

# A few steps towards a NL fragment

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## Current stage

$S$	$\rightarrow$	$NP$	$VP$
$[[S]]$	$\leftarrow$	$([[NP]])$	$[[VP]]$
$0$	$\leftarrow$	$(1)$	$2$
<hr/>			
$NP$	$\rightarrow$	$PN$	
$0$	$\leftarrow$	$(\Phi)1$	
<hr/>			
$VP$	$\rightarrow$	$IV$	
$0$	$\leftarrow$	$1$	
<hr/>			
$NP$	$\rightarrow$	$Det$	$N$
$0$	$\leftarrow$	$(1)$	$2$
<hr/>			
$VP$	$\rightarrow$	$TV$	$NP$
$0$	$\leftarrow$	$((\Psi)1)$	$2$

$PN$	$\rightarrow$	Sam
$0$	$\leftarrow$	$s$
$\Phi$	$=$	$\lambda u \lambda P. P u$
<hr/>		
$IV$	$\rightarrow$	sleeps
$0$	$\leftarrow$	$\lambda x. S x$
<hr/>		
$TV$	$\rightarrow$	loves
$0$	$\leftarrow$	$\lambda x \lambda y. L x y$
$\Psi$	$=$	$\lambda R \lambda P \lambda x. (P)(R)x$
<hr/>		
$Det$	$\rightarrow$	a
$0$	$\leftarrow$	$\lambda P \lambda Q. \exists x (P x \wedge Q x)$
$Det$	$\rightarrow$	every
$0$	$\leftarrow$	$\lambda P \lambda Q. \forall x (P x \rightarrow Q x)$
<hr/>		
$N$	$\rightarrow$	man
$0$	$\leftarrow$	$\lambda x. M x$

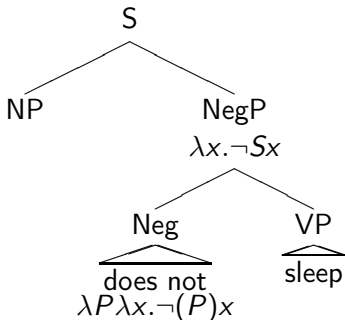
## Application

$$\begin{aligned} \llbracket \text{Sam sleeps} \rrbracket &= \left( \left( \frac{\Phi}{\langle e, \langle et, t \rangle \rangle} \right) \frac{\text{Sam}}{e} \right) \frac{\text{sleeps}}{et} \\ &= \left( \left( \frac{\lambda u \lambda P. P u}{\langle e, \langle et, t \rangle \rangle} \right) \frac{s}{e} \right) \frac{\lambda x. S x}{et} \\ &= \left( \frac{\lambda P. P s}{\langle et, t \rangle} \right) \frac{\lambda x. S x}{et} \\ &= \left( \frac{\lambda x. S x}{et} \right) \frac{s}{e} \\ &= \frac{S s}{t} \end{aligned}$$

# Application

$$\begin{aligned} \llbracket \text{Every woman loves a man} \rrbracket &= ((\text{every})\text{woman})(\text{loves})(\text{a})\text{man} \\ &= ((\lambda P \lambda Q. \forall x (Px \rightarrow Qx)) \lambda u. Wu) (\lambda R \lambda a. (R) \lambda b. Lab) (\lambda A \lambda B. \exists y (Ay \wedge By)) \lambda v. Mv \\ &= (\lambda Q. \forall x ((\lambda u. Wu)x \rightarrow Qx)) (\lambda R \lambda a. (R) \lambda b. Lab) (\lambda A \lambda B. \exists y (Ay \wedge By)) \lambda v. Mv \\ &= (\lambda Q. \forall x (Wx \rightarrow Qx)) (\lambda R \lambda a. (R) \lambda b. Lab) (\lambda A \lambda B. \exists y (Ay \wedge By)) \lambda v. Mv \\ &= (\lambda Q. \forall x (Wx \rightarrow Qx)) (\lambda R \lambda a. (R) \lambda b. Lab) \lambda B. \exists y ((\lambda v. Mv)y \wedge By) \\ &= (\lambda Q. \forall x (Wx \rightarrow Qx)) (\lambda R \lambda a. (R) \lambda b. Lab) \lambda B. \exists y (My \wedge By) \\ &= (\lambda Q. \forall x (Wx \rightarrow Qx)) \lambda a. (\lambda B. \exists y (My \wedge By)) \lambda b. Lab \\ &= (\lambda Q. \forall x (Wx \rightarrow Qx)) \lambda a. \exists y (My \wedge (\lambda b. Lab)y) \\ &= (\lambda Q. \forall x (Wx \rightarrow Qx)) \lambda a. \exists y (My \wedge Lay) \\ &= \forall x (Wx \rightarrow (\lambda a. \exists y (My \wedge Lay))x) \\ &= \forall x (Wx \rightarrow \exists y (My \wedge Lxy)) \end{aligned}$$

