Compositional Treatment of Quantification

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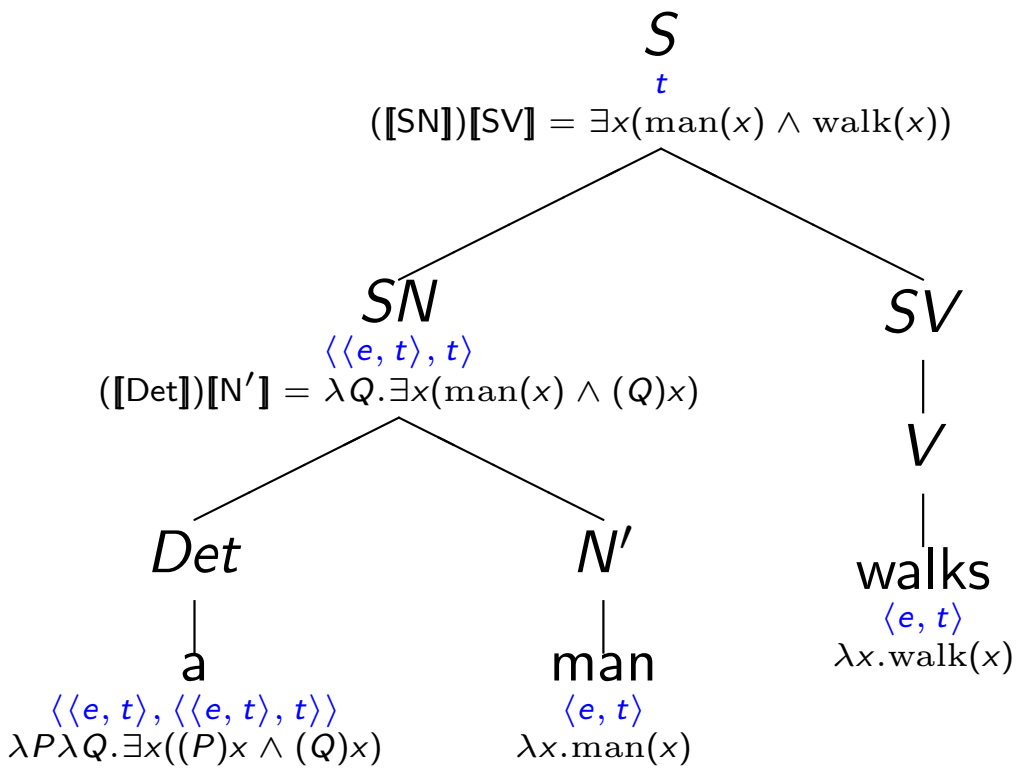
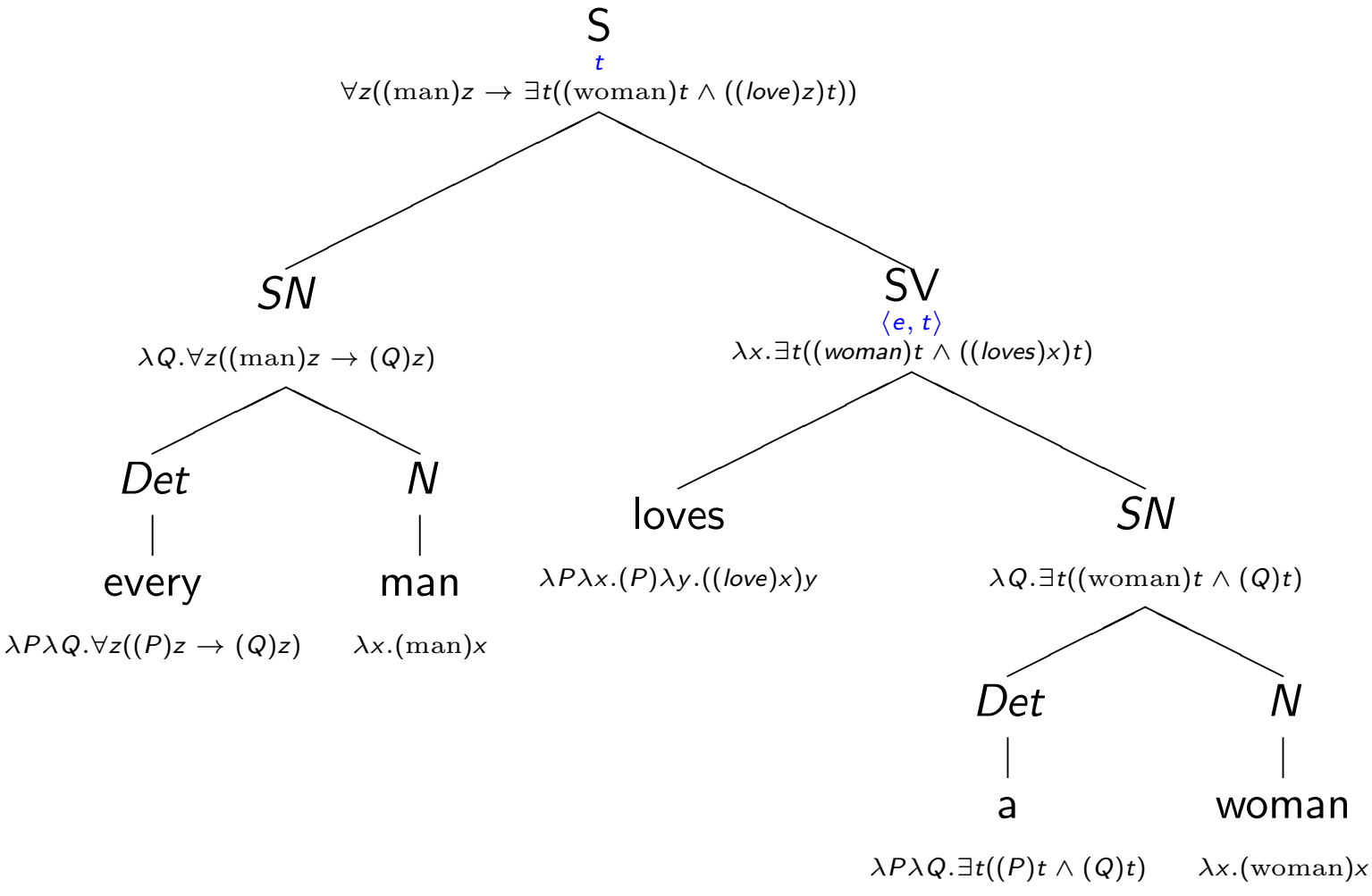
Plan

Quantifiers



Fragment: summary



Quantifiers interpretation

in situ ?

