

# Recent Developments in Computational Semantics Introduction I

Manfred Pinkal – Saarland University – WS 2013/14



# Semantic Processing

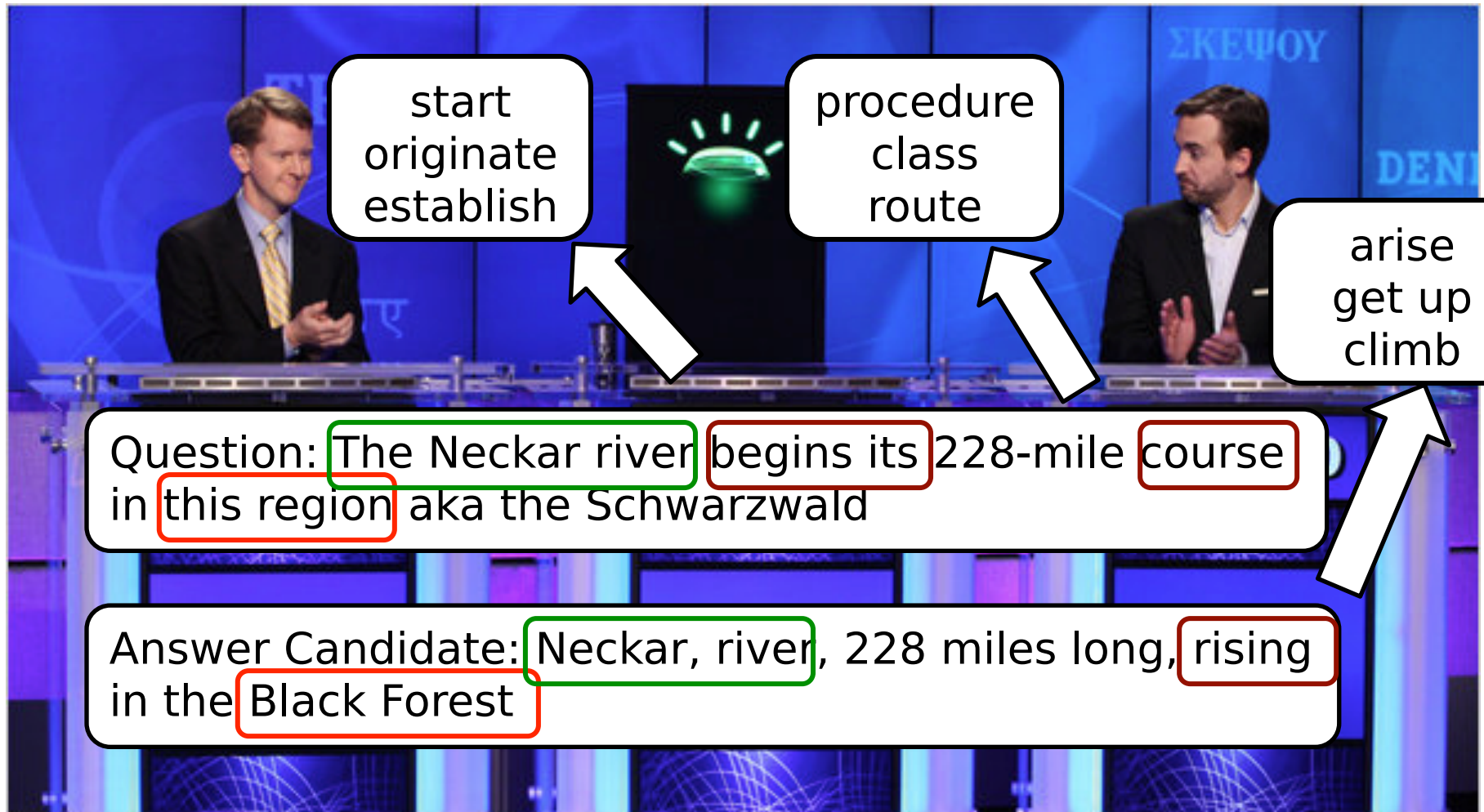
Meaning Representation



Text/ Utterance



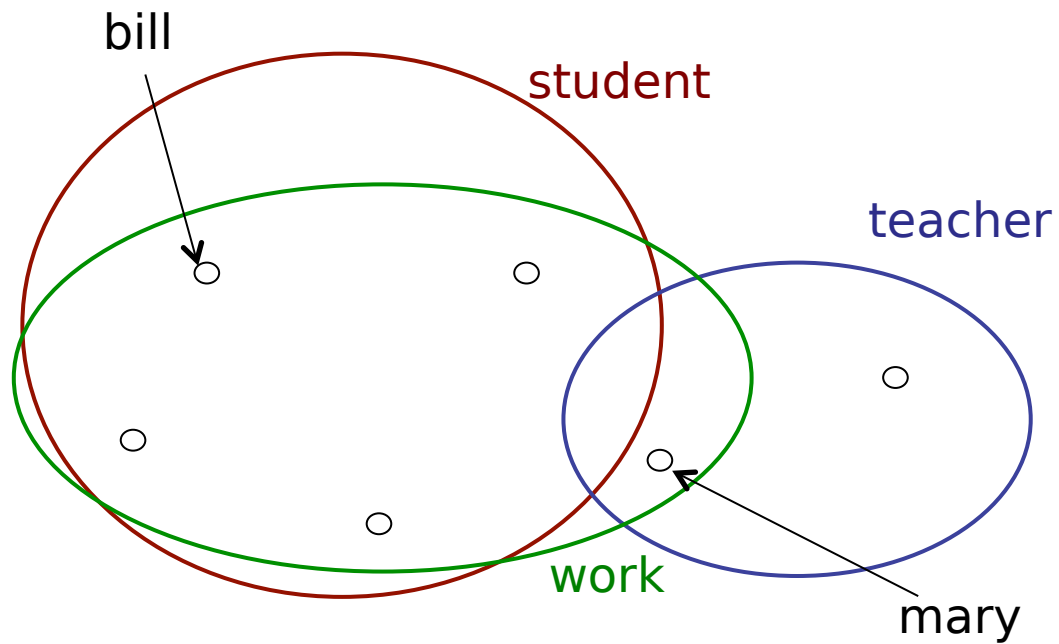
Laura is sleeping



# First-Order Logic: Semantic Representation

- ❑ *Flipper is a dolphin*                       $\text{dolphin}(\text{flipper})$
- ❑ *Bill works*                                       $\text{work}(\text{bill})$
- ❑ *Mary likes John*                               $\text{like}(\text{mary}, \text{john})$
  
- ❑ *Bill reads an interesting book.*  
     $\exists b (\text{book}(b) \wedge \text{interesting}(b) \wedge \text{read}(\text{bill}, b))$
- ❑ *Dolphins are mammals, not fish.*  
     $\forall d (\text{dolphin}(d) \rightarrow \text{mammal}(d) \wedge \neg \text{fish}(d))$
- ❑ *Dolphins live in pods.*  
     $\forall d (\text{dolphin}(d) \rightarrow \exists p (\text{pod}(p) \wedge \text{live-in}(d, p)))$

# First-Order Logic: Models



# First-Order Logic: Semantic Interpretation

■  $\llbracket \text{work}(\text{bill}) \rrbracket^M = 1$

iff  $\llbracket \text{bill} \rrbracket^M \in \llbracket \text{work} \rrbracket^M$

■  $\llbracket \forall x(\text{student}(x) \rightarrow \text{work}(x)) \rrbracket^M = 1$

iff  $\llbracket \text{student} \rrbracket^M \subseteq \llbracket \text{work} \rrbracket^M$

■  $\llbracket \forall x(\text{prime}(x) \rightarrow (\text{odd}(x) \vee x=2)) \rrbracket^M = 1$

