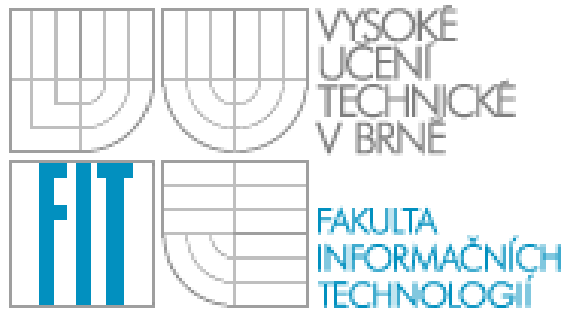


Lexicalized Tree Adjoining Grammar

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4. Lexicalized Tree Adjoining Grammar
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Lexicalization of CFG

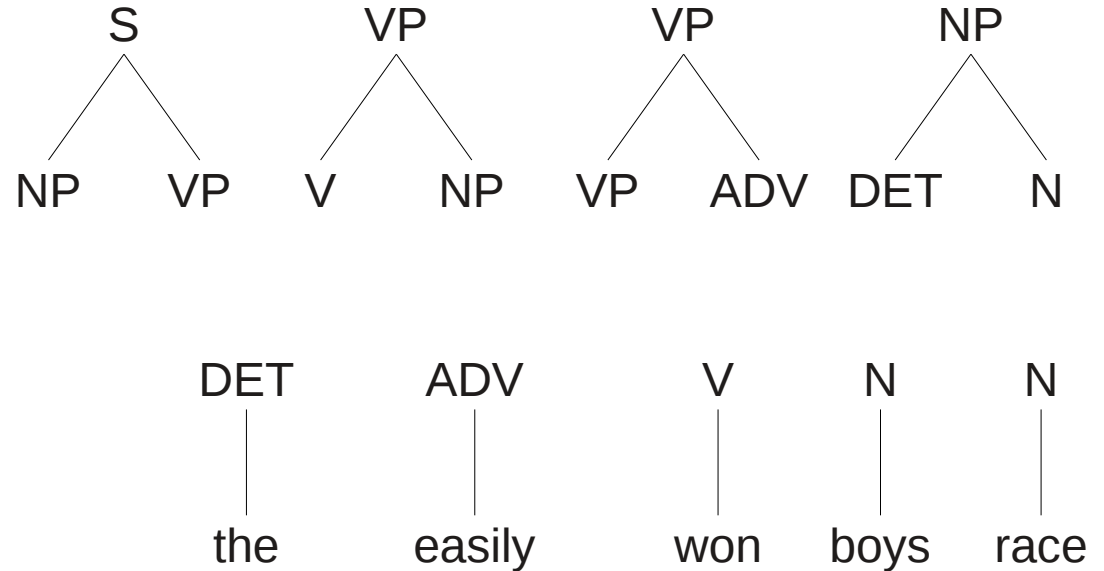
CFG G_1 :

1. $S \rightarrow NP VP$
2. $VP \rightarrow V NP$
3. $VP \rightarrow VP ADV$
4. $NP \rightarrow DET N$
5. $DET \rightarrow the$
6. $N \rightarrow \{man, car\}$
7. $V \rightarrow likes$
8. $ADV \rightarrow passionately$

Lexicalization of CFG

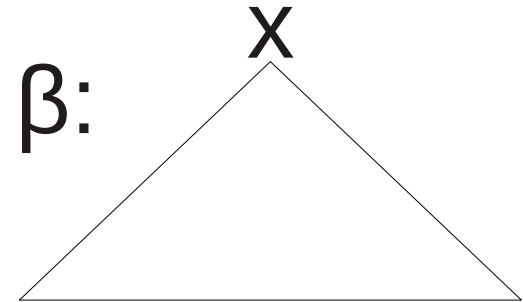
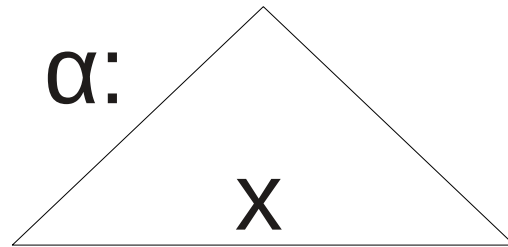
CFG G_1 :

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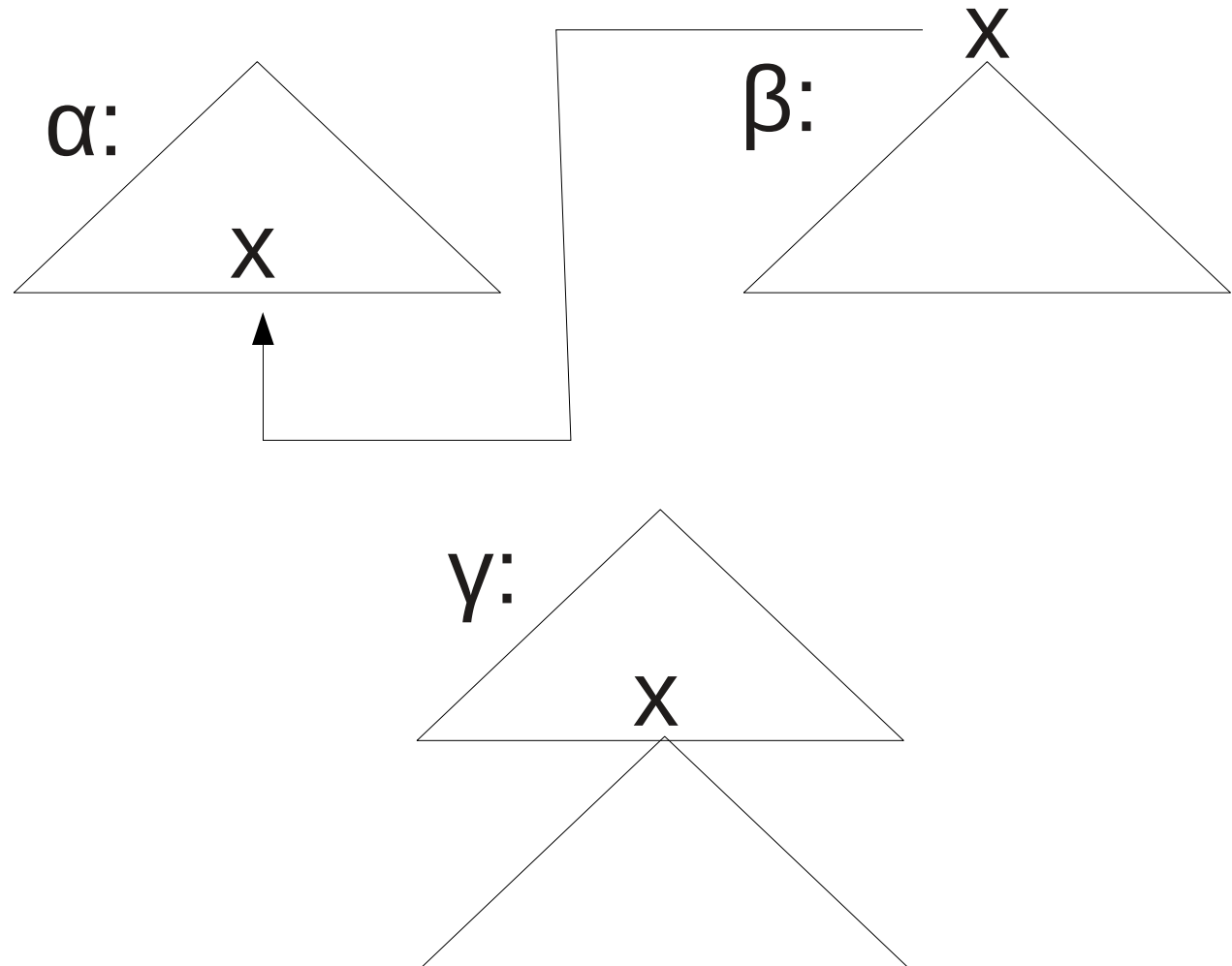
Tree Substitution Grammars (TSG)

