Developing Probabilistic Models for Identifying Semantic Patterns in Texts

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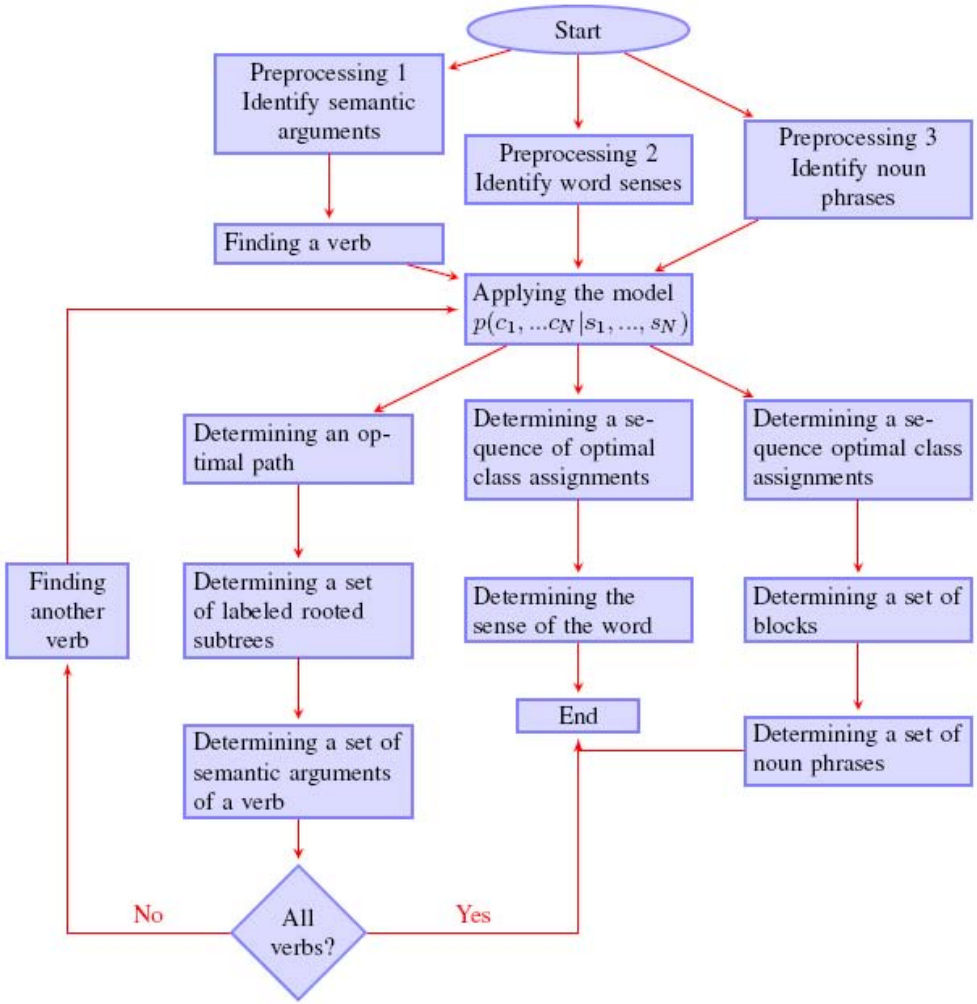
Introduction

Three text patterns capturing semantics of a sentence

- Semantic arguments of a verb
  - Semantic arguments of a verb can be used to answer the questions of who, what, when, where, and why.
- The meaning of a word
  - The sense of a polysemous word can be used to understand the meaning of the word.
- Noun phrases
  - Noun phrases of a sentence combining with verbs can be used to find the abstraction of the sentence.

The Algorithm

- The key of the algorithm is a probabilistic graphical model.



The Probabilistic Graphical Model

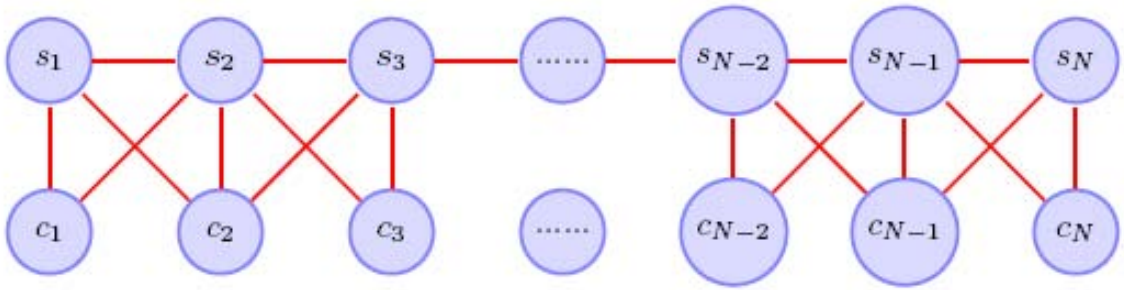


Figure: The conditional independence graph defining our graphical model.