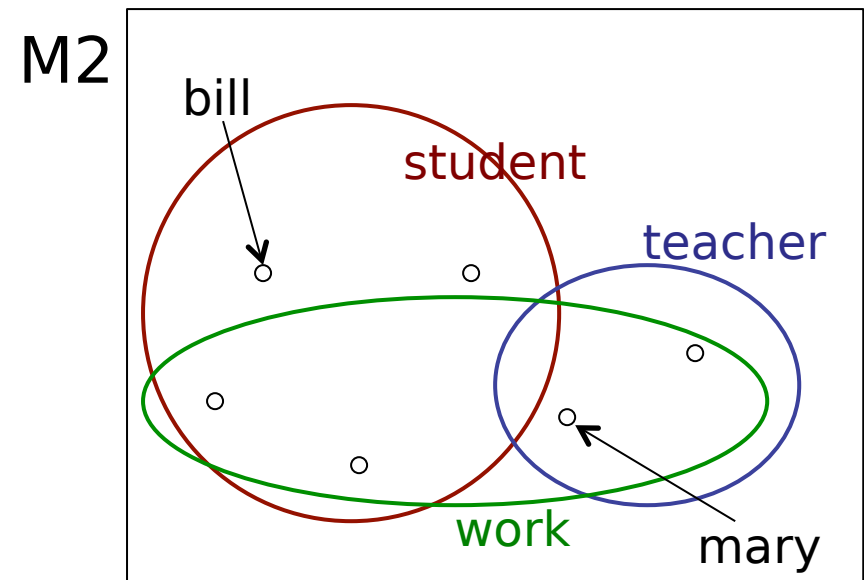
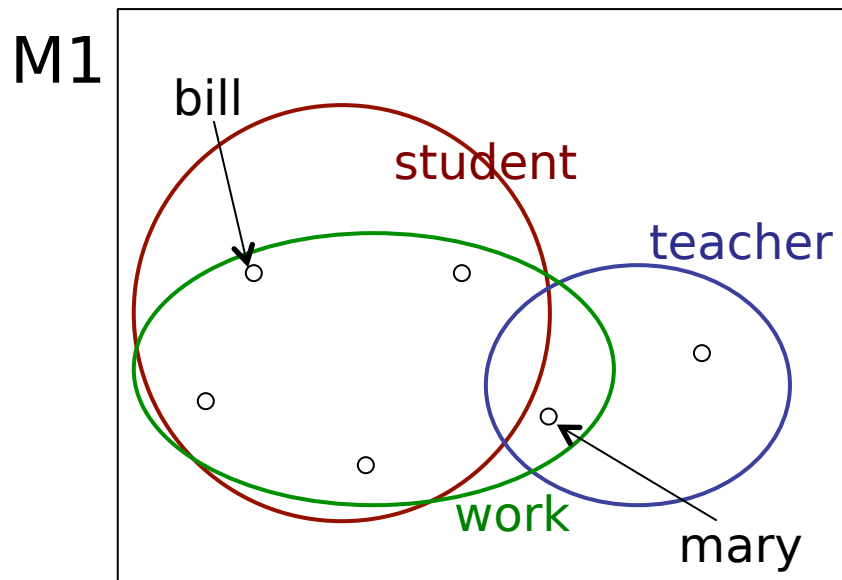
iff  $\llbracket \text{prime} \rrbracket^M \subseteq \llbracket \text{work} \rrbracket^M \cup \{2\}$

# Truth Values and Truth Condition

*Every student works*  $\Rightarrow \forall x(\text{student}(x) \rightarrow \text{work}(x))$

$\llbracket \forall x(\text{student}(x) \rightarrow \text{work}(x)) \rrbracket^{M,g} = 1$

iff  $V_M(\text{student}) \subseteq V_M(\text{work})$



# Empirical Validation

M. Cresswell's "Most certain principle of semantics"

*"For two sentences A and B, if in some possible situation A is true and B is false, A and B must have different meanings."*

