Grammar Formalisms
Syntax in LTAG

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Outline

Derivation trees (1)

TAG derivations are described by **derivation trees**:
For each derivation in a TAG there is a corresponding derivation tree. This tree contains

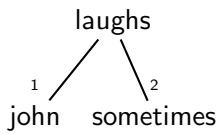
- **nodes** for all elementary trees used in the derivation, and
- **edges** for all adjunctions and substitutions performed throughout the derivation.

Whenever an elementary tree γ was attached to the node at address p in the elementary tree γ', there is an edge from γ' to γ labeled with p.

(For the tree addresses, **Gorn addresses** are used: The root has address ϵ (or 0), and the ith daughter of the node with address p has address pi.)

Derivation trees (2)

Example:
derivation tree for the derivation of *John sometimes laughs*



⇒ Semantic dependency graph?

Derivation trees

- are context-free, and
- uniquely determine the derived tree.

⇒ TAG is a **linear context-free rewriting system, LCFRS**

Linguistic analyses with LTAG

- Linguistic role of the adjunction/substitution dualism
- Design principles for elementary trees
  - Lexicalization
  - Extended domain of locality
  - Factoring of recursion
  - Elementary tree minimality

Lexicalization

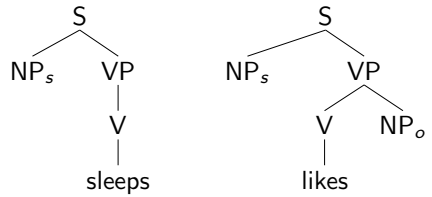
Each elementary tree has at least one non-empty lexical item, its lexical **anchor**.

⇒ All widely used grammar formalisms support some kind of lexicalization!

Reasons for lexicalization:

- The properties of a constituent depend on the lexical items occurring in the constituent: the structure of a VP depends on the subcategorization properties of its verb.

$VP \rightarrow V_{intrans}$
$VP \rightarrow V_{trans} NP$

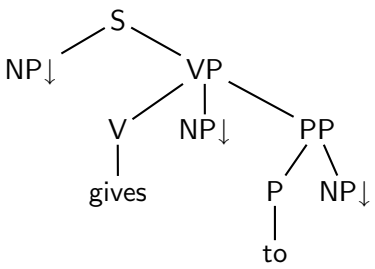


Elementary tree minimality

- Elementary trees contain slots only for the complements of their lexical head.
- Elementary trees are projections of lexical items.
- Factoring of recursion

Example: to-infinitives
Example:

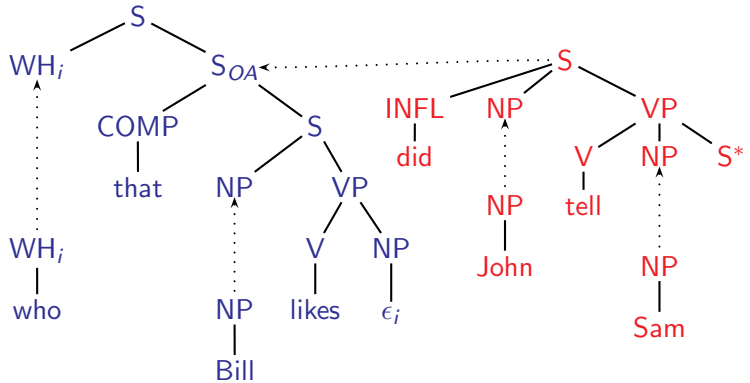
(1) John gives a book to Mary



Extended domain of locality

- All dependencies are represented in elementary trees.
- locality constraints (constraints for UDC, island constraints) → adjunction constraints

(2)
a. who$_i$ did John tell Sam that Bill likes t_i
b. who$_i$ did John tell Sam that Mary said that Bill likes t_i



Principles related to semantics

Predicate argument cooccurrence:

Each elementary tree associated with a predicate contains substitution nodes for each of its arguments.

Semantic anchoring:

Elementary trees are not semantically void (*to, that.*)

Compositional principle:

An elementary tree corresponds to a single semantic unit.

Functional elements

Besides lexical predicates, there are functional elements (complementizers, determiners, auxiliaries, negation) whose treatment in LTAG is less clear. They can be

- either in separate elementary trees (e.g., XTAG grammar)
- or in the elementary tree of the lexical item they are associated with.

Sample derivations

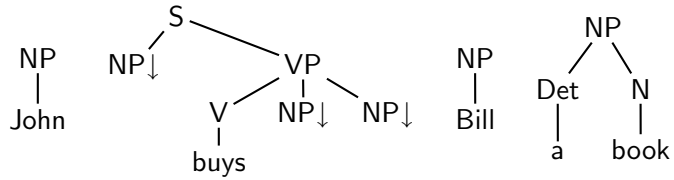
- Complements: NPs, PPs, adjectives, clauses (raising, controlling)
- Adjuncts: adjectives, particles, relative clauses

Complements ⇒ Substitution, Adjuncts ⇒ Adjunction ?

