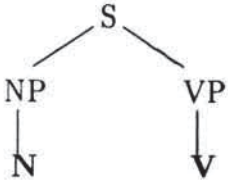
The similarity with context-free grammars can lead to the conclusion that TAGs are simply an equivalent description for context-free grammars. But one important property of TAGs is that they are more powerful than context-free grammars (e.g., there exists a TAG for $a^n b^n c^n$ or the copy language ww). This additional power is called *mild context-sensitivity* because not the complete set of context-sensitive languages is covered by TAGs (e.g., the languages $a^n b^n c^n d^n e^n$ or the copy language www).

The TAG formalism was introduced as an adequate formalism for encoding natural language grammars referring to the property of mild context-sensitivity. There is strong evidence in the linguistic community that this is the right complexity for natural language description.

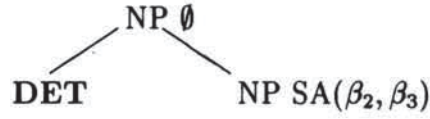
The workshop dealt with various problems in the formal area, e.g., extensions for the pure TAG formalism, automata models for the grammar representation or efficient parsing algorithms. Most investigations were motivated by specific applications (e.g., natural language parsing and generation, help systems).

In this interdisciplinary field of computer science, computational linguistics and

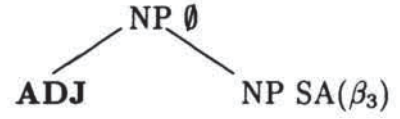
initial tree α :



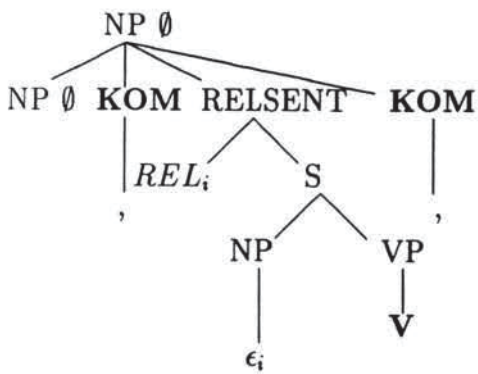
auxiliary tree β_1 :



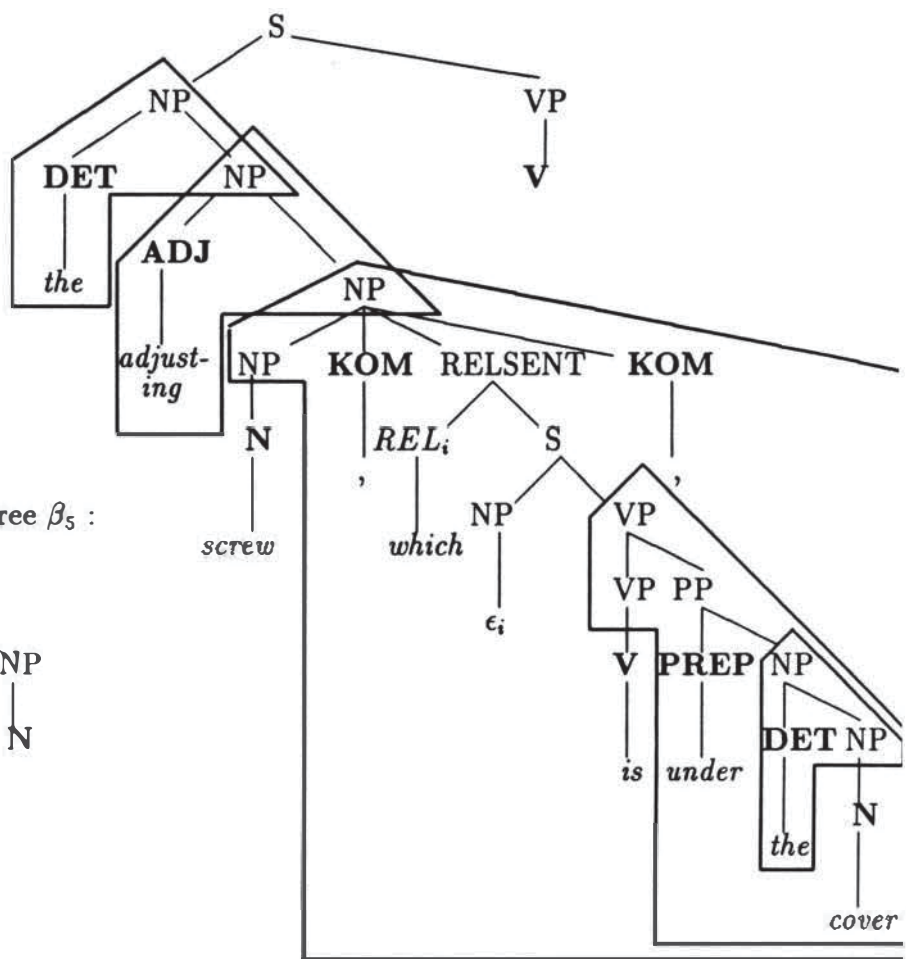
auxiliary tree β_2 :



