Grammar Implementation with Tree Adjoining Grammar:

LTAG Semantics

Laura Kallmeyer, Simon Petitjean

Heinrich-Heine-Universität Düsseldorf

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Overview

1. Introduction

2. Bridge Verbs

3. Raising, Control, Adverbs

[Kallmeyer and Romero, 2008]

Introduction

Reminder: quantifiers in LTAG with unification-based semantics:

$$\boxed{\begin{array}{l} l_2 : every'(x, \boxed{4}, \boxed{5}), \\ \boxed{4} \geq \boxed{7}, \ \boxed{5} \geq \boxed{6} \end{array}}$$

$$\text{NP}_{[\text{I}=x,\text{MINS}=\boxed{6}]}$$

$$\text{Det} \qquad \text{NP*}_{[\text{I}=x,\text{P}=\boxed{7}]}$$

$$\text{every}$$

$$\text{NP}_{[\text{I}=\boxed{8},\text{P}=l_4]}$$

$$\text{N}$$

$$\text{man}$$

$$\boxed{l_4 : man'(\boxed{8})}$$

$$\text{S}_{[\text{P}=\boxed{3}]}$$

$$\text{NP}^{[\text{I}=\boxed{1},\text{MAXS}=\boxed{2},\text{MINS}=l_1]} \qquad \text{VP}^{[\text{P}=\boxed{3}]}_{[\text{P}=l_1]}$$

$$\text{V}$$

$$\text{laughs}$$

$$\boxed{\begin{array}{l} l_1 : laugh'(\boxed{1}), \\ \boxed{2} \geq \boxed{3} \end{array}}$$
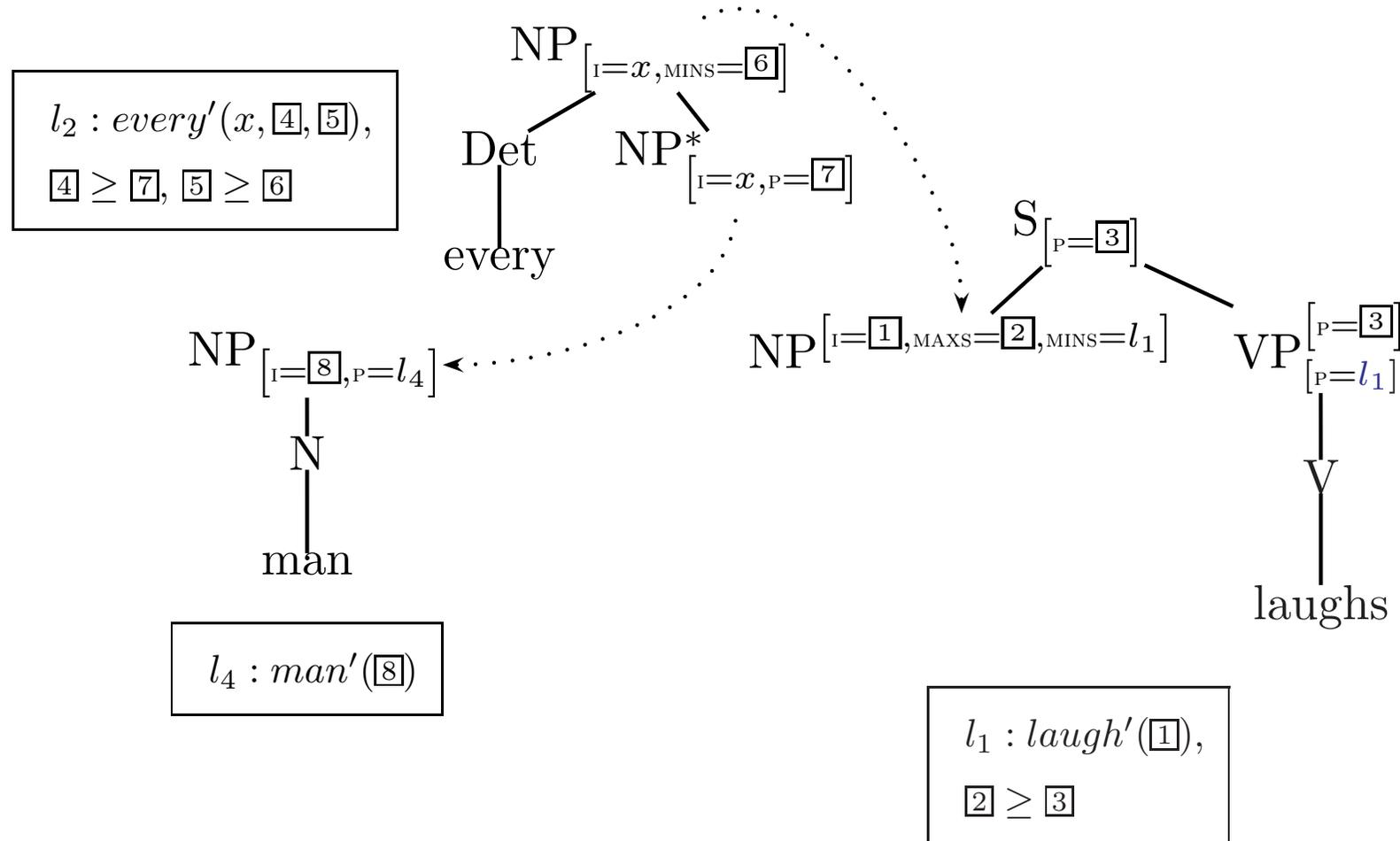
Introduction