(1) All the actors of the film love a woman.

Quantifiers interpretation

in situ ?

(1) All the actors of the film love a woman.

$\forall\exists$ But it is not always their wife.

Quantifiers interpretation

in situ ?

(1) All the actors of the film love a woman.

∃∀ Even though she is not a good actress

Quantifiers interpretation

in situ ?

(1) All the actors of the film love a woman.

Isolated example ?

Quantifiers interpretation

in situ ?

(1) All the actors of the film love a woman.

(2)
a. All students have read a paper.
b. Each newcomer have to take a test.
c. A specialist will review each paper.
d. A guide will accompany every visitor.
e. There is a label next to each plate.

Quantifiers interpretation

Two problems for compositionality

- non respect of the locality principle (semantic contribution unique and independant from the context)
- no provision for (semantic) ambiguity in our system

Quantifiers interpretation

Possible answers

- Treatment through types: lexical/semantic ambiguity
- Quantifying in (Montague, 1973)
- Mouvement (QR, May (1989))
- Semantic Treatment (Cooper storage)
- Treatment through enrichment of the logic
- Treatment through underspecification

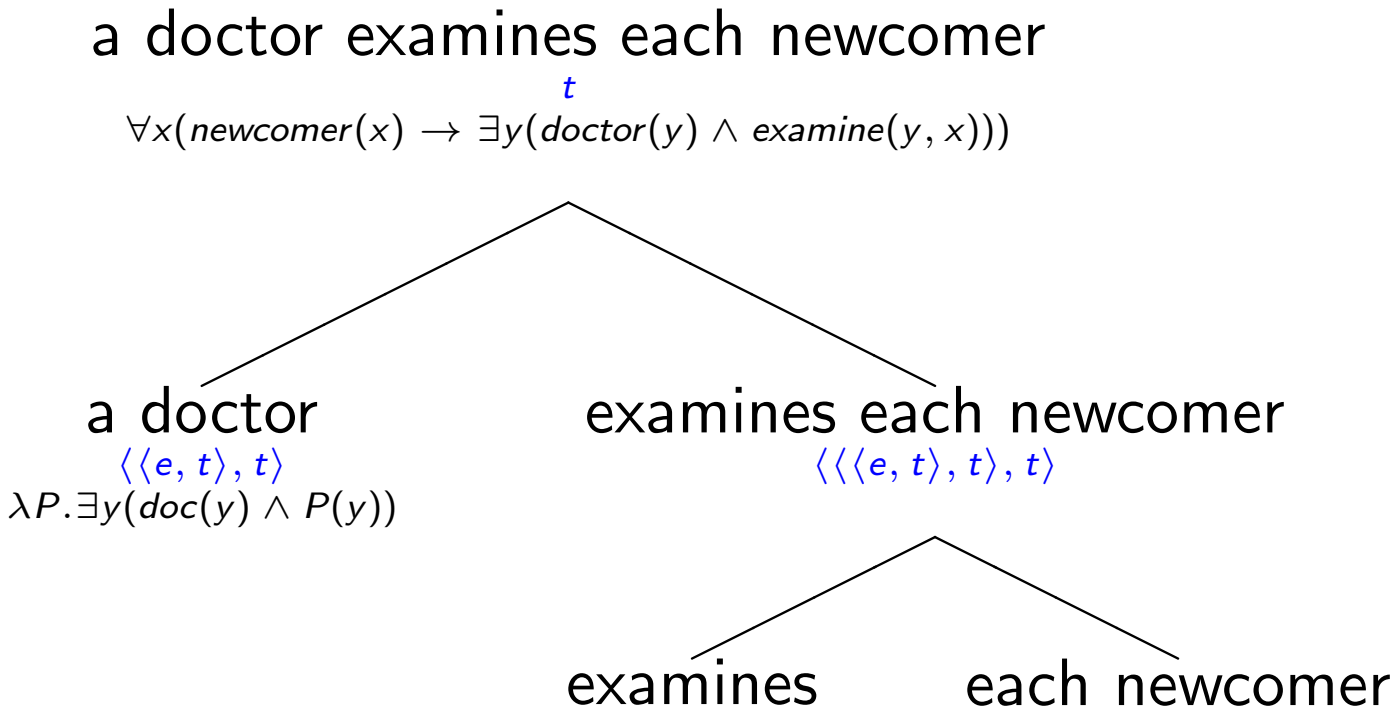
Plan

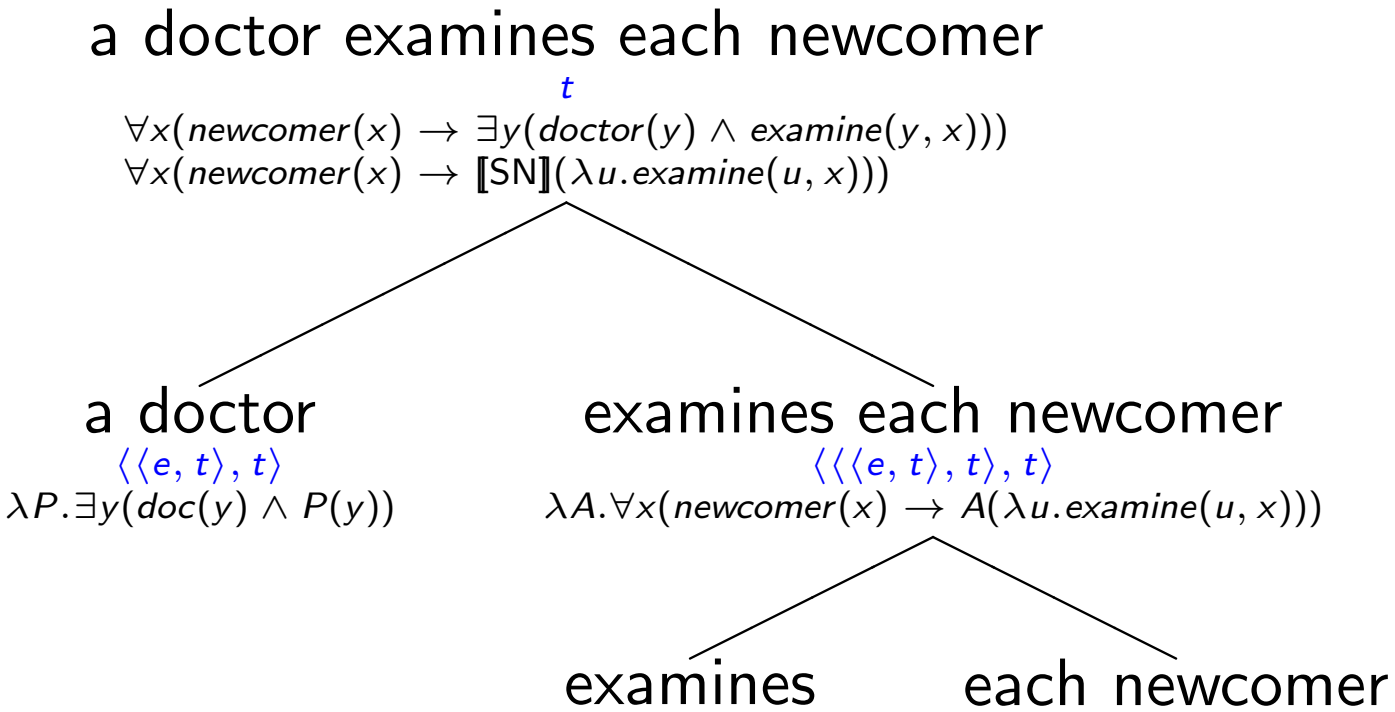
Semantic ambiguity

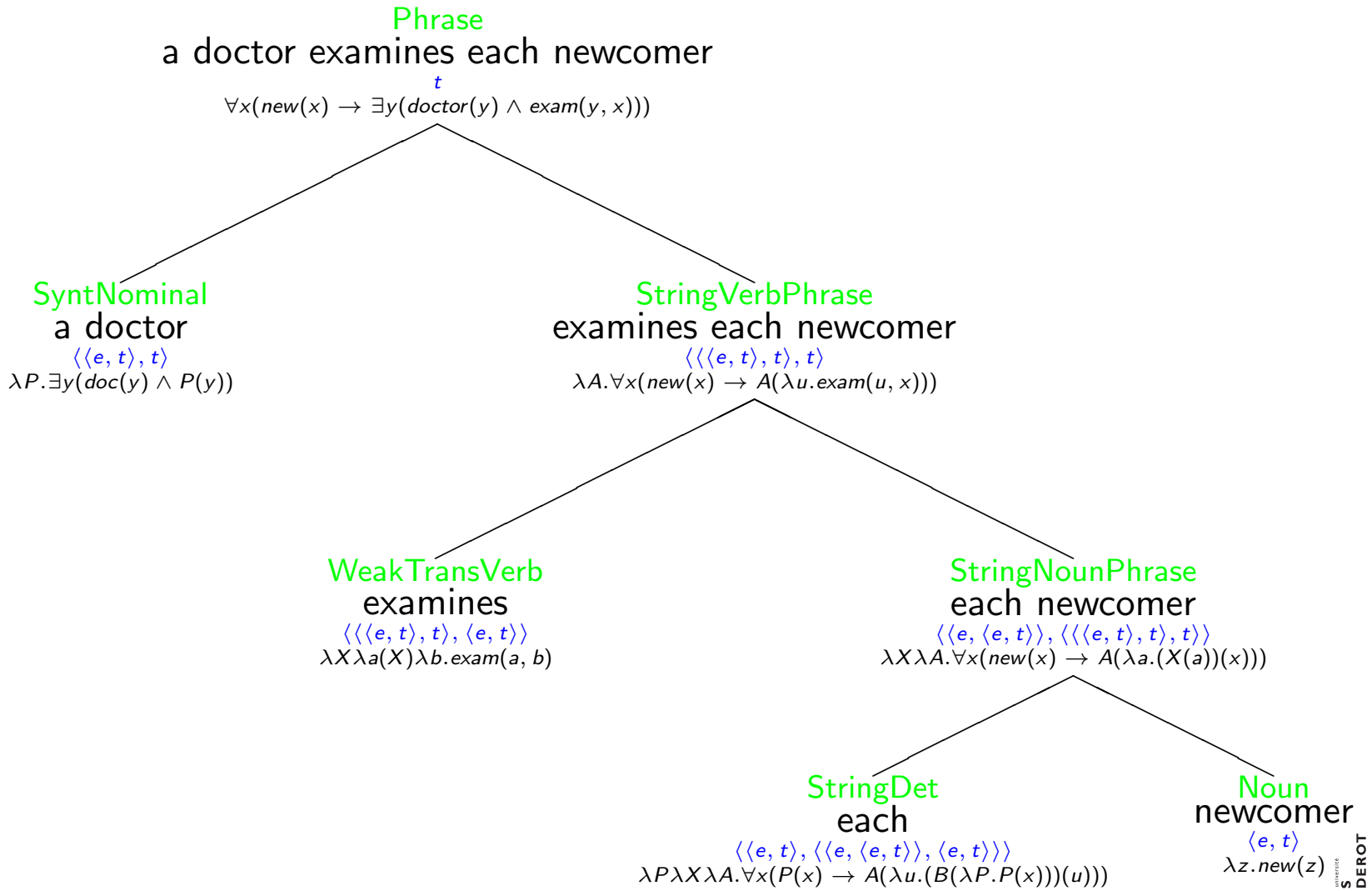
Play with types

Problem:
How can we define the contribution of *each newcomer* to get to good reading ?