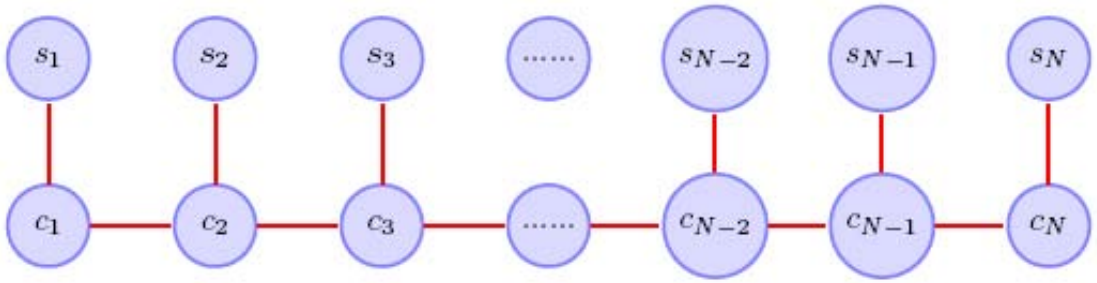
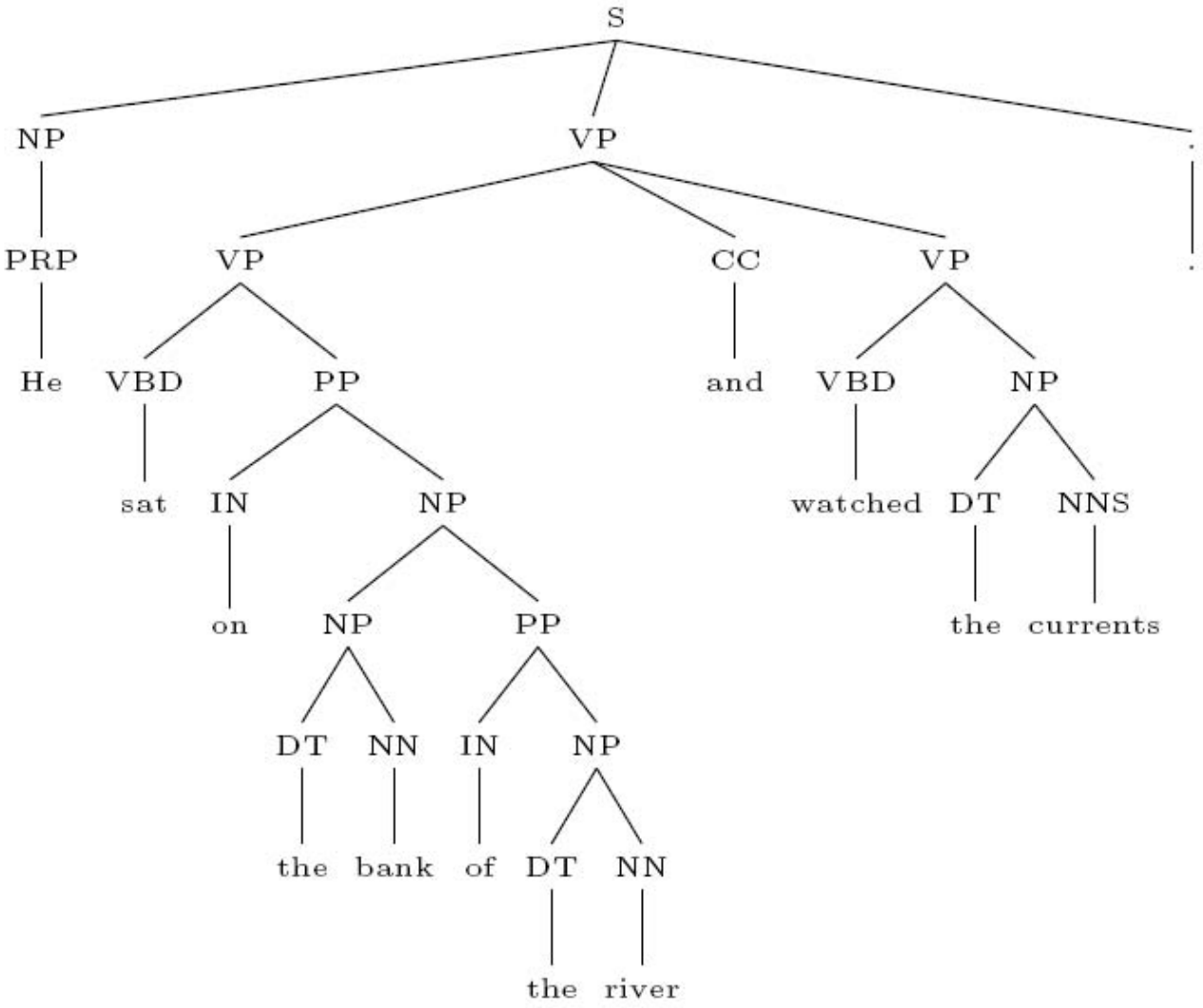