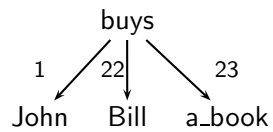
Sample derivations - Complements (1)

(3) John buys Bill a book

Elementary trees:

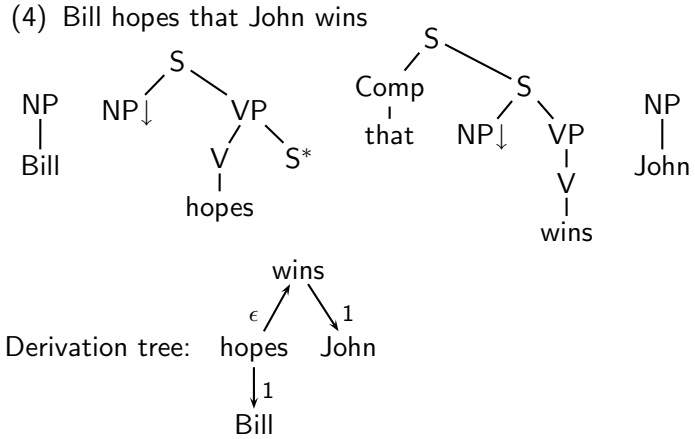


Derivation tree:



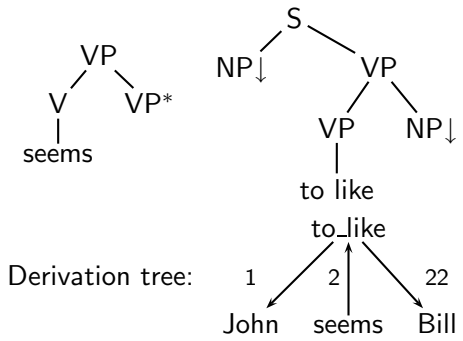
Sample derivations - Complements (2)

(4) Bill hopes that John wins



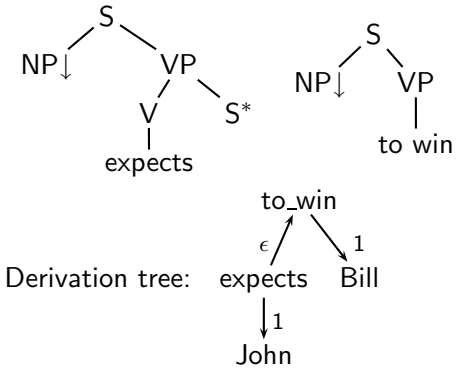
Sample derivations - Complements (2)

(5) John seems to like Bill



Sample derivations - Complements (2)

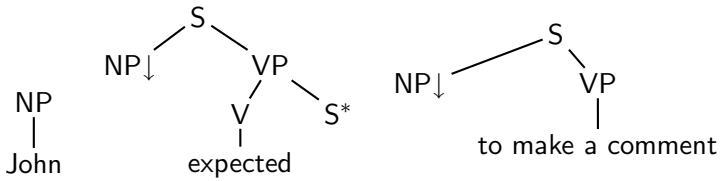
(6) John expects [Bill to win]



Sample derivations - Complements (2)

(7) John expected [Mary to make a comment]

expected selects for a subject NP and an infinitival sentence:

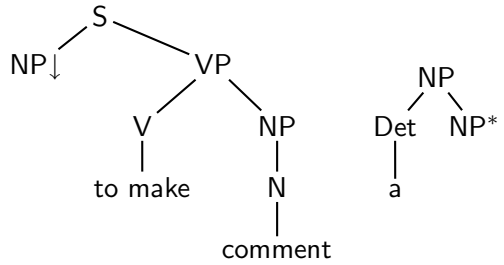


The sentential object is realised as a foot node in order to allow extractions:

(8) whom does John expect to come?

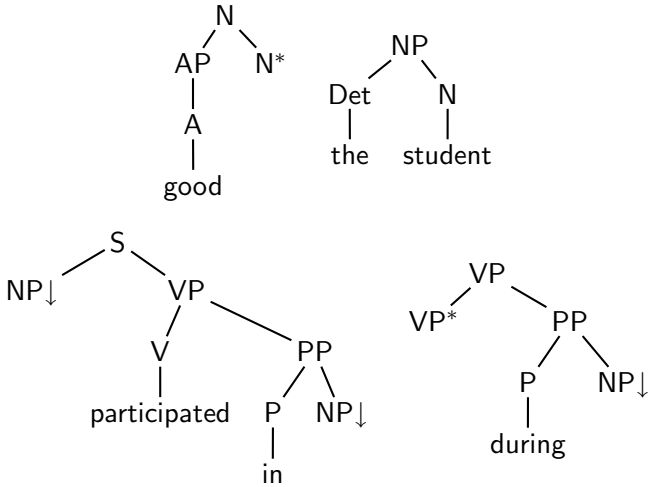
Sample derivations - Complements (3)

to make a comment: *make* and *comment* in the same elementary tree since they form a light verb construction:



Sample derivations - Adjuncts (1)

(9) the good student participated in every course during the semester



Sample derivations - Adjuncts (1)

(10) the dog [who ate the cake]

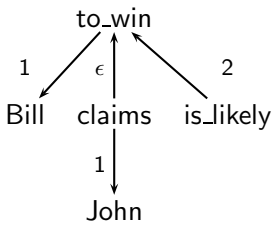
Extraposed relative clauses:

(11) Somebody$_i$ lives nearby [who$_i$ has a CD-burner].

Derivation trees = Semantic dependency structure ?

The derivation tree is not always the semantic dependency structure:

(12) John claims Bill is likely to win



Symmary

- TAG derivations are described by derivation trees.
- In LTAG, elementary trees for lexical predicates contain slots for all arguments of these predicates, for nothing else. Recursion is factored away.
- The derived tree describes the constituent structure while the derivation tree is close to a semantic dependency graph.