Substitution:



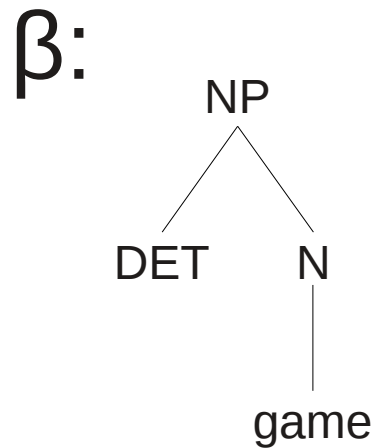
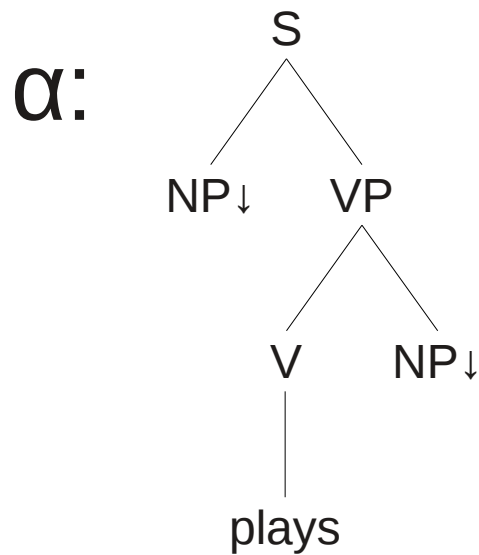
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Substitution:



Tree Substitution Grammars (TSG)

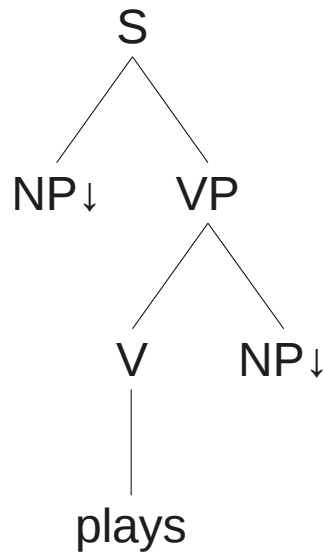
Substitution:



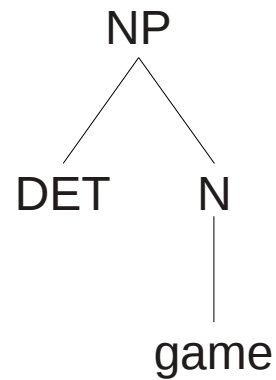
Tree Substitution Grammars (TSG)

Substitution:

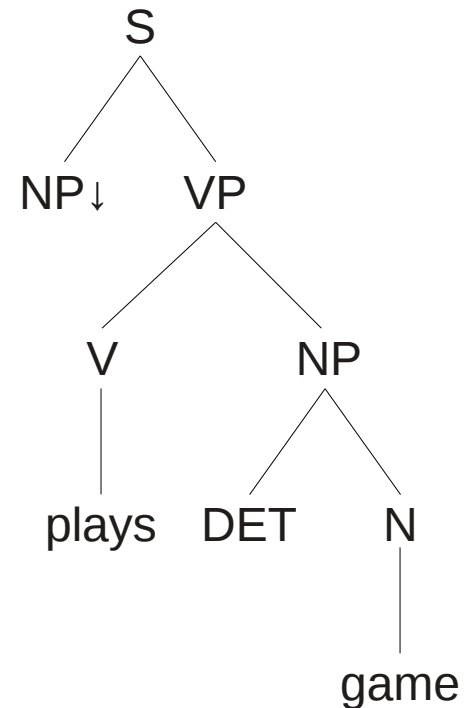
α :



β :



γ :



Tree Substitution Grammars (TSG)

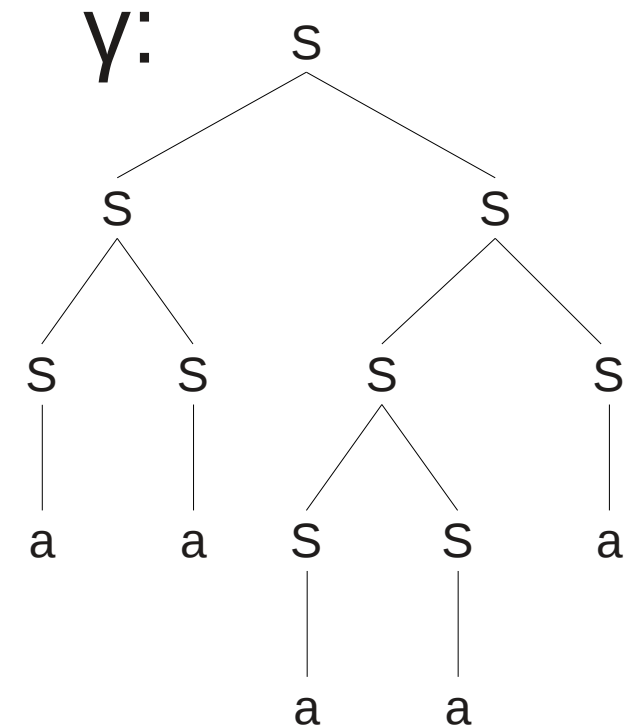
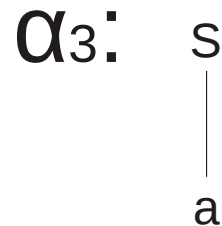
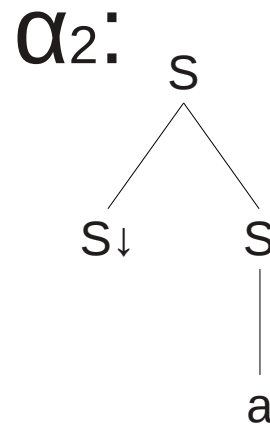
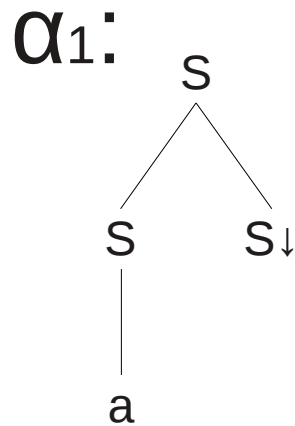
Can CFG be strongly lexicalized using TSG?