Figure: The usual conditional independence graph for Markov dependencies among the classes.

An example of identifying semantic arguments of a verb

He sat on the bank of the river and watched the currents.



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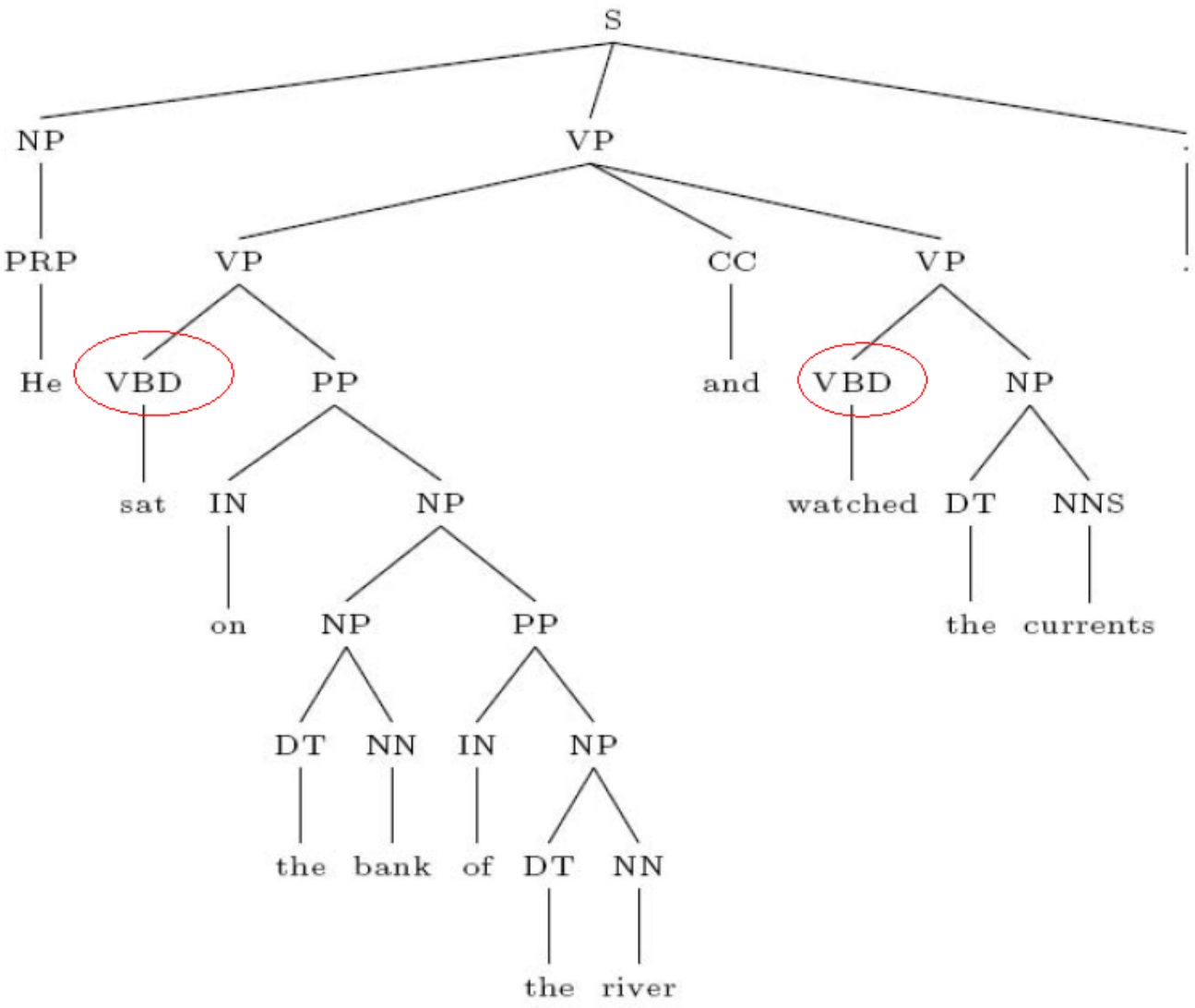