(3) a. A doctor examines each newcomer
b. $\forall x(newcomer(x) \rightarrow \exists y(doctor(y) \wedge examine(y, x)))$


a doctor examines each newcomer
t
$\forall x(newcomer(x) \rightarrow \exists y(doctor(y) \wedge examine(y, x)))$
a doctor
$\langle\langle e, t\rangle, t\rangle$
$\lambda P.\exists y(doc(y) \wedge P(y))$
examines each newcomer
$\langle\langle\langle e, t\rangle, t\rangle, t\rangle$
examines
each newcomer

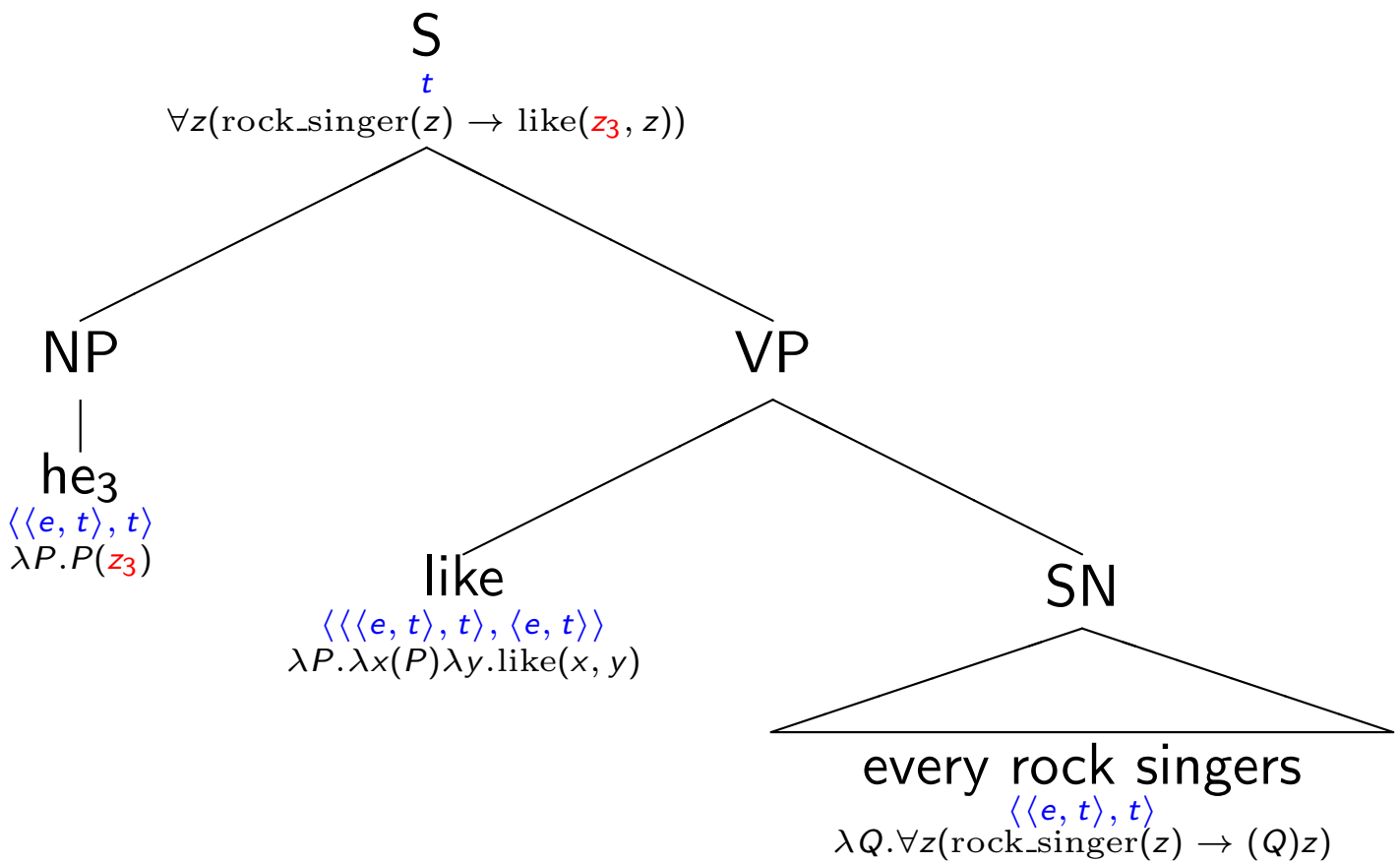

a doctor examines each newcomer
t
$\forall x(newcomer(x) \rightarrow \exists y(doctor(y) \wedge examine(y,x)))$
$\forall x(newcomer(x) \rightarrow [\![\mathsf{SN}]\!](\lambda u.examine(u,x)))$
a doctor
$\langle\langle e,t\rangle,t\rangle$
$\lambda P.\exists y(doc(y) \wedge P(y))$
examines each newcomer
$\langle\langle\langle e,t\rangle,t\rangle,t\rangle$
$\lambda A.\forall x(newcomer(x) \rightarrow A(\lambda u.examine(u,x)))$
examines
each newcomer


Phrase
a doctor examines each newcomer
t
$\forall x(new(x) \rightarrow \exists y(doctor(y) \wedge exam(y, x)))$
SyntNominal
a doctor
$\langle\langle e, t\rangle, t\rangle$
$\lambda P.\exists y(doc(y) \wedge P(y))$
StringVerbPhrase
examines each newcomer
$\langle\langle\langle e, t\rangle, t\rangle, t\rangle$
$\lambda A.\forall x(new(x) \rightarrow A(\lambda u.exam(u, x)))$
WeakTransVerb
examines
$\langle\langle\langle e, t\rangle, t\rangle, \langle e, t\rangle\rangle$
$\lambda X\lambda a(X)\lambda b.exam(a, b)$
StringNounPhrase
each newcomer
$\langle\langle e, \langle e, t\rangle\rangle, \langle\langle\langle e, t\rangle, t\rangle, t\rangle\rangle$
$\lambda X\lambda A.\forall x(new(x) \rightarrow A(\lambda a.(X(a))(x)))$
StringDet
each
$\langle\langle e, t\rangle, \langle\langle e, \langle e, t\rangle\rangle, \langle e, t\rangle\rangle\rangle$
$\lambda P\lambda X\lambda A.\forall x(P(x) \rightarrow A(\lambda u.(B(\lambda P.P(x)))(u)))$
Noun
newcomer
$\langle e, t\rangle$
$\lambda z.new(z)$

Pronouns according to Montague

Indexed variable

(4) He likes every rock singer.