Tree Substitution Grammars (TSG)

CFG G_2 :

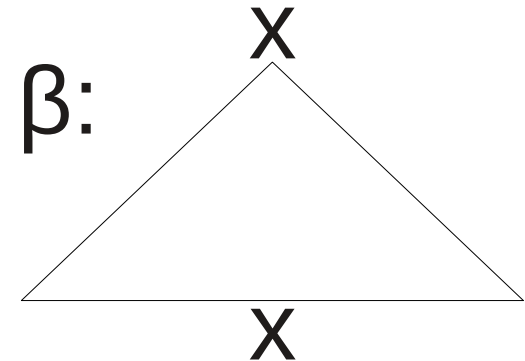
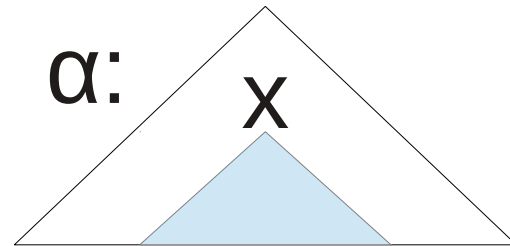
$S \rightarrow SS$

$S \rightarrow a$



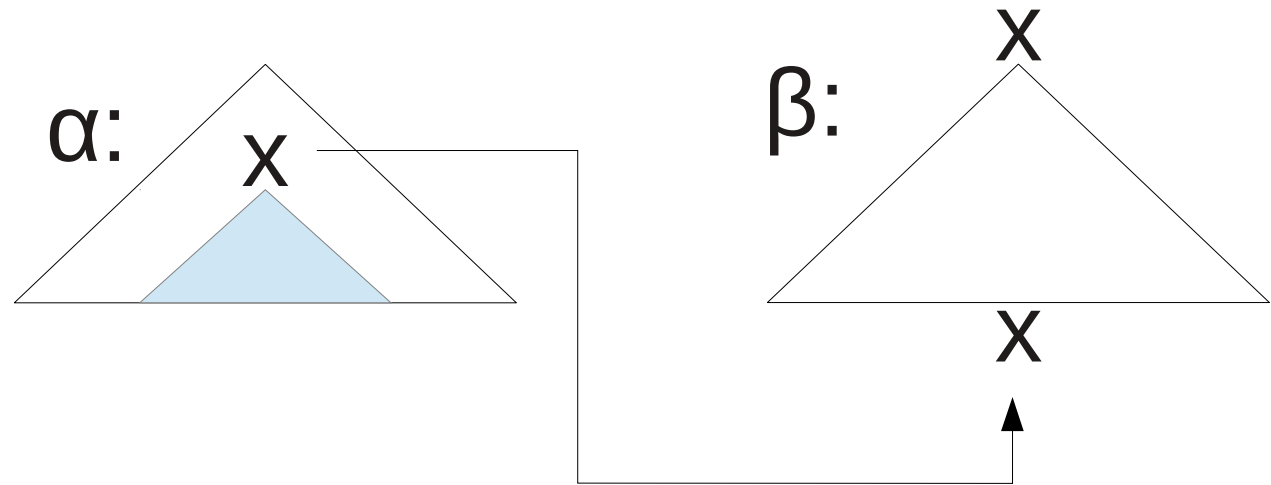
Tree Adjoining Grammars (TAG)

Adjunction:



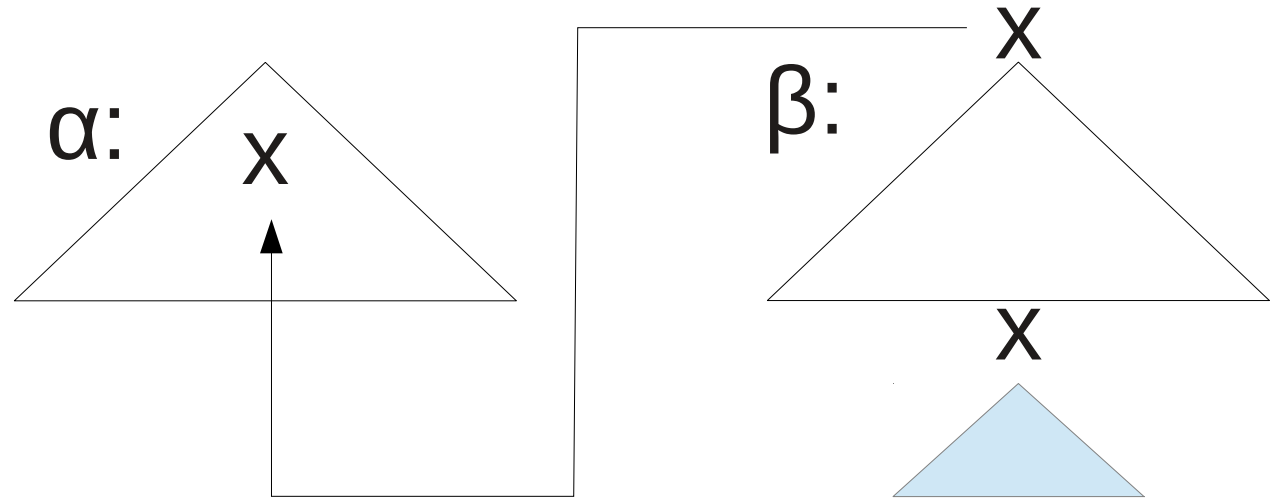
Tree Adjoining Grammars (TAG)

