

# Recent Developments in Computational Semantics Introduction II

Manfred Pinkal – Saarland University – WS 2013/14



# The Logical Framework

- Compositionality
- Truth-Conditional Semantics
- Controlled Inference

# The Logical Framework: Challenges

## ❑ Coverage and Robustness: The Knowledge Bottleneck

- ❑ *Can we meet for lunch today?*
- ❑ *My seminar will start at noon.*

## ❑ Ambiguity and Disambiguation

- ❑ *The box is in the pen.*
- ❑ *The pen is in the box.*

S: (n) **pen** (a writing implement with a point from which ink flows)

S: (n) playpen, **pen** (a portable enclosure in which babies may be left to play)

# Basic Disambiguation Tasks

- ❑ Word-Sense Disambiguation (WSD)

  - ❑ Background Reading: McCarthy 2009

  - ❑ [Mihalcea 2005](#)

  - ❑ [Ponzetto&Navigli 2010 / Li et al. 2010](#)

- ❑ Syntactic Disambiguation

  - ❑ Statistical Parsers

- ❑ Semantic Role Labeling

  - ❑ [Gildea&Jurafsky 2002](#)

  - ❑ [Palmer et al. 2005](#)

  - ❑ [Das et al. 2010](#)

  - ❑ [Lang&Lapata 2011](#)

# The Logical Framework: Challenges

- ❑ Coverage and Robustness: The Knowledge Bottleneck
- ❑ Ambiguity and Disambiguation
- ❑ Inappropriateness of the Logical Framework
  - ❑ Word senses, usage variants, vagueness
  - ❑ Logical entailment and common-sense reasoning

- ❑ **S:** (n) **match**, [lucifer](#), [friction match](#) (lighter consisting of a thin piece of wood or cardboard tipped with combustible chemical; ignites with friction) *"he always carries matches to light his pipe"; "as long you've a lucifer to light your fag"*
- ❑ **S:** (n) **match** (a formal contest in which two or more persons or teams compete)
- ❑ **S:** (n) **match** (a burning piece of wood or cardboard) *"if you drop a match in there the whole place will explode"*
- ❑ **S:** (n) **match**, [mate](#) (an exact duplicate) *"when a match is found an entry is made in the notebook"*
- ❑ **S:** (n) **match** (the score needed to win a match)
- ❑ **S:** (n) [catch](#), **match** (a person regarded as a good matrimonial prospect)
- ❑ **S:** (n) [peer](#), [equal](#), **match**, [compeer](#) (a person who is of equal standing with another in a group)
- ❑ **S:** (n) [couple](#), [mates](#), **match** (a pair of people who live together) *"a married couple from Chicago"*
- ❑ **S:** (n) **match** (something that resembles or harmonizes with) *"that tie makes a good match with your jacket"*

# Distributional Semantics

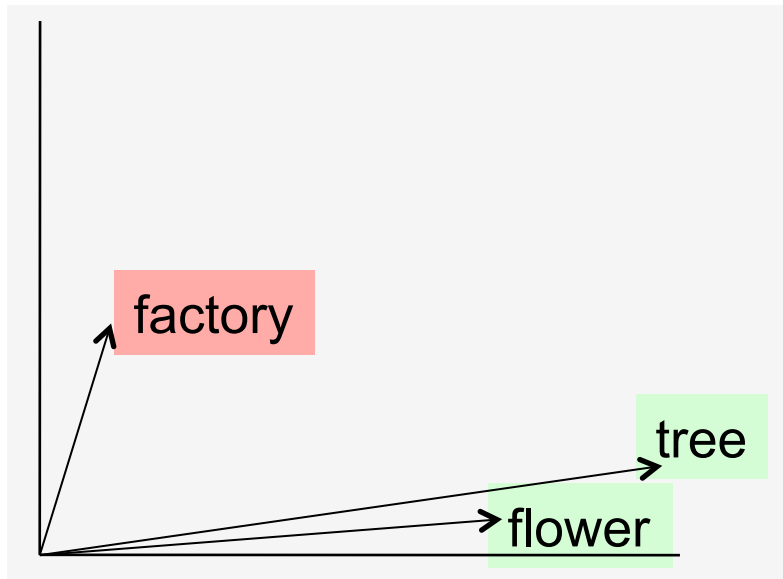
Z. Harris' "Distributional Hypothesis"

Words that occur in the same contexts tend to have similar meanings.