Reminder: quantifier data

Quantificational NPs can in principle scope freely; their scope is not directly linked to their surface position.

(1) Exactly one student admires every professor
$\exists > \forall, \forall > \exists$

(2) Two policemen spy on someone from every city
$\forall > \exists > 2$ (among others)

(3) John seems to have visited everybody
$seem > \forall, \forall > seem$

Attitude verbs block the scope of embedded quantificational NPs:

(4) Mary thinks John likes everybody
thinks > everybody, *everybody > thinks

Bridge verbs (1)

In LTAG, because of the extended domain of locality, it is straightforward to define some elements as blocking the embedded scope window and defining a new one for higher quantifiers:

(5) Mary thinks John laughs

MAXS_1

$\text{MINS}_1 : think'$

MAXS_2

$\text{MINS}_2 : laugh'$

```
                                    S
                                   / \
                              Mary    VP
                                     / \
                                 thinks  S
                                        / \
                                    John   VP
                                            |
                                          laughs
```

Bridge verbs (2)

(6) Mary thinks John laughs

$S_{[P=\boxed{5}]}$

$NP_{[MAXS=\boxed{4},MINS=l_2]}$

$VP^{[P=\boxed{5}]}_{[P=l_2]}$

$S_{[P=\boxed{2},MAXS=\boxed{1}]}$

thinks

$S^*_{[MAXS=\boxed{6}]}$

$NP^{[MAXS=\boxed{1},MINS=l_1]}$

$VP^{[P=\boxed{2}]}_{[P=l_1]}$

laughs

$l_2 : think'(m,\boxed{3}),$

$\boxed{4} \geq \boxed{5}, \boxed{3} \geq \boxed{6}$

$l_1 : laugh'(j),$

$\boxed{1} \geq \boxed{2}$
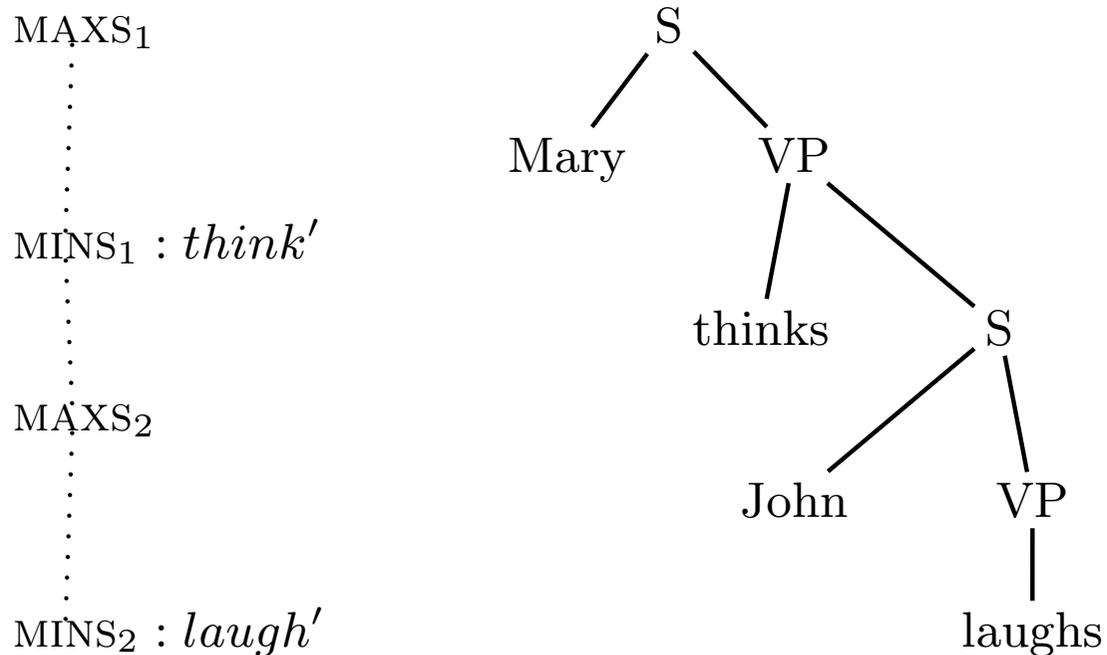
Bridge verbs (3)