Pronouns according to Montague II

(5) a. He likes every rock singer.
b. $\forall z(\text{rock\_singer}(z) \rightarrow \text{like}(z_3, z))$

Variable **free** and indexed
No anaphora resolution
But the variable can be captured (λ-abstraction on a free variable)

(6) No pupil enjoys the books that he$_4$ reads (x) too early

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$$Ez_4x$$

Pronouns according to Montague II

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Variable **free** and indexed
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(6) No pupil enjoys the books that he$_4$ reads (x) too early

$$(Bx \wedge Ez_4x)$$

Pronouns according to Montague II

(5) a. He likes every rock singer.
b. $\forall z(\text{rock\_singer}(z) \rightarrow \text{like}(z_3, z))$

Variable **free** and indexed
No anaphora resolution
But the variable can be captured (λ-abstraction on a free variable)

(6) z enjoys the books that he$_4$ reads (x) too early

$$\forall x((Bx \wedge Ez_4x) \rightarrow Ez_4y)$$

Pronouns according to Montague II

(5) a. He likes every rock singer.
b. $\forall z(\text{rock\_singer}(z) \rightarrow \text{like}(z_3, z))$

Variable **free** and indexed
No anaphora resolution
But the variable can be captured (λ-abstraction on a free variable)

(6) $\lambda z_4.\ z_4$ apprécie the books that he$_4$ reads (x) too early

$$\forall x((Bx \wedge Ez_4x) \rightarrow Ez_4y)$$

Pronouns according to Montague II

(5) a. He likes every rock singer.
b. $\forall z(\text{rock\_singer}(z) \rightarrow \text{like}(z_3, z))$

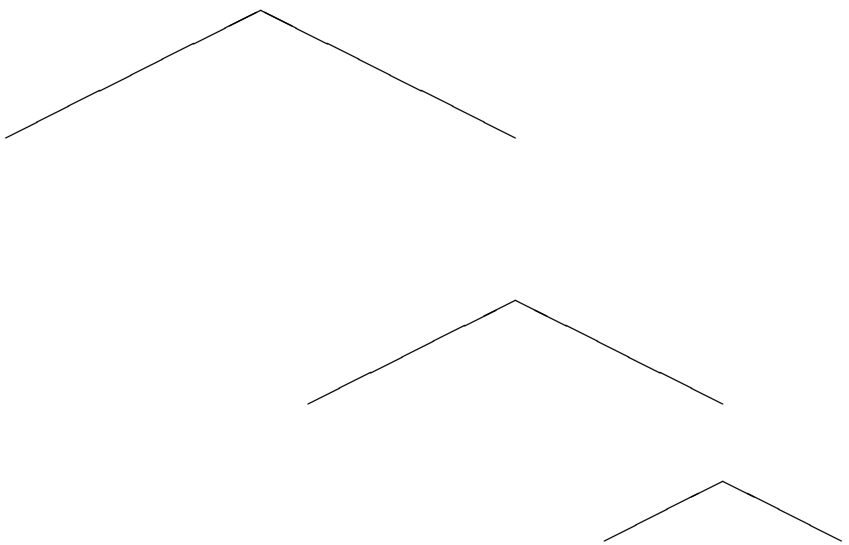
Variable **free** and indexed
No anaphora resolution
But the variable can be captured (λ-abstraction on a free variable)

(6) No pupil enjoys the books that he$_4$ reads (x) too early

$$\forall z_4 \, (Pz_4 \rightarrow \neg \forall x((Bx \wedge Ez_4x) \rightarrow Ez_4y))$$

Quantifying in (Montague)

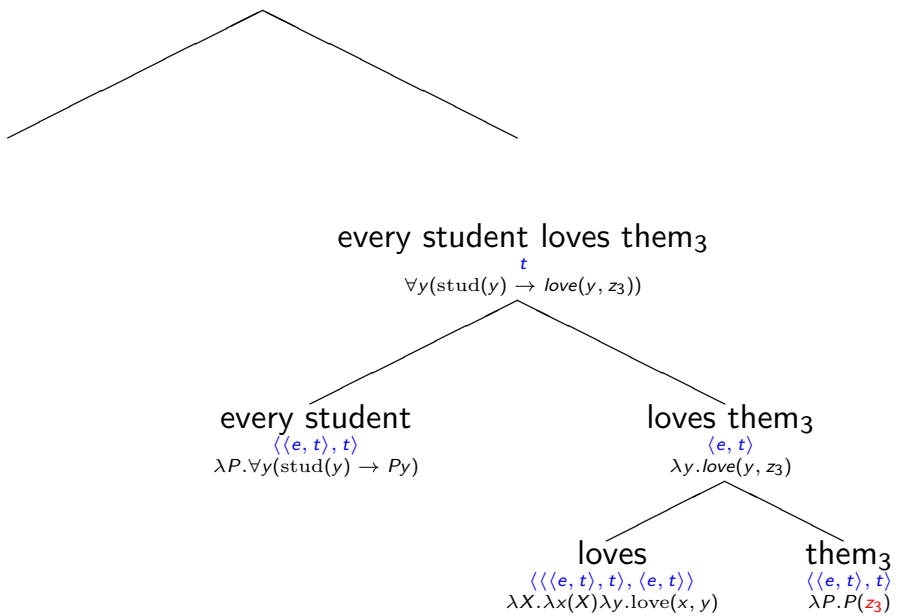
(7) Every student loves a woman.



Quantifying in (Montague)

(7) Every student loves a woman.