# Controlled Inference

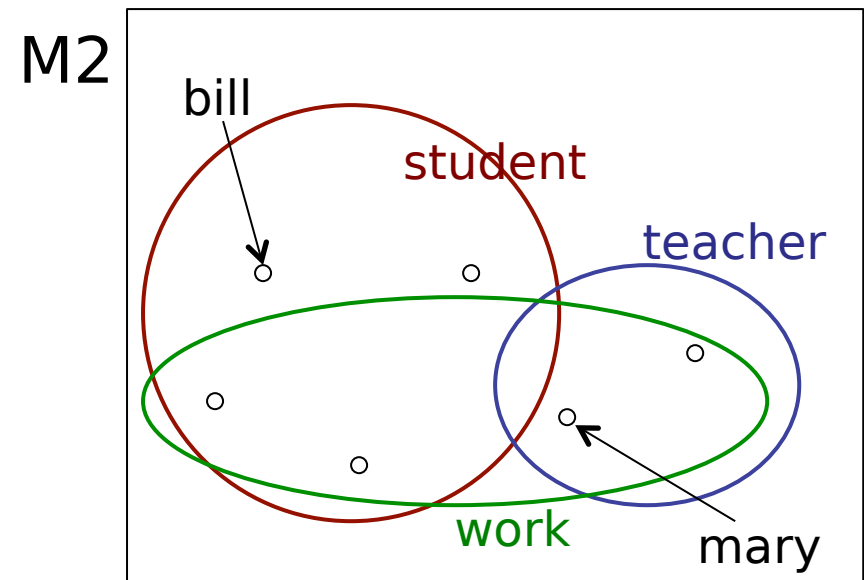
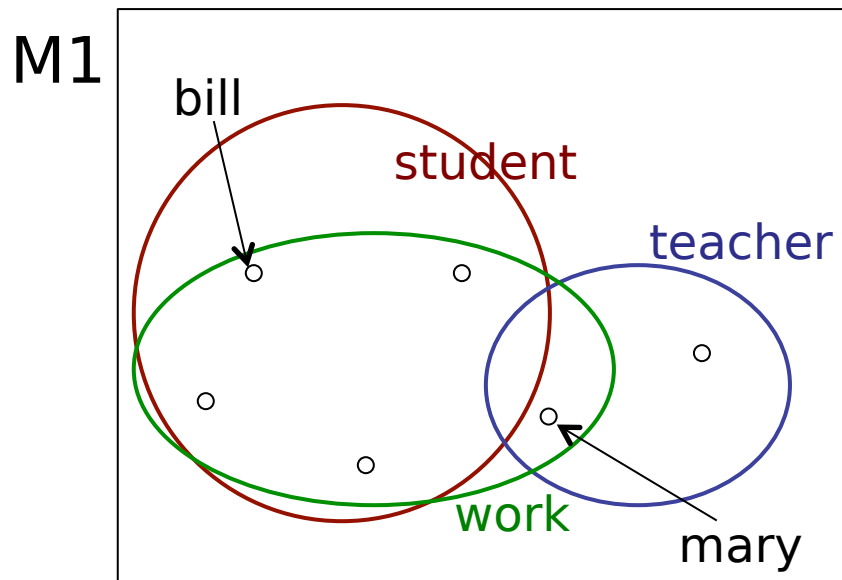
$$A \vdash B \text{ iff } A \vDash B$$

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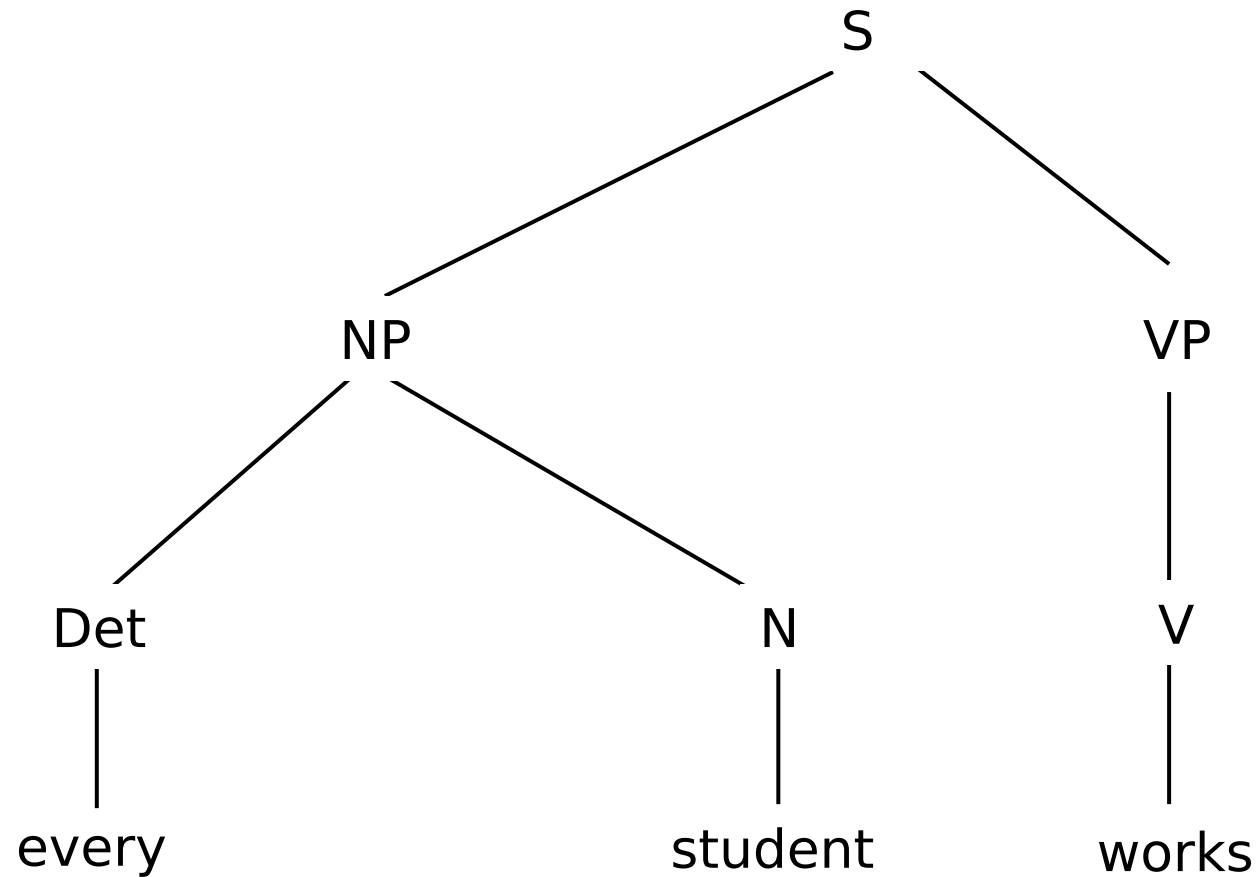