(7) Mary thinks John likes everybody

- *everybody* has to take scope within the scope window of *likes.*

- *thinks* scope over the MAXS of *likes,* and consequently also over *everybody*

$\Rightarrow$ only one scope order:

(8) $think'(m, every'(x, person'(x), like'(j, x)))$

Adverbs, Raising and Control Verbs (1)

In contrast to quantificational NPs, the scope of a quantificational element attached to the verbal spine is fully determined by the surface syntax:

(9) John seems to sometimes laugh
    a. $seem'(sometimes'(laugh'(j)))$
    b. * $sometimes'(seem'(j, laugh'(j)))$

(10) John wants Mary to sometimes laugh.
    a. $want'(j, sometimes'(laugh'(m)))$
    b. * $sometimes'(want'(j, laugh'(m)))$

Relevant features: P features that decorate the verbal spine.

Adverbs

(11) Intentionally, John often meets Mary

$S_{[p=l_2]}$ ⋯⋯⋯⋯⋯➤ $S_{[p=\boxed{1}]}$

Adv $S^{*[p=\boxed{3}]}$

intentionally

NP

John

$VP^{[p=\boxed{1}]}_{[p=l_1]}$

V   NP

meets   Mary

$VP_{[p=l_3]}$

Adv $VP^{*[p=\boxed{5}]}$

often

$l_2 : intentionally'(\boxed{2}),$

$\boxed{2} \geq \boxed{3}$

$l_1 : meet'(j, m)$

$l_3 : often'(\boxed{4}),$

$\boxed{4} \geq \boxed{5}$
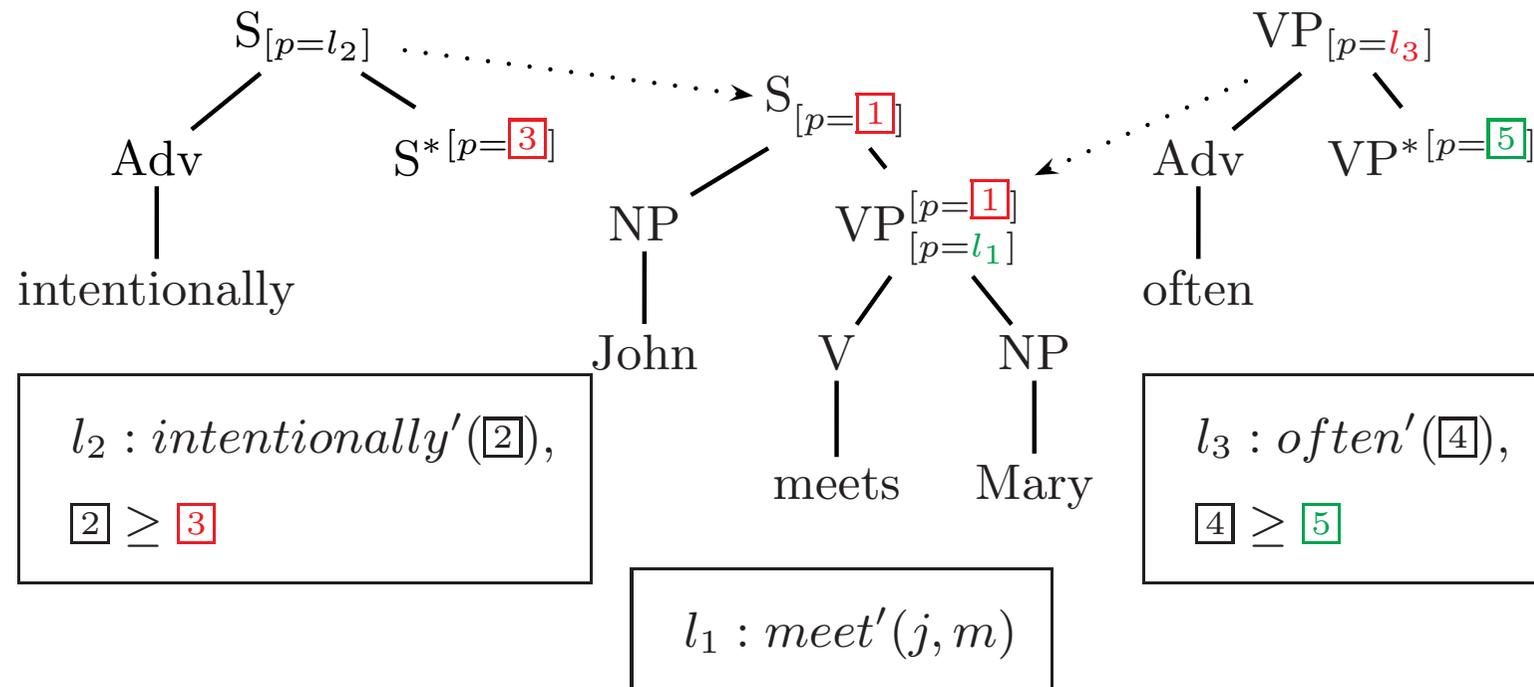
Raising verbs