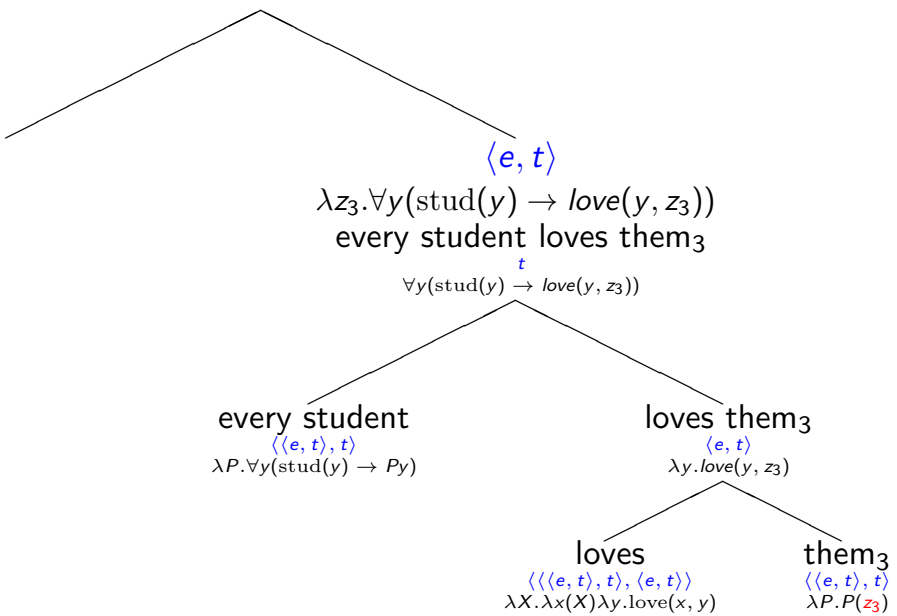
- Substitution of the quantified NP with a pronoun



Quantifying in (Montague)

(7) Every student loves a woman.

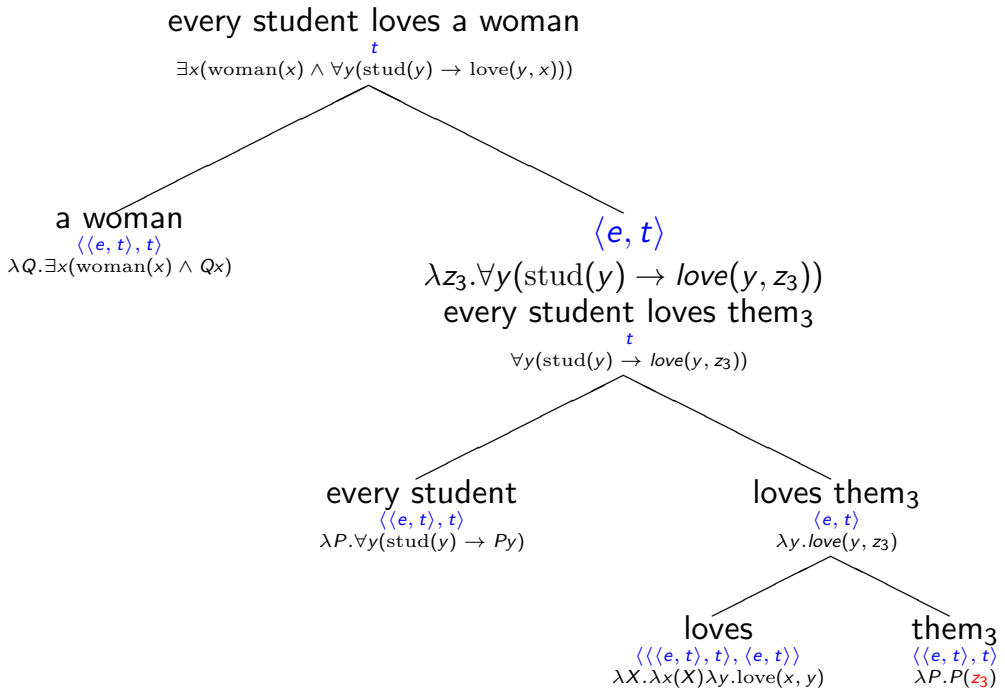
- Substitution of the quantified NP with a pronoun
- re-abstraction on the index



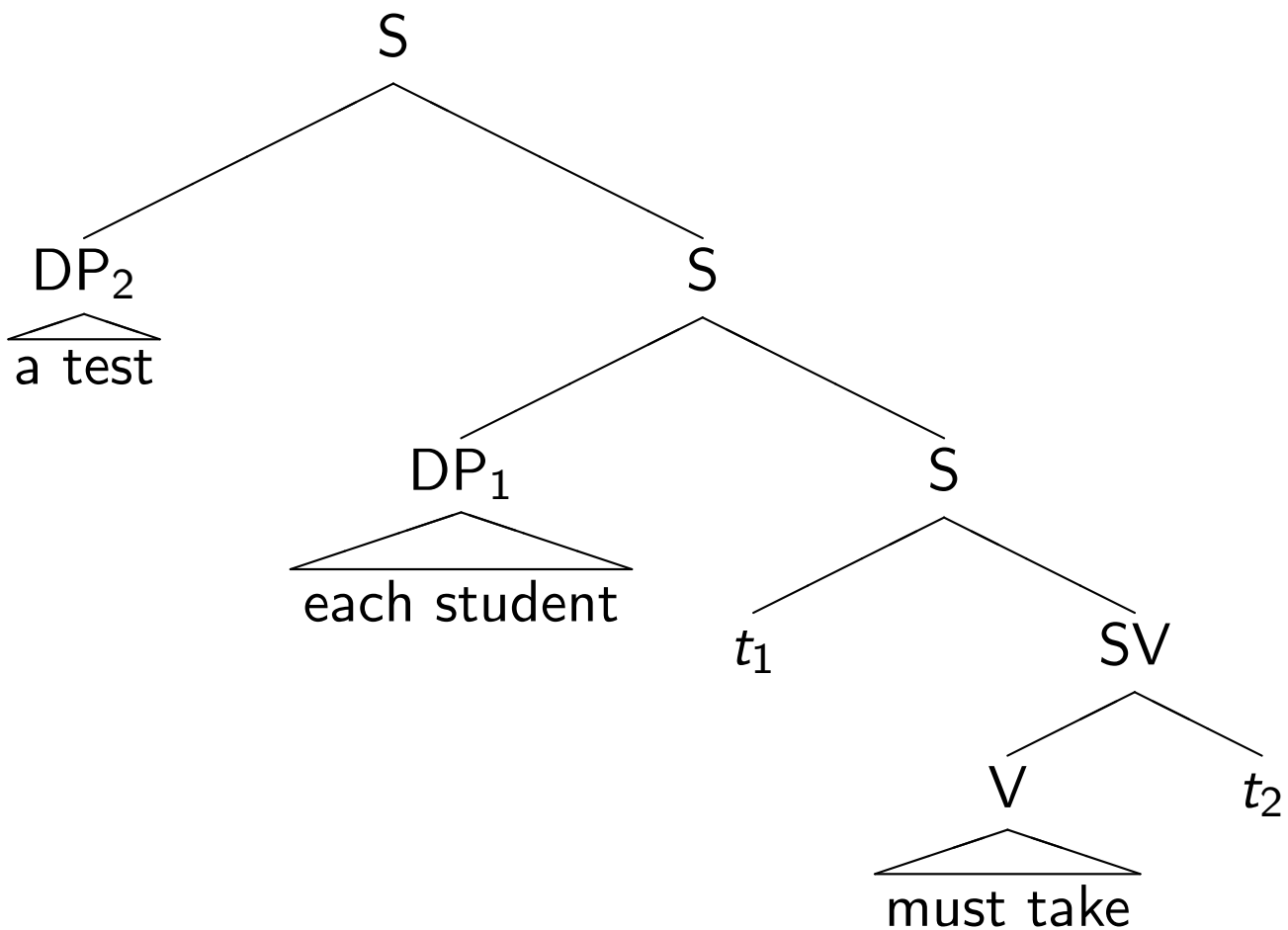
Quantifying in (Montague)