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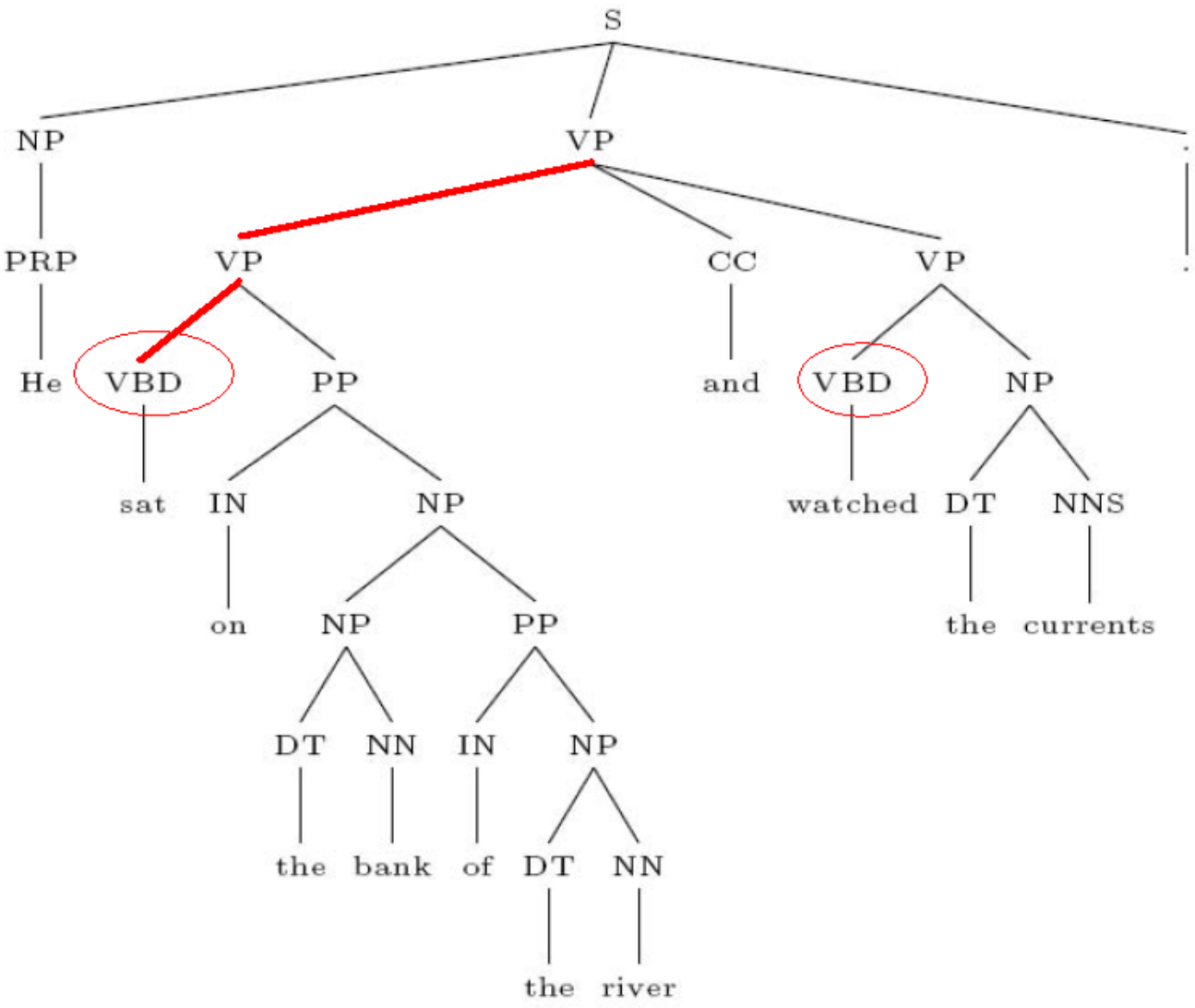