Raising verbs are similar to adverbs:

(12) John seems to come
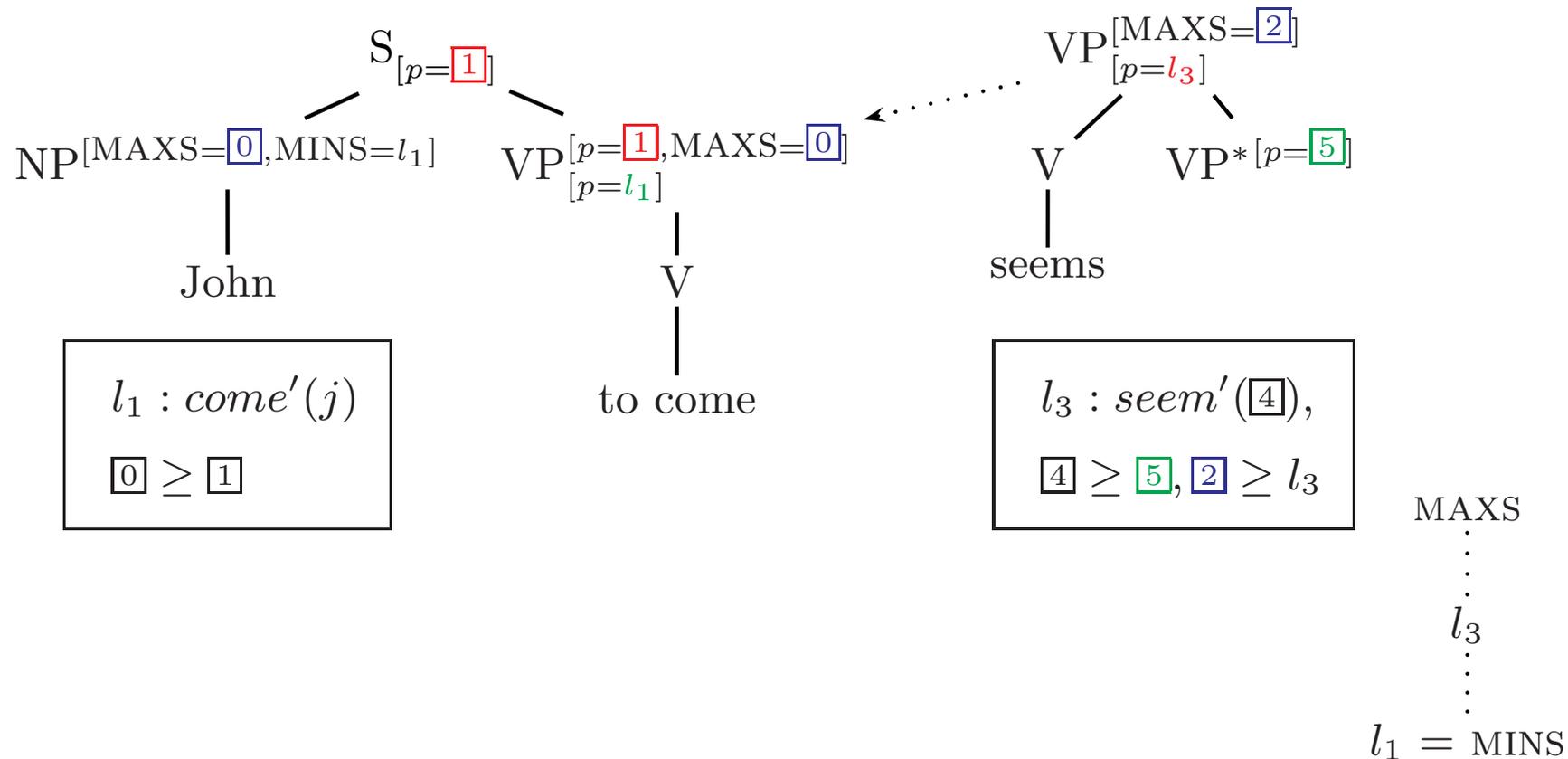
Control verbs (1)