(7) Every student loves a woman.

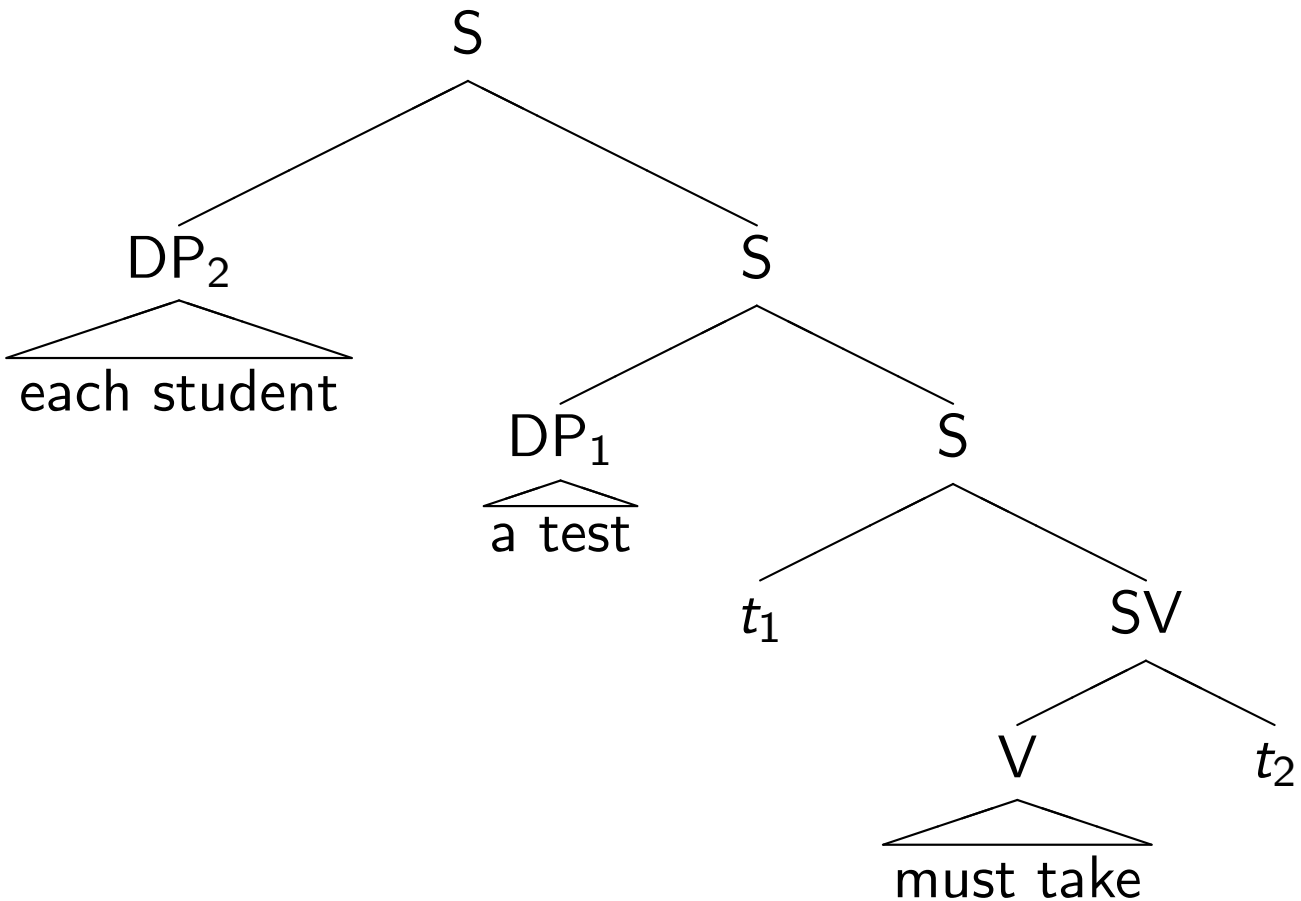
- Substitution of the quantified NP with a pronoun
- re-abstraction on the index
- Introduction of the quantified NP at the right level



Quantifier Raising



Quantifier Raising



Cooper storage

- Two-level representation
- Additional operations: load/unload
- Ambiguity implemented as multiple “unload sites”.

Enrichment of logic

Logic *independance-friendly à la* Hintikka (1992) :

$$\begin{matrix}\forall x \\ \exists y\end{matrix} \ (\mathrm{man}(x) \rightarrow (\mathrm{woman}(y) \wedge \mathrm{love}(x, y)))$$

See also: variable-free semantic (Jacobson, 1999) etc.