# Compositionality

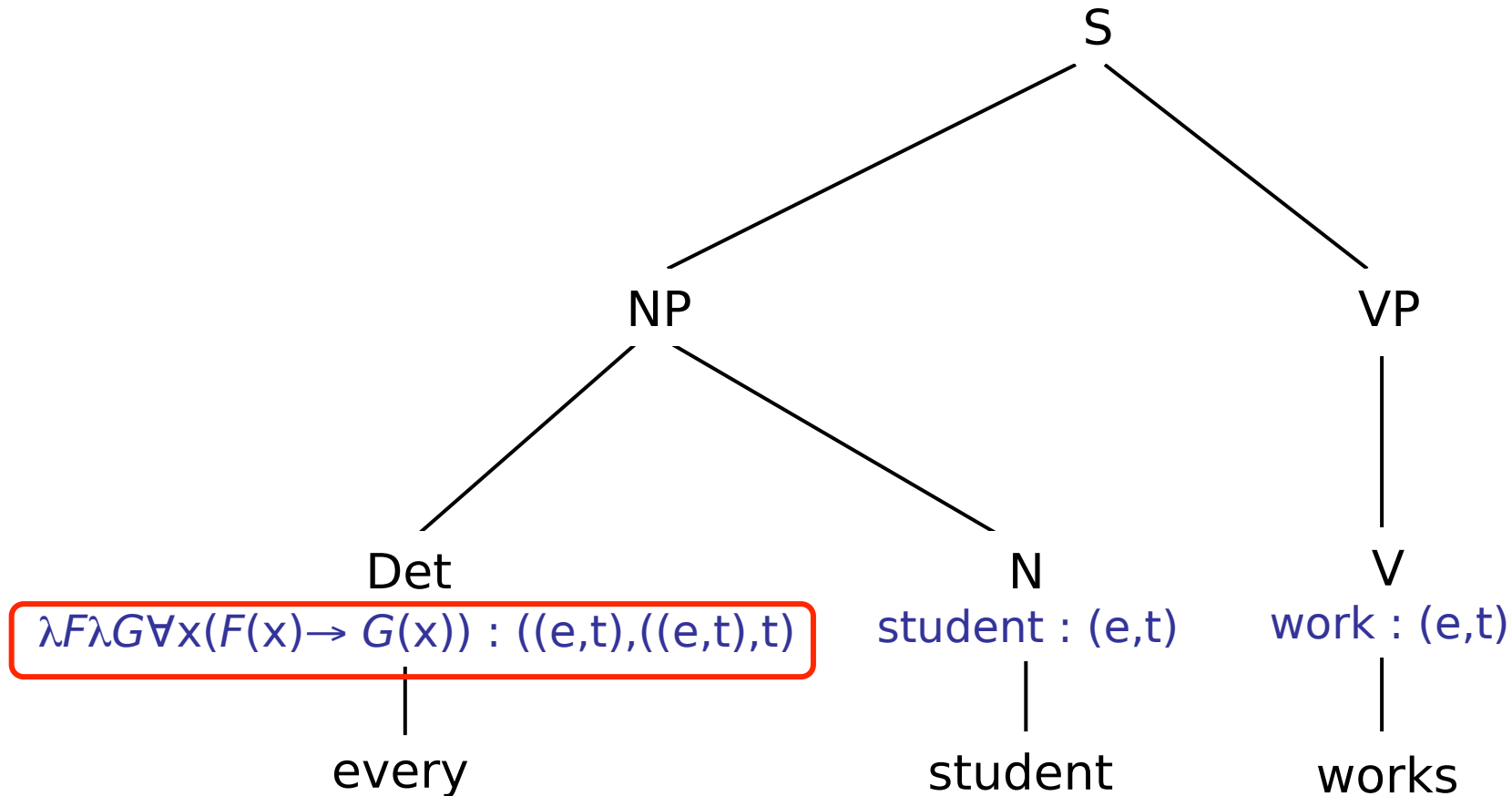
G. Frege's "Principle of Compositionality"