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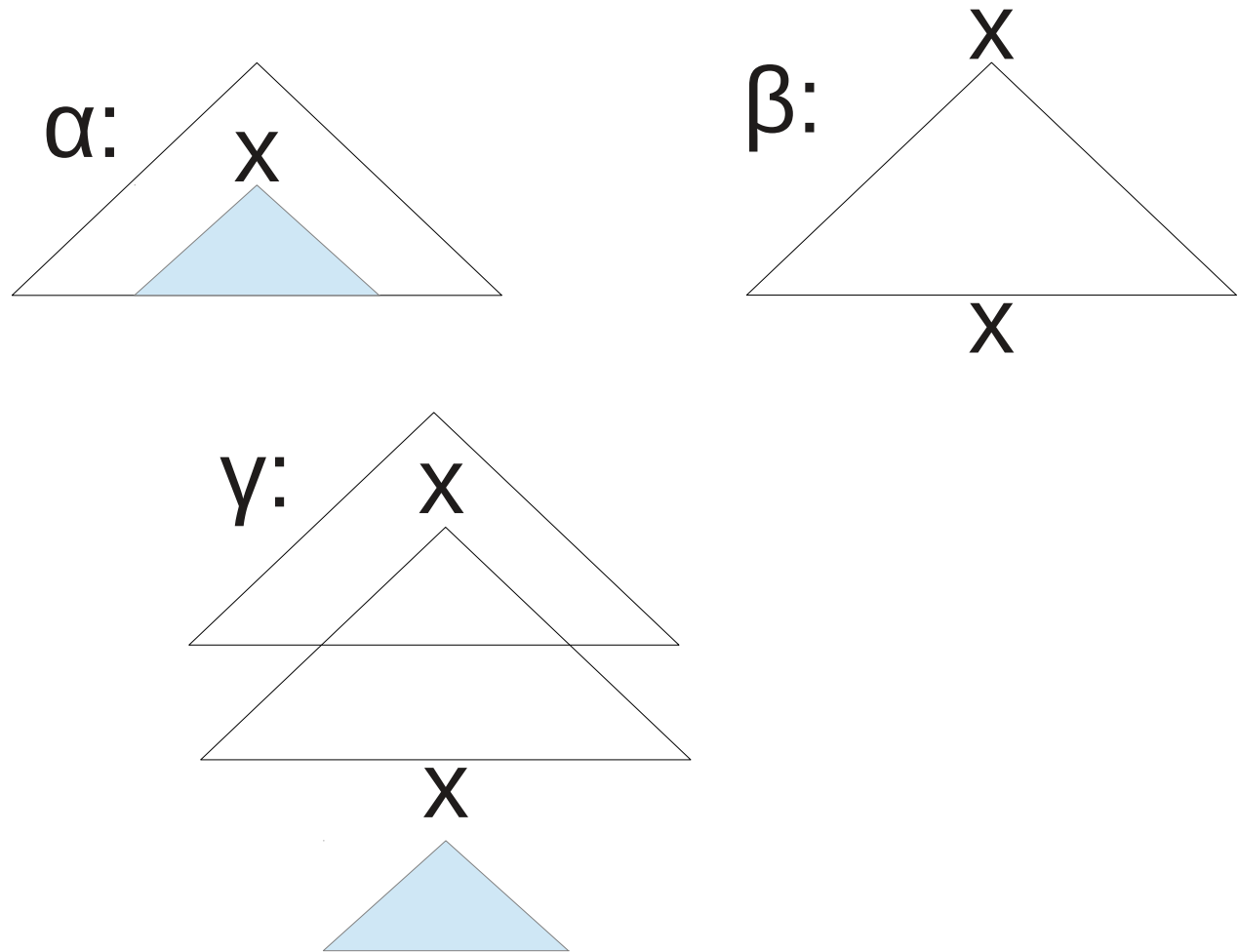
Tree Adjoining Grammars (TAG)

Adjunction:



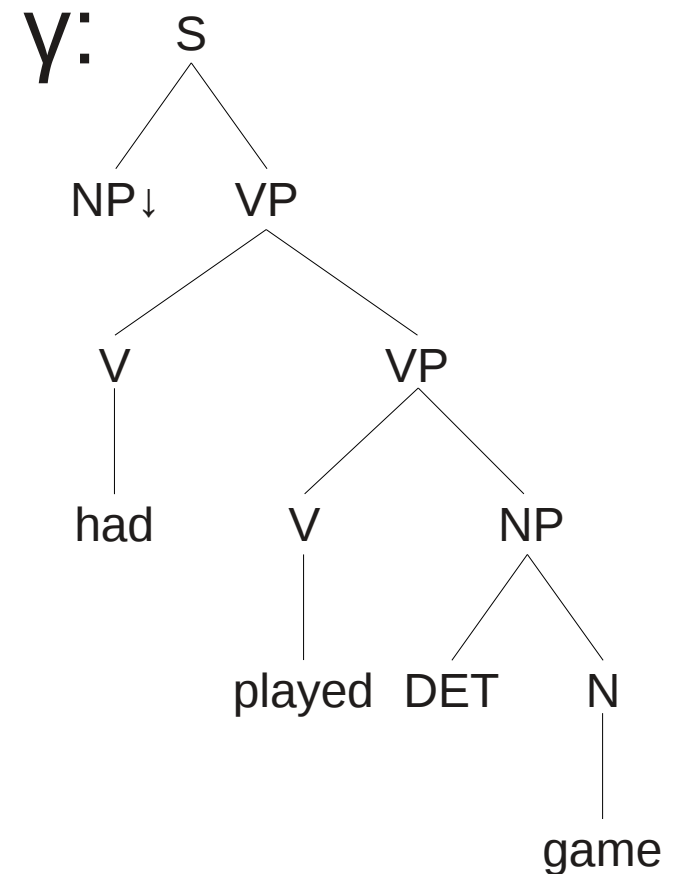
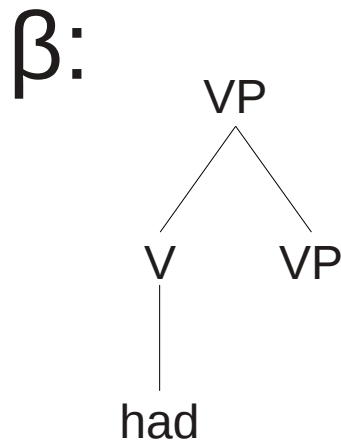
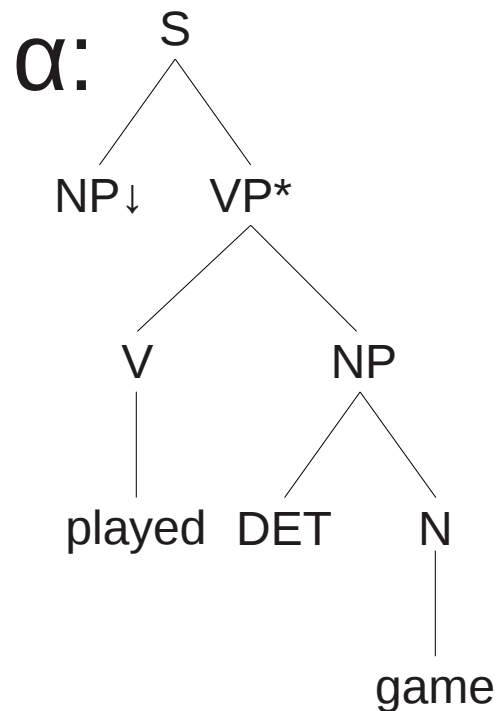
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Tree Adjoining Grammars (TAG)