Harris 1954

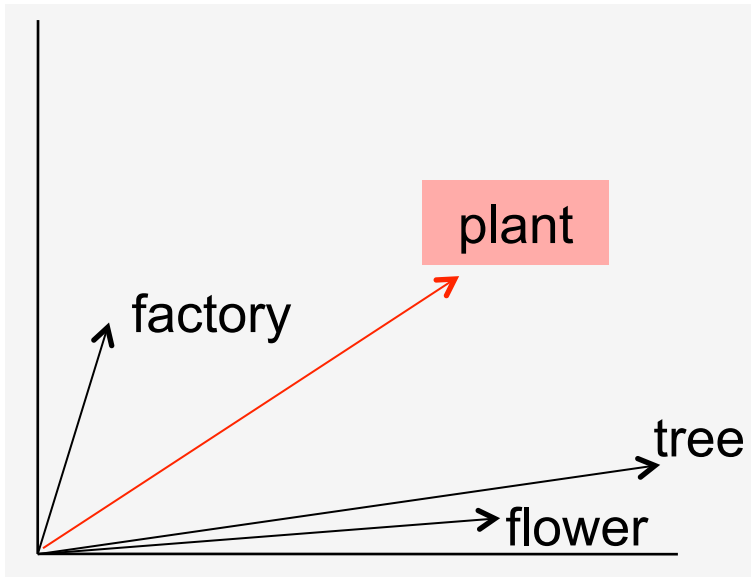
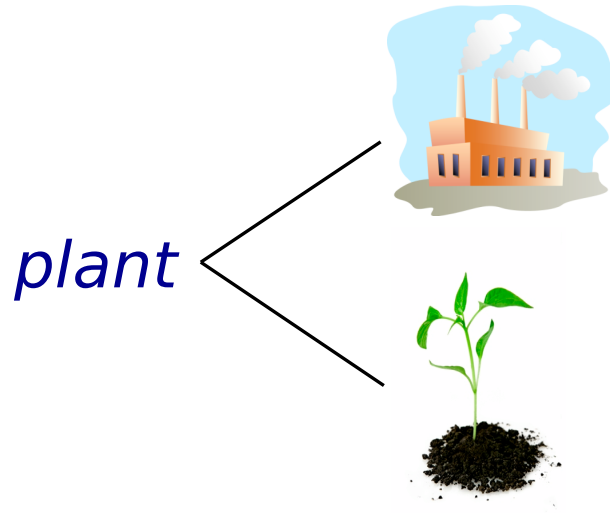
# Distributional Semantics