*"The meaning of a complex expression is uniquely determined by the meanings of its sub-expressions and its syntactic structure."*

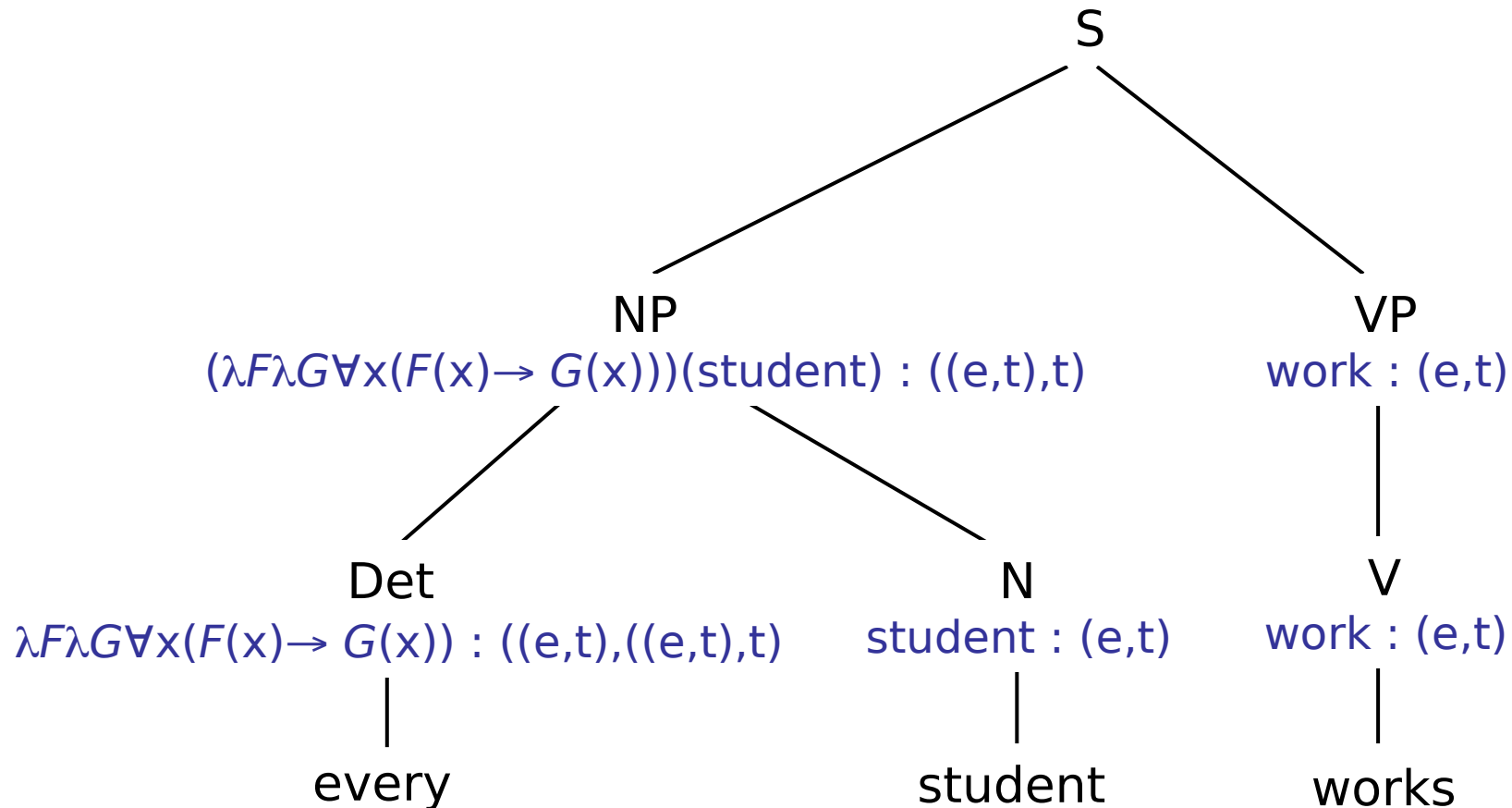