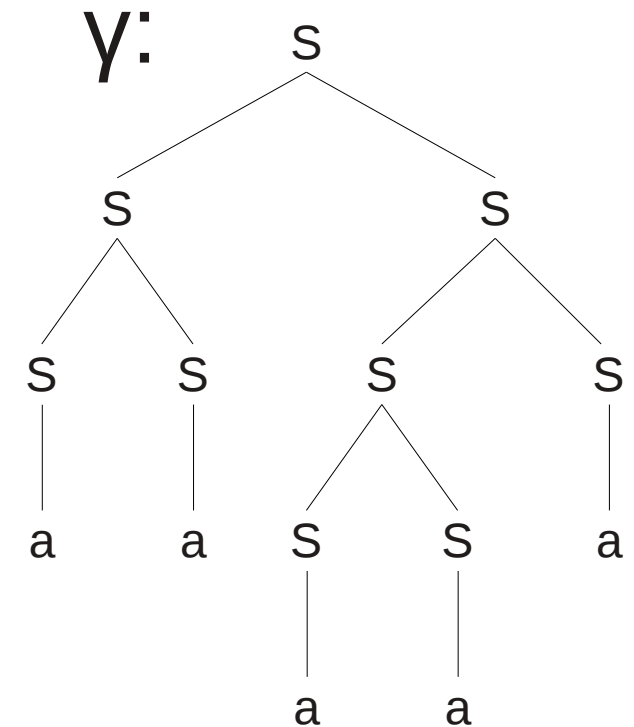
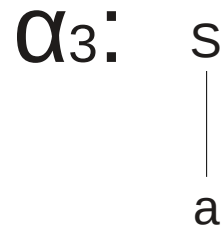
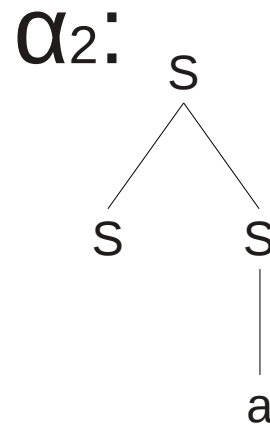
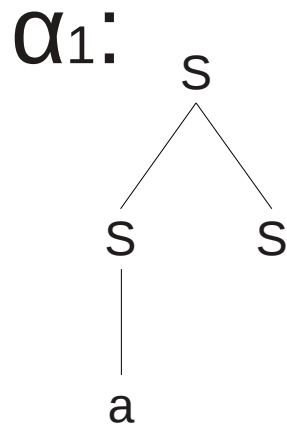
Can CFG be strongly lexicalized using TAG?

Tree Adjoining Grammars (TAG)

CFG G_2 :

1. $S \rightarrow SS$

2. $S \rightarrow a$



Tree Adjoining Grammars (TAG)

Open Problem:

Is there another way to lexicalize CFG
without adjunction?

Lexicalized Tree Adjoining Grammars (LTAG)

LTAG:

$$(T, N, I, A, S), \\ N \cap T = \emptyset, S \in N$$

1. T is a finite set of terminal symbols;
2. N is a finite set of non-terminal symbols;
3. S is a distinguished non-terminal symbol;
4. I is a finite set of finite trees, called initial trees;
5. A is a finite set of finite trees, called auxiliary trees;
6. All terminal symbols are lexical items;
7. At least one terminal symbol must appear at the frontier of all initial or auxiliary trees.

Lexicalized Tree Adjoining Grammars (LTAG)

Initial Trees:

1. Interior nodes are labeled by non-terminals;
2. Nodes on the frontier of initial trees are labeled by terminals or non-terminals; non-terminal symbols on the frontier of the trees in / are marked for substitution;

Lexicalized Tree Adjoining Grammars (LTAG)

Initial Trees:

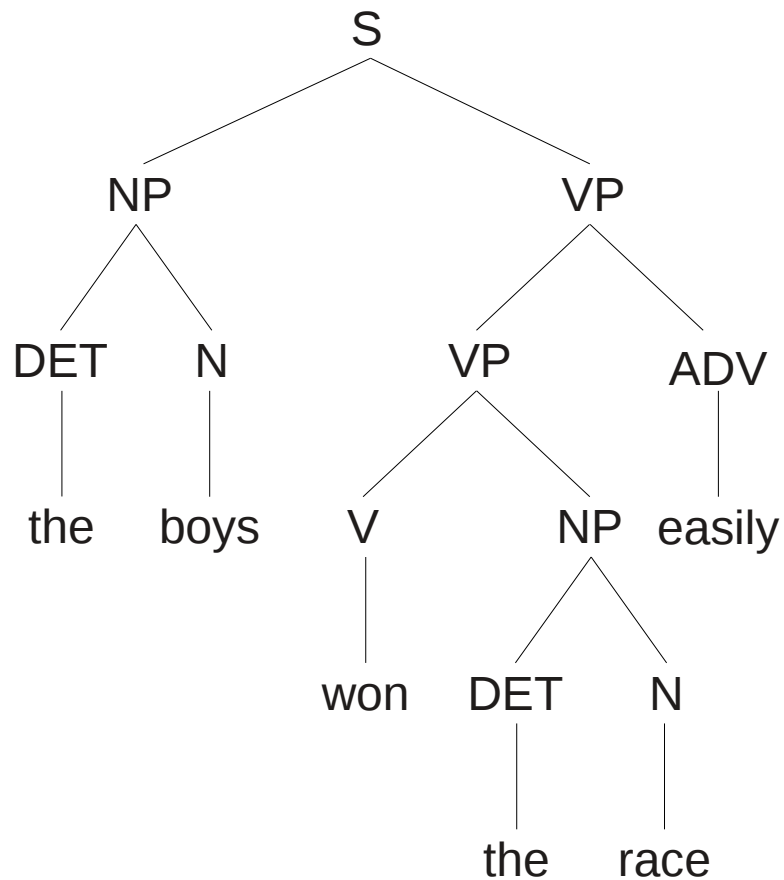
1. Interior nodes are labeled by non-terminals;
2. Nodes on the frontier of initial trees are labeled by terminals or non-terminals; non-terminal symbols on the frontier of the trees in I are marked for substitution;