Under-specification

- Formulae are cut into labelled "blocks"
- A langage allows to specify partial relations between blocs (constraints)
- A calculus produces all logical structures compatible with the constraints, only when it is needed

Examples :

- MRS (Minimal Recursion Semantics) — companion formalism for HPSG (Copestake *et al.* , 2005)
- UDRT (Underspecified DRT) (Reyle, 1993)

But also: Quasi-Logical Form, Underspecified Logical Form, Ontological Promiscuity, Hole Semantics, the Constraint Language for Lambda Structures, Normal Dominance Constraints (Bunt, 2007)

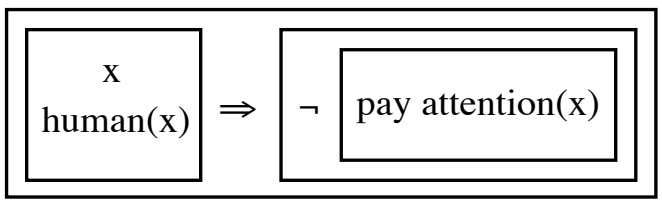
Under-specification (cont'd) I

Example: UDRT

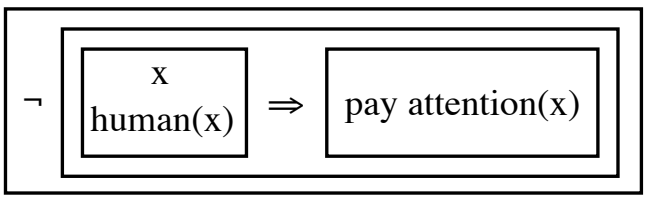
(1) Everybody didn't pay attention. (Frank and Reyle 1995b)

The DRT representation for the two readings of (1) is as follows:

(2) a.



b.



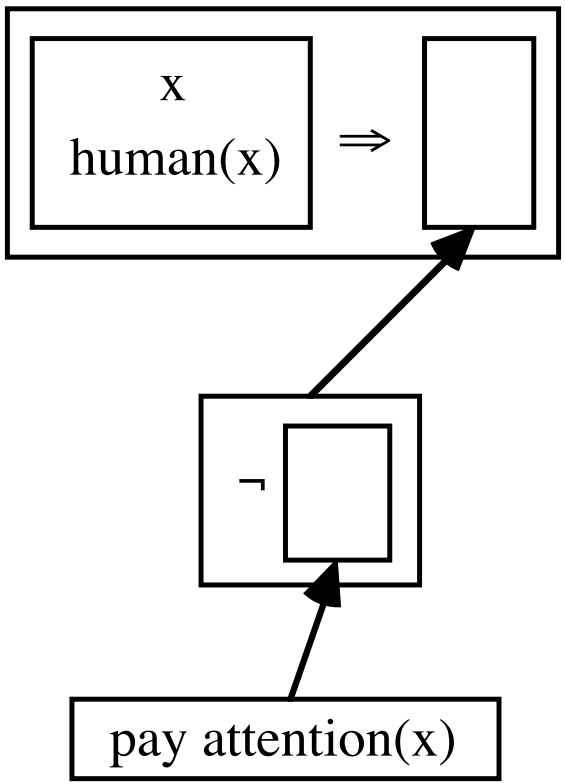
Figures borrowed from (Keller, 1997)

Under-specification (cont'd) II

Example: UDRT

(3)

a.



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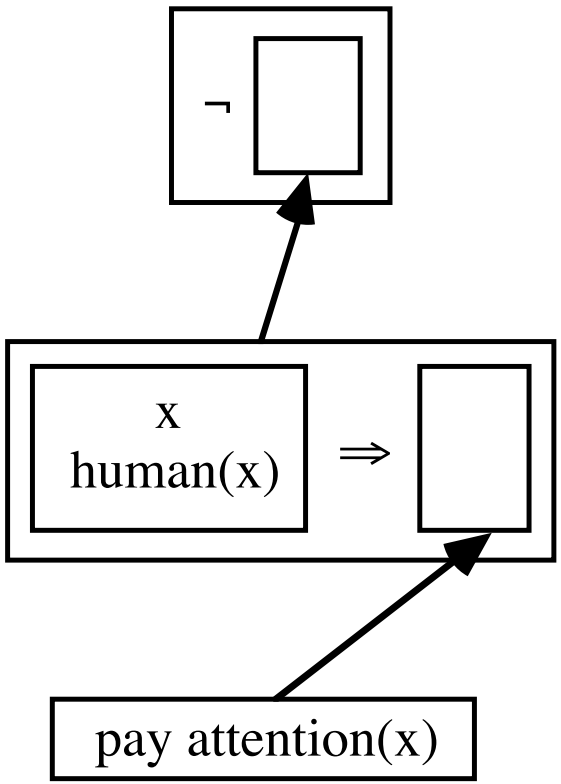
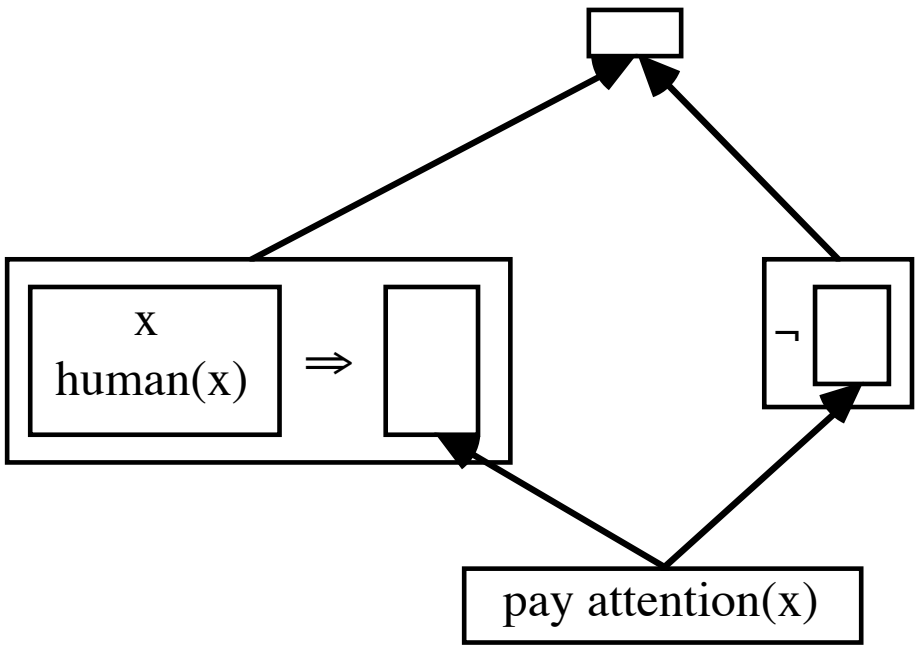


Under-specification (cont'd) III

Example: UDRT

(4)



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