$$\text{sim}(a,b) = \cos(\vec{a}, \vec{b})$$



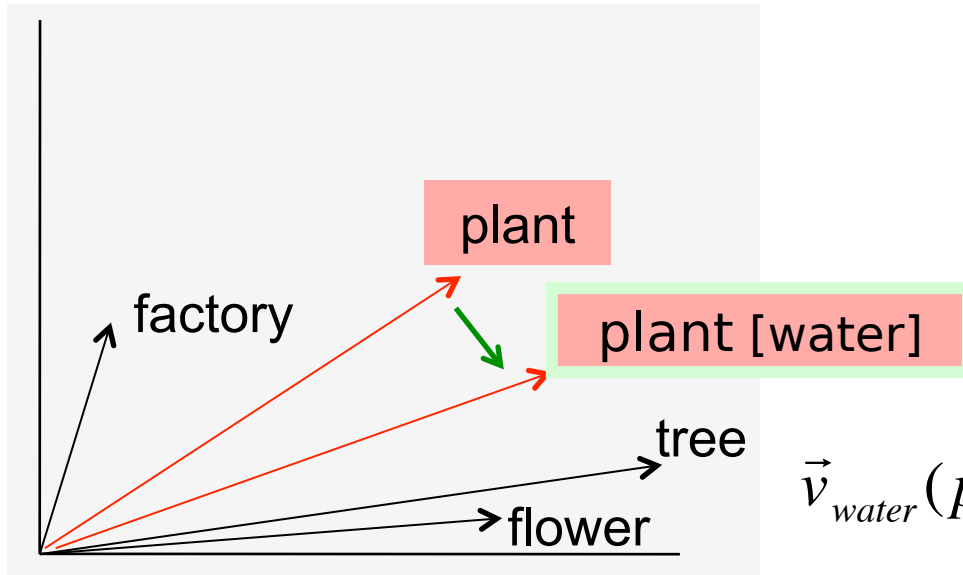
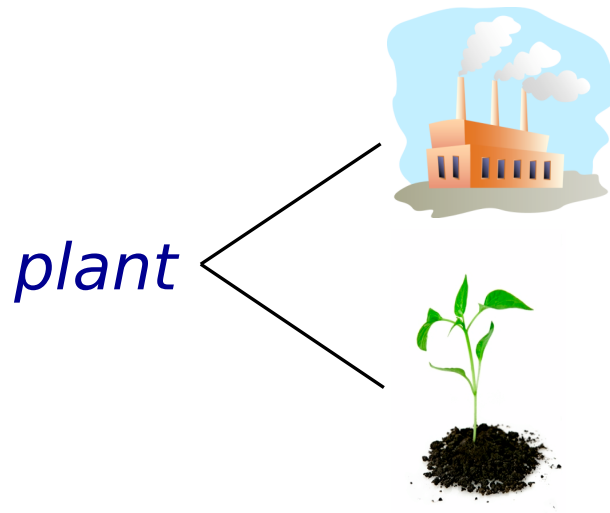
	<b>factory</b>	<b>flower</b>	<b>tree</b>	<b>water</b>	<b>fork</b>
...	...	...	...	...	...
<b>grow</b>	15	147	330	106	3
<b>garden</b>	5	200	198	118	17
<b>worker</b>	279	0	5	18	0
<b>production</b>	102	6	9	28	0
<b>wild</b>	3	216	35	30	0
...	...	...	...	...	...

# Contextual Specification



	plant	factory	flower	tree	water	fork
...	...	...	...	...	...	...
grow	517	15	147	330	106	3
garden	316	5	200	198	118	17
worker	84	279	0	5	18	0
production	130	102	6	9	28	0
wild	96	3	216	35	30	0
...	...	...	...	...	...	...