Lexicalized Tree Adjoining Grammars (LTAG)

Auxiliary Trees:

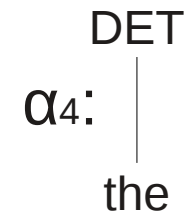
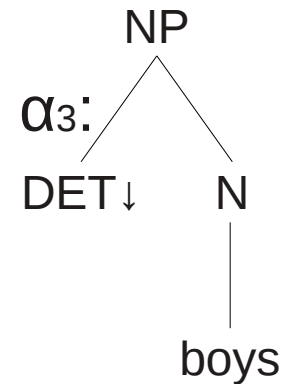
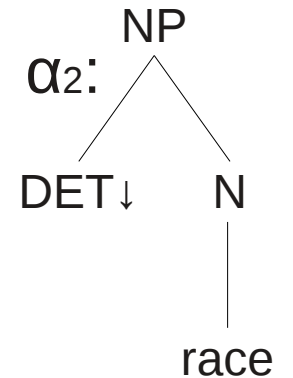
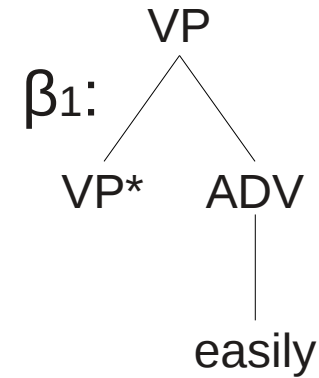
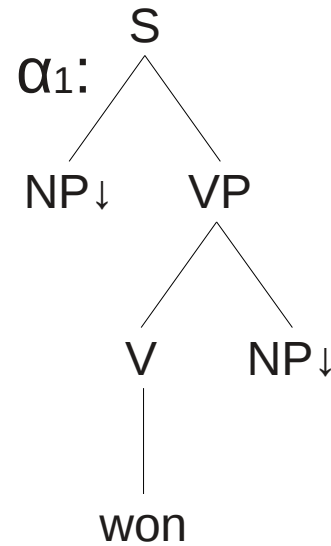
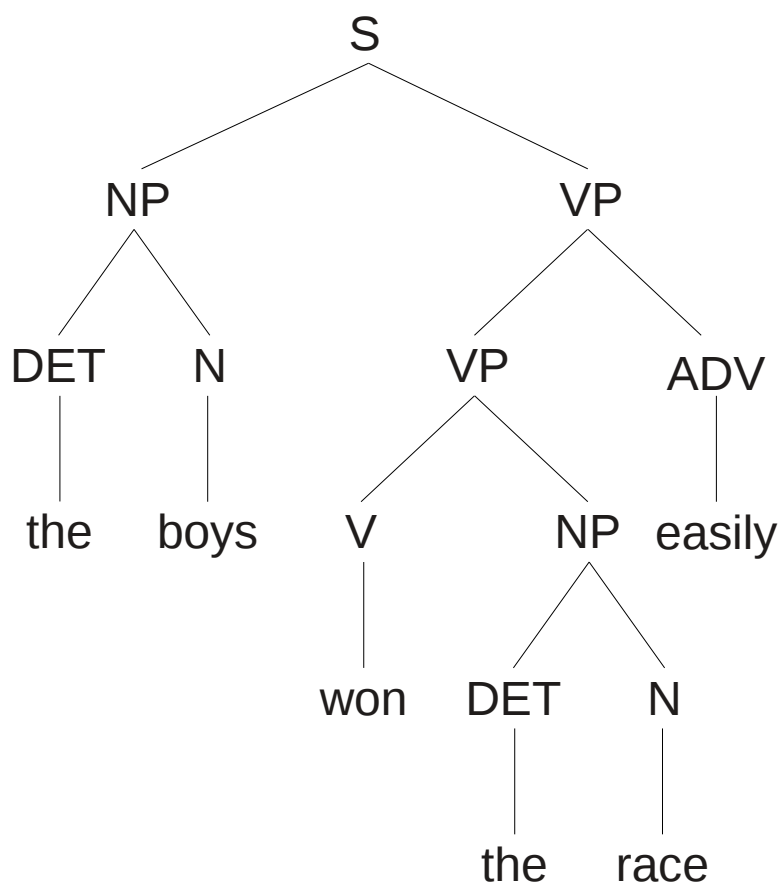
1. Interior nodes are labeled by non-terminal symbols;
2. Nodes on the frontier of auxiliary trees are labeled by terminal symbols or non-terminal symbols. Non-terminal symbol on the frontier of the trees in A are marked for substitution except for one node, called the foot node; the foot node must be identical to the label of the root node.

Lexicalized Tree Adjoining Grammars (LTAG)