# Negation

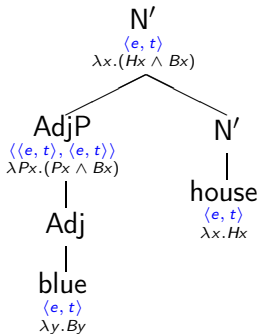


$S$	$\rightarrow$	$NP$	$NegP$
0	$\leftarrow$	(1)	2
$NegP$	$\rightarrow$	$Neg$	$VP$
0	$\leftarrow$	(1)	2
$Neg$	$\rightarrow$	does not	
0	$\leftarrow$	$\lambda P \lambda x. \neg (P)x$	

# Adjectival modification

- (1) a. a blue house  
 b. a fast typist

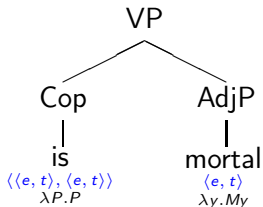
$x$  is blue  $\wedge$   $x$  is a house  
 $x$  is fast **as a** typist



$N'$	$\rightarrow$	$AdjP$	$N'$
0	$\leftarrow$	(1)	2
$AdjP$	$\rightarrow$	$Adj$	
0	$\leftarrow$	$(\Omega)1$	
$\Omega$	$=$	$\lambda Q \lambda P \lambda x. (Px \wedge Qx)$	
$Adj$	$\rightarrow$	blue	
0	$\leftarrow$	$\lambda x. Bx$	

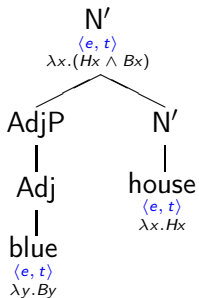
## Attributive sentences

(2) Socrates is mortal.



$VP$	$\rightarrow$	$Cop$	$AdjP$
0	$\leftarrow$	(1)	2
$AdjP$	$\rightarrow$	$Adj$	
0	$\leftarrow$	<del>(1)</del>	1
$Cop$	$\rightarrow$	is	
0	$\leftarrow$	$\lambda P.P$	

## back to Adjectival modification



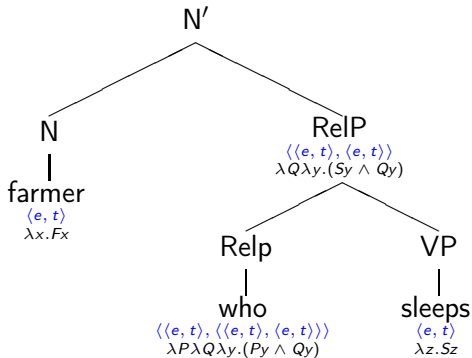
$N'$	$\rightarrow$	$AdjP$	$N'$
0	$\leftarrow$	$((\Omega)1)$	2
$\Omega$	$=$	$\lambda Q \lambda P \lambda x.(Px \wedge Qx)$	
$AdjP$	$\rightarrow$	$Adj$	
0	$\leftarrow$	1	
$Adj$	$\rightarrow$	blue	
0	$\leftarrow$	$\lambda x.Bx$	



## Coordination

- (3)
  - a. Jay and Max sleep.
  - b. Jay loves and respect Ali.
  - c. Jay came and Max left.

## Relative propositions (part)



## Discussion

- *lingua franca* for the description of (compositional) semantic phenomena
- tool for the study of non-compositional phenomena
  - scope inversion for quantifiers (+ ambiguity)
  - scope interaction negation/universal quantifiers
  - neg-raising (4)
  - donkey sentences
  - ...
- wide coverage grammars for nlp/cl (Steedman, Bos, ...)

(4) I don't want you to play with Joe.  
(= I want you not to play with Joe)

(10) Tous ceux qui rejettent tout le monde apprécient un gourou.