# Contextual Specification



	plant	factory	flower	tree	water	fork
...	...	...	...	...	...	...
grow	517	15	147	330	106	3
garden	316	5	200	198	118	17
worker	84	279	0	5	18	0
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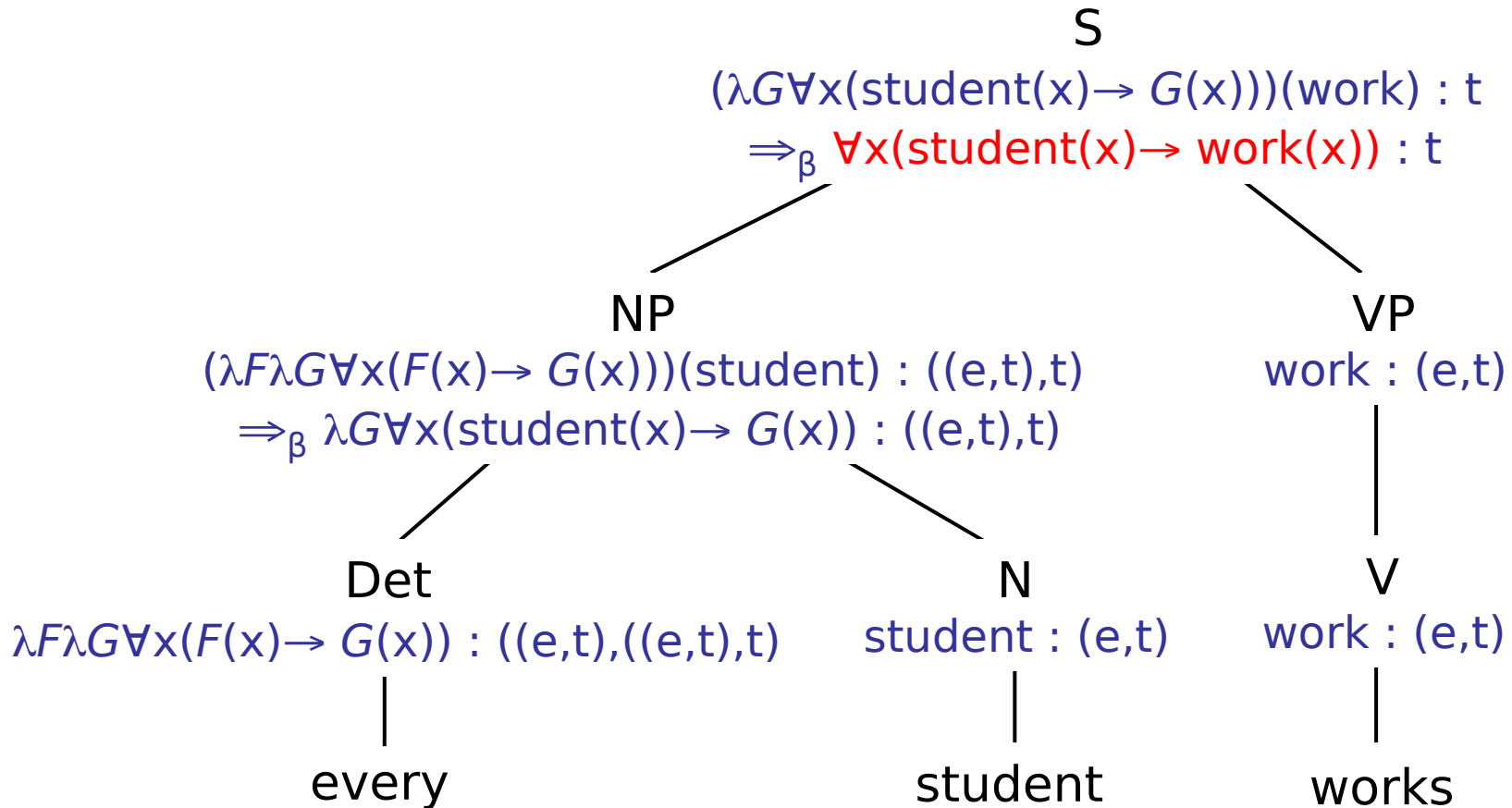
$$\vec{v}_{water}(plant) = \sum_w f(plant, w) * f(water, w) * \vec{e}_w$$

Erk&Padó 2008, Thater et al. 2011

# Similarity-based inference?

$A \vdash B$  iff  $A \models B$       iff  $A \approx B$  ?