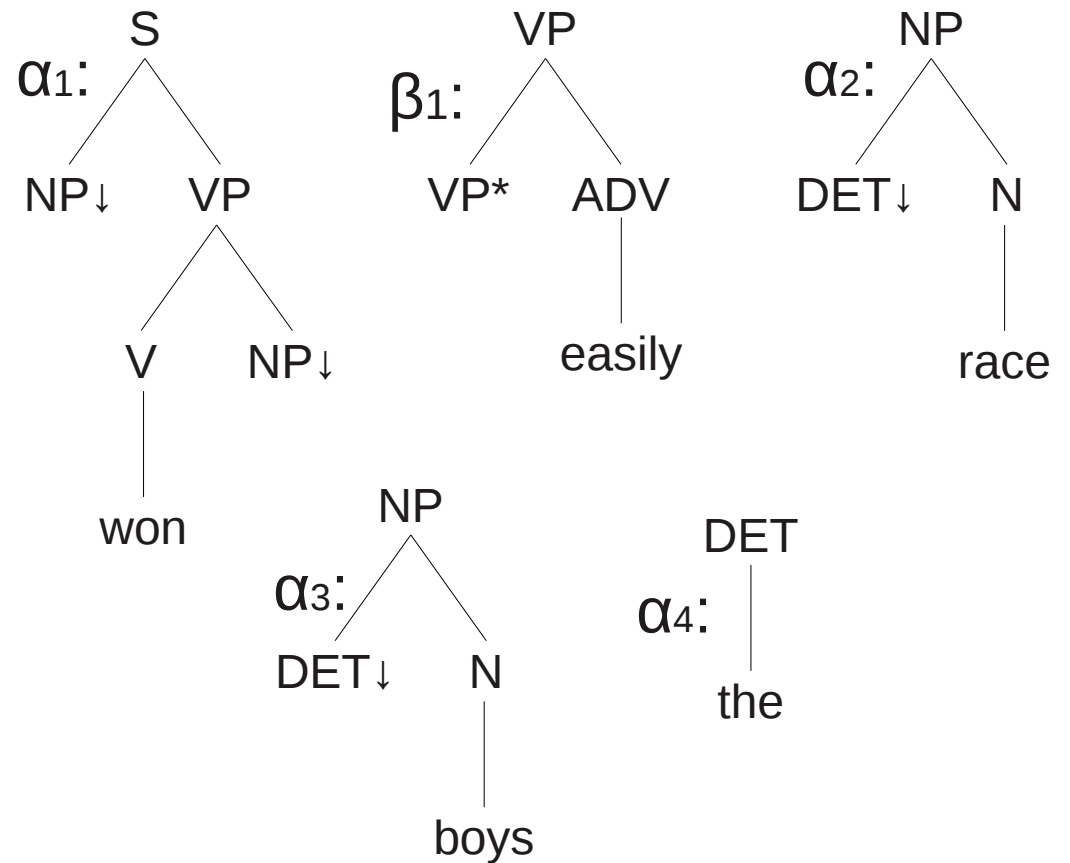


derived tree

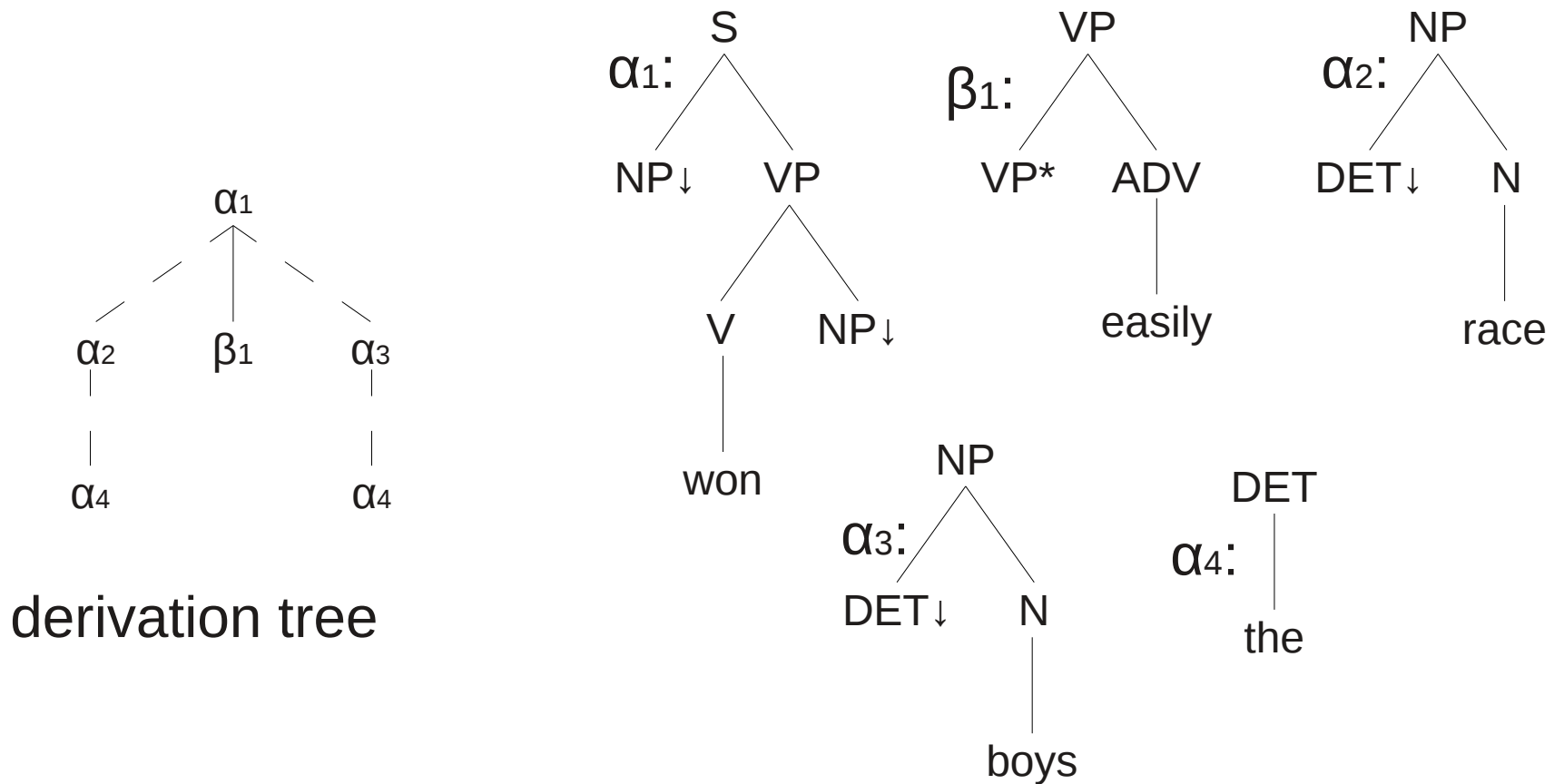
Lexicalized Tree Adjoining Grammars (LTAG)