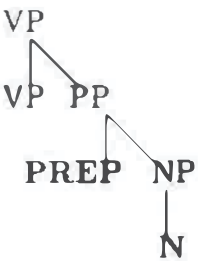
auxiliary tree β_3 :



tree γ , which contains all adjoinings below the NP node of α , is an intermediate state during incremental generation :



auxiliary tree β_4 :



auxiliary tree β_5 :

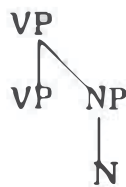


Figure 1: Example for adjoinings with the resulting sentence fragment 'The adjusting screw, which is under the cover, ...'

psycholinguistics the talks found interesting feedback and a lot of very fruitful discussions went on during the three days.

References

- [Joshi et al. 75] **A. K. Joshi, L. S. Levy, M. Takahashi** : *Tree Adjoining Grammars*, Journal of Computer and Systems Science 10:1, Seite 136-163, 1975.
- [Joshi 85] **A. K. Joshi** : *An Introduction to Tree Adjoining Grammars*, Technical Report MS-CIS-86-64, Department of Computer and Information Science, Moore School, University of Pennsylvania, Philadelphia, Pennsylvania, 1985.

Acknowledgements

We want to thank the International Conference and Research Center for Computer Science (IBFI) for the financial support and the IBFI staff for their assistance with arranging the workshop.

We want to thank the German AI Center (DFKI) for additional funding of our workshop. This made it possible to support people from overseas to attend the workshop.

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Program

Wednesday, August 15:

Welcome by Reinhard Wilhelm (IBFI) and Wolfgang Wahlster (DFKI)

Formal Properties of Synchronous Tree-Adjoining Grammars, *S. Shieber*

TAGs with Unification, *B. Buschauer, P. Poller, A. Schauder, K. Harbusch*

Metarules in Tree Adjoining Grammars, *T. Becker*

Multicomponent TAGs, *D. Weir* - Talk given by *K. Vijay-Shanker*

Embedded Pushdown Automata, *K. Vijay-Shanker*

TAGs by Interpreting Context Free Tree Languages, *Y. Guan, G. Hotz*

Thursday, August 16:

The systematic construction of Earley Parsers:: Application to the production of an $O(n^6)$ Earley Parser for Tree Adjoining Grammars, *B. Lang*

The Valid Prefix Property and Parsing Tree Adjoining Grammars, *Y. Schabes* Parallel TAG Parsing on the Connection Machine, *M. Palis, D. Wei*

Tree Adjoining Grammar, Segment Grammar and Incremental Sentence Generation, *G. Kempen, K. DeSmedt*

Incremental Natural Language Generation with TAGs in the WIP Project, *W. Finkler*

Implications of Tree Adjoining Grammar for Natural Language Generation, *D. McDonald, M. Meteer*

Friday, August 17:

Features in a Lexicalized TAG for English, *Sharon Cote*

A TAG analysis of the Third construction in German, *Anthony Kroch, Beatrice Santorini, Aravind Joshi*

French and english determiners: Interaction of morphology, syntax and semantics in Lexicalized Tree Adjoining Grammars, *Anne Abeillé*

Japanese Tree Adjoining Grammar and its Application to On-Line Help System NeoAssist, *Kuniaki Uehara*

Coordination in TAG in the manner of CCG (Combinatory Category Grammars): Fixed vs Flexible Phrase Structure, *Aravind Joshi*