- Scopal behaviour as adverbs and raising verbs: embedding of lower P and providing of a new, higher P value.

- Passes its MAXS to the MAXS of the embedded infinitive (no blocking of quantifier scope).

- Provides the controller via an I feature.

Control verbs (2)

(13) John tries to sleep

$S_{[P=\boxed{5}]}$ $\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\rightarrow$ $S_{[P=\boxed{3},I=\boxed{1}]}$

$NP^{[I=\boxed{8},MAXS=\boxed{4},MINS=l_2]}$ $VP^{[P=\boxed{5}]}_{[P=l_2]}$ PRO $VP^{[P=\boxed{3}]}_{[P=l_1]}$

tries $\quad$ $S*^{[P=\boxed{6},I=\boxed{8},MAXS=\boxed{4}]}$ $\qquad$ to sleep
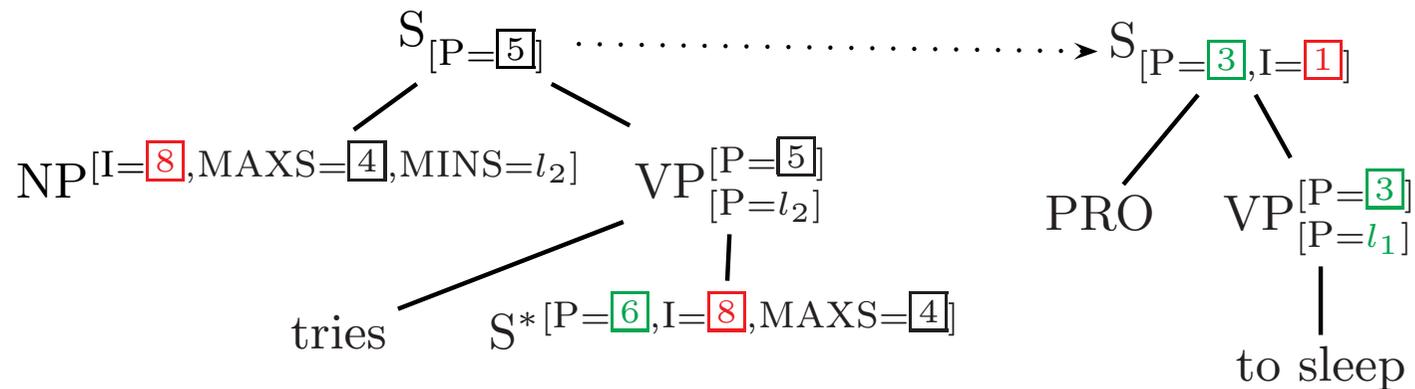
$$l_2 : try'(\boxed{8},\boxed{7}),\ \boxed{4} \geq \boxed{5}, \boxed{7} \geq \boxed{6}$$

$$l_1 : sleep'(\boxed{1})$$

References

[Kallmeyer and Romero, 2008] Kallmeyer, L. and Romero, M. (2008).
    Scope and situation binding in LTAG using semantic unification.
    Research on Language and Computation, 6(1):3–52.