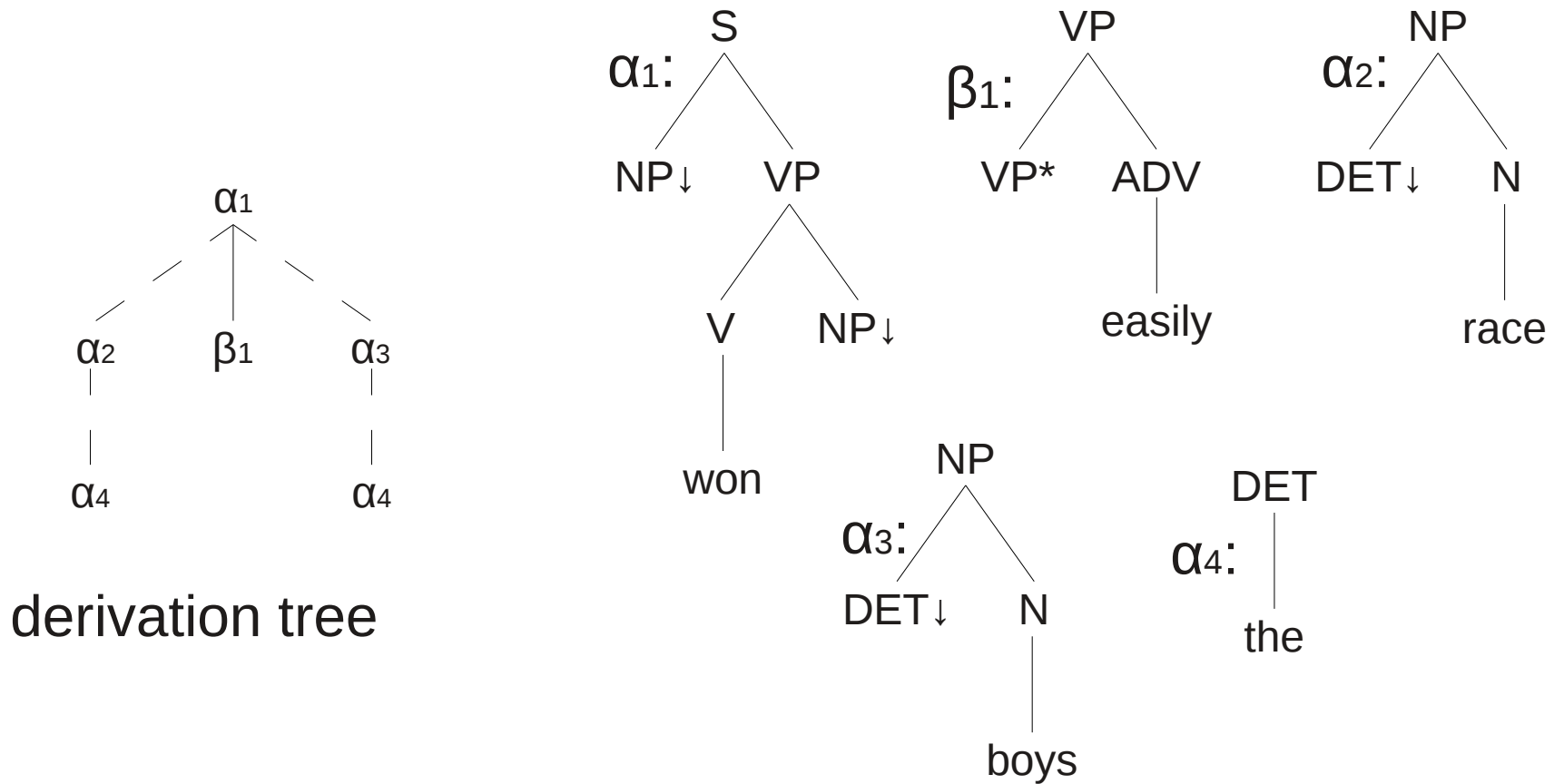
Lexicalized Tree Adjoining Grammars (LTAG)



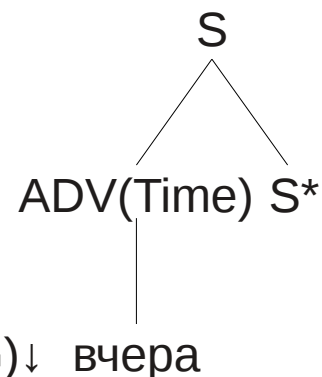
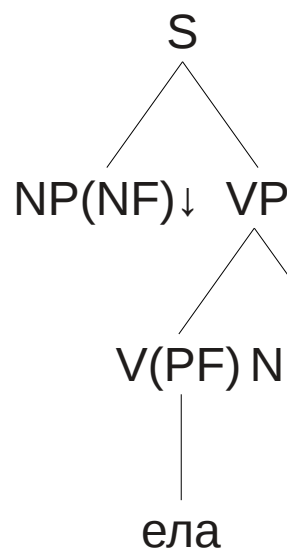
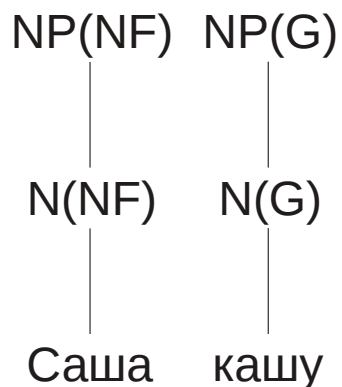
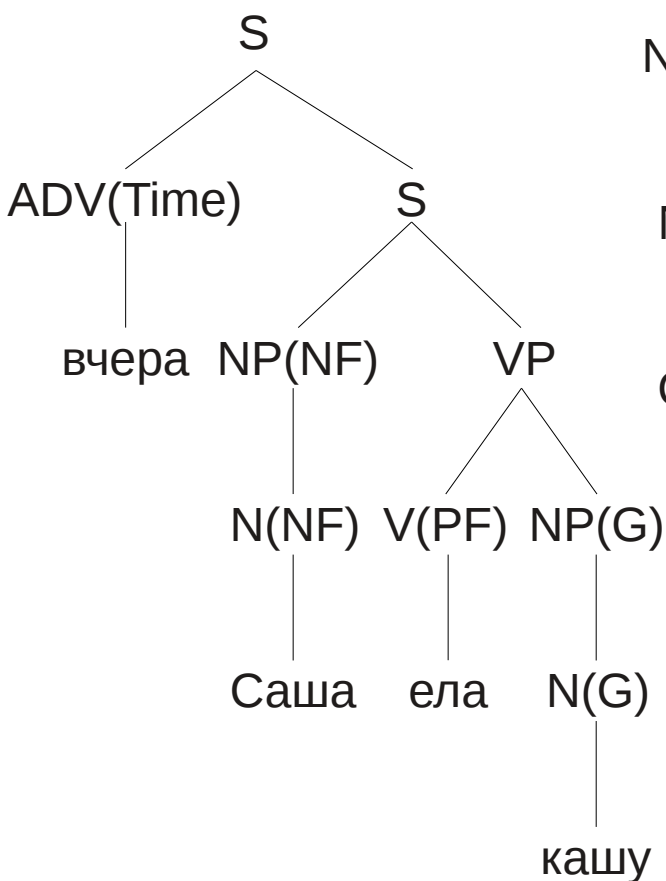
Lexicalized Tree Adjoining Grammars (LTAG)



Lexicalized Tree Adjoining Grammars (LTAG)



Russian Example of LTAG



N(NF) – noun in nominative case
 N(G) – noun in generative case
 V(PF) – verb, past, feminine gender
 ADV(Time) – adverb of time

References

1. Joshi, A.K. 2003. Starting with complex primitives pays off: Complicate Locally, Simplify Globally. Slides for CogSci 2003;
2. Joshi, A.K. and Schabes, Y. 1991. Tree Adjoining Grammars and Lexicalized Grammars, DCIS University of Pennsylvania;
3. Joshi, A.K. and Schabes, Y. 1997. Tree-Adjoining Grammars, in G. Rozenberg and A. Salomaa (eds.), Handbook of Formal Languages, Springer, Berlin, New York, pp. 69 - 124.

Thank you for your attention!