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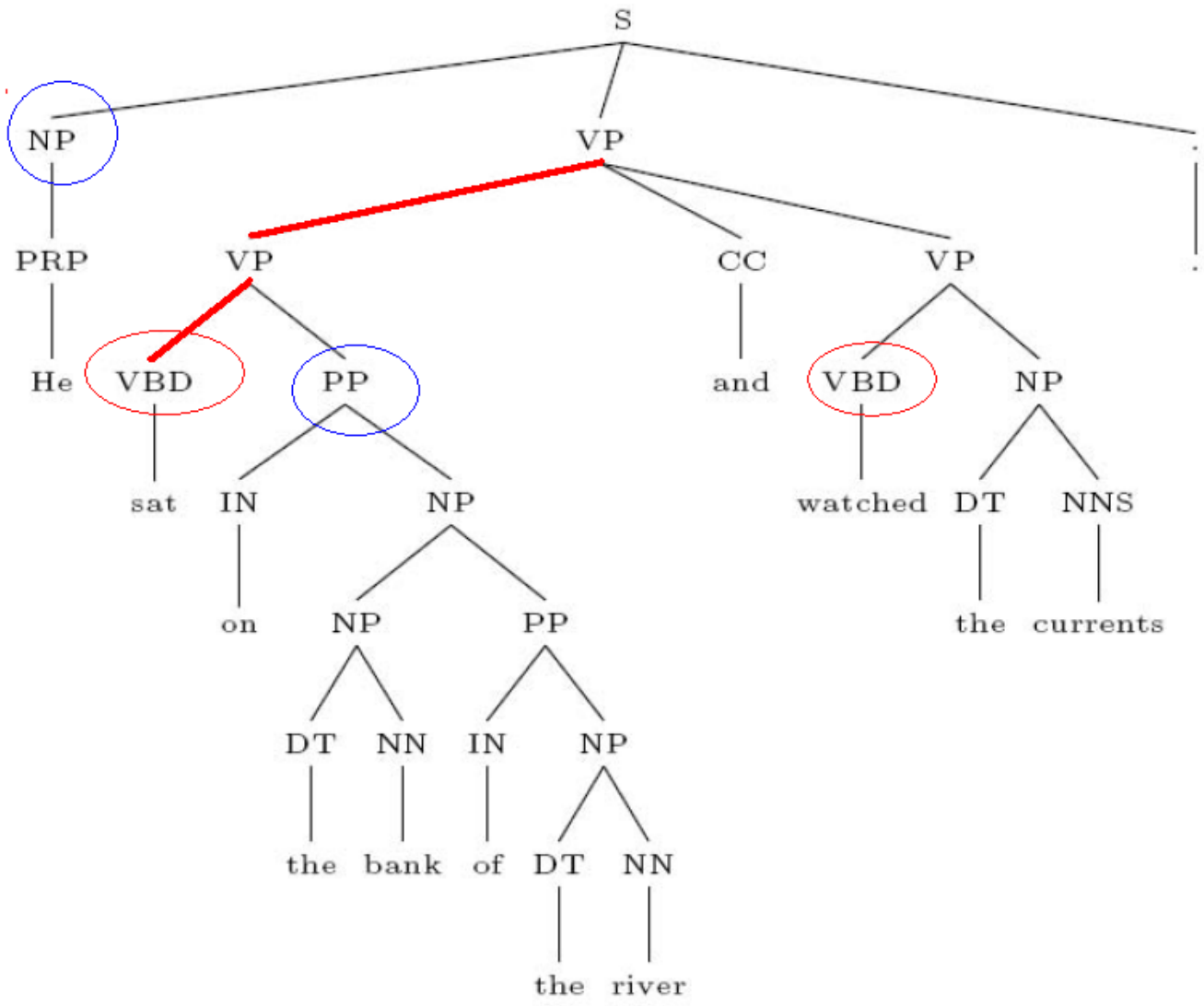

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