# Compositionality?

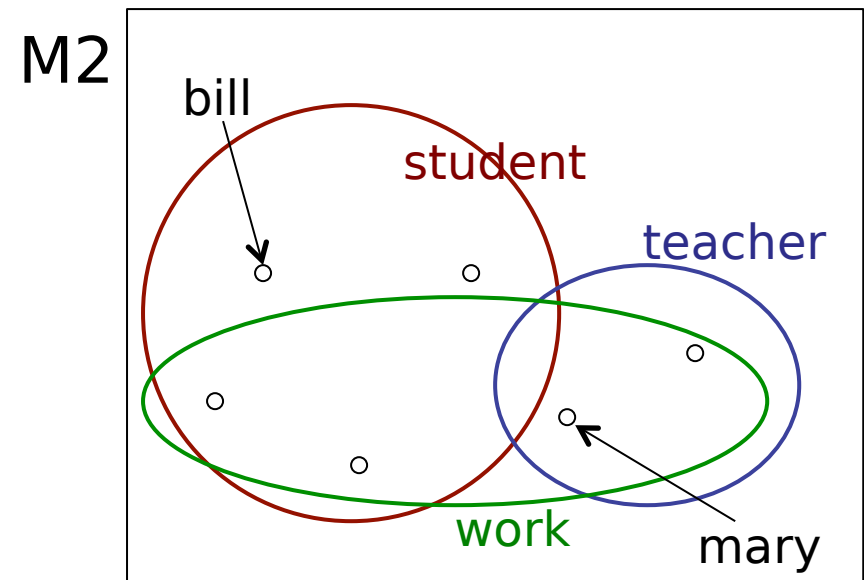
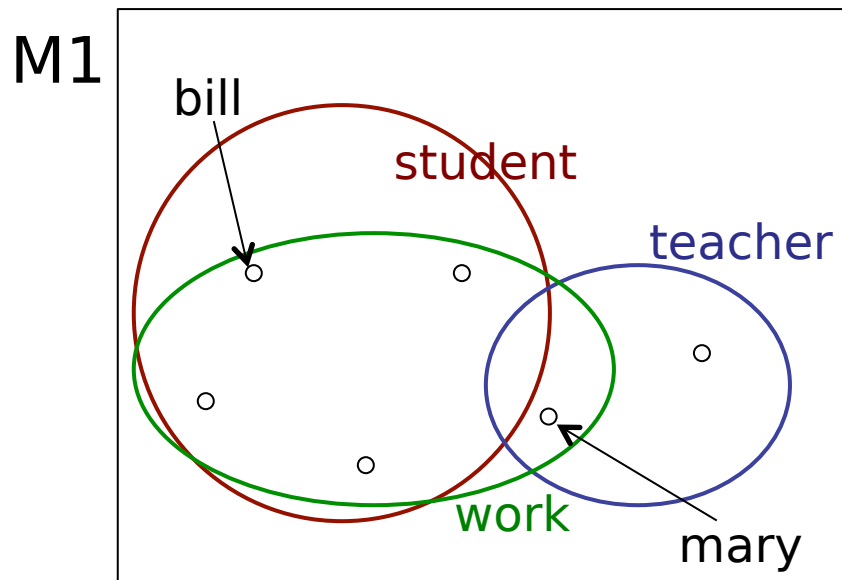