# Compositionality



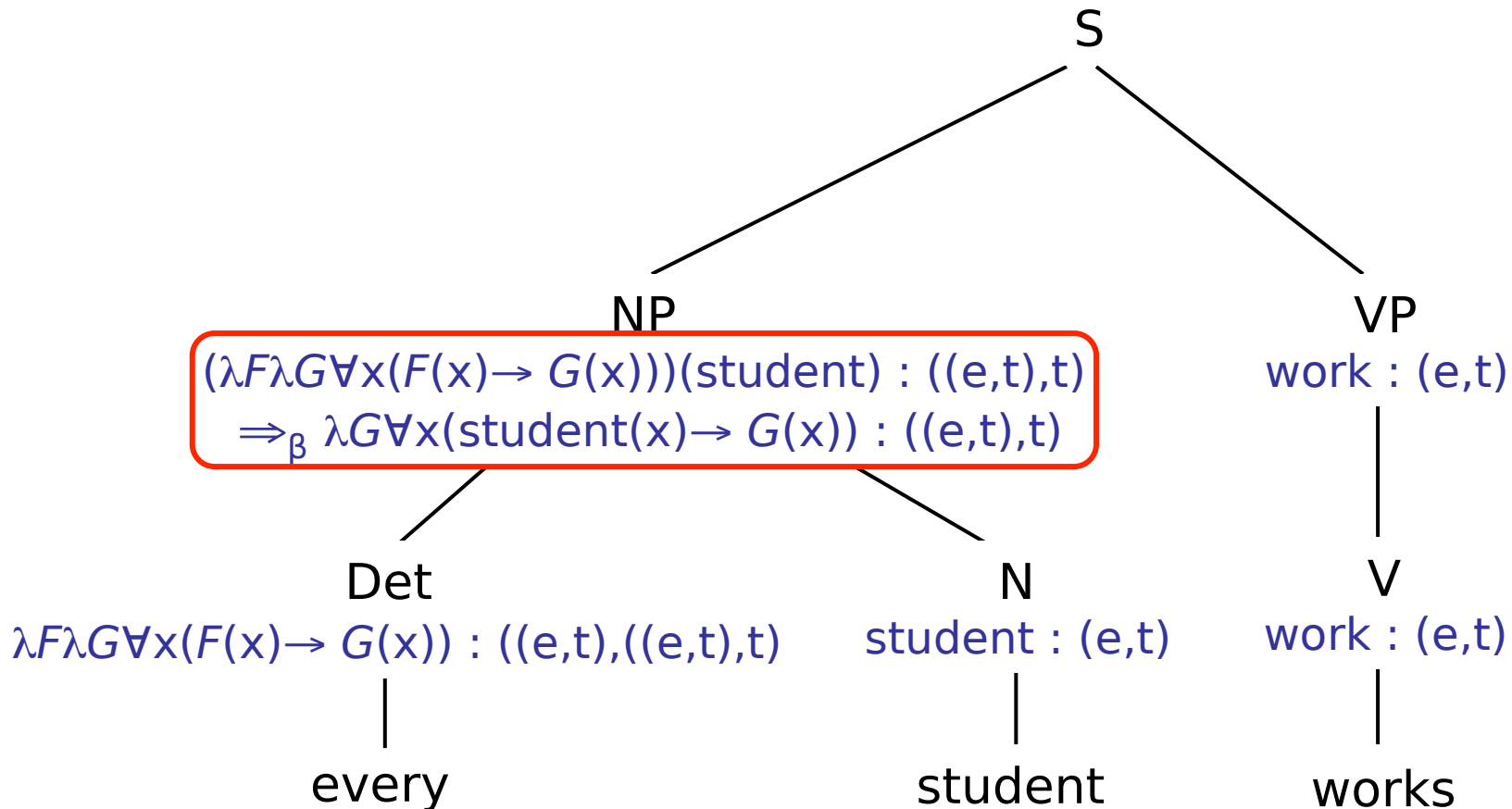
# Typed Lambda Calculus for Semantic Composition



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