# Grounding Meaning in the World?

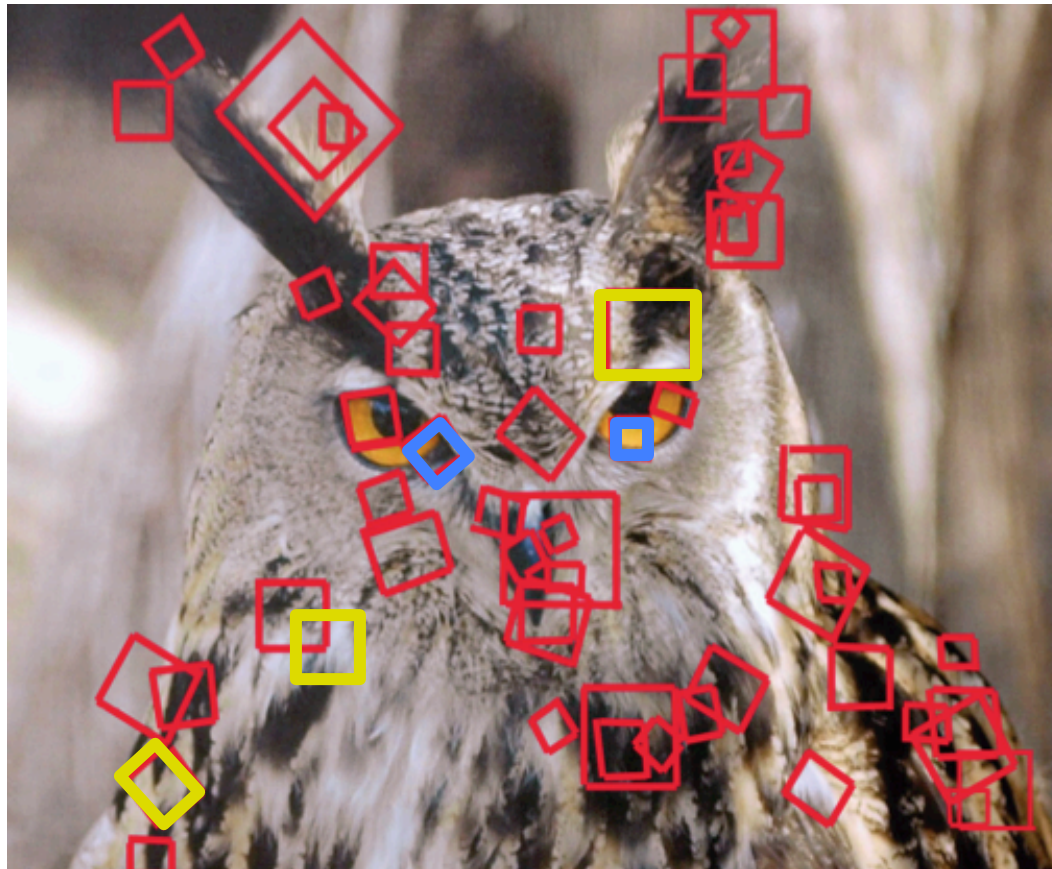
*Every student works*  $\Rightarrow \forall x(\text{student}(x) \rightarrow \text{work}(x))$

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

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



# Grounding Distributional Meaning in Visual Information



Feng&Lapata 2010, Bruni et al. 2011

# Grounding Action Descriptions in Videos



Rohrbach et al. 2012, Regneri et al. 2012

# Topics for Seminar Presentations

- Background Reading: Chambers&Jurafsky 2008, Ch. 20.7
- Contextualisation
  - Erk&Pado 2008 (Thater et al. 2010, 2011)
  - Dinu&Lapata 2010 (Dinu 2010)
- Compositionality
  - Mitchell&Lapata 2008
  - Baroni&Zamparelli 2010
- Grounding in visual information
  - Bruni et al. 2001
  - Farhadi et al. 2010
  - Regneri et al. 2013
  - Silberer&Lapata 2012

# Different Views on Semantic Processing

- ❑ Statistical methods as disambiguation disambiguation modules complementing knowledge-based NLP
- ❑ Statistical models as meaning representations
- ❑ Statistical methods for acquisition of semantic knowledge
- ❑ More „natural“ (and efficient) logic-based methods

# More Seminar Topics

- ❑ Extraction of Script Knowledge
  - ❑ Chambers&Jurafsky 2008, 2009
  - ❑ Regneri et al. 2010, 2011
- ❑ Distributional Semantics and Language Models
  - ❑ Mitchell&Lapata 2009
- ❑ Recent Logic-based Approaches
  - ❑ Bos&Markert 2005 (Dagan et al. 2006)
  - ❑ MacCartney&Manning 2007 (MacCartney 2009)
  - ❑ Lewis&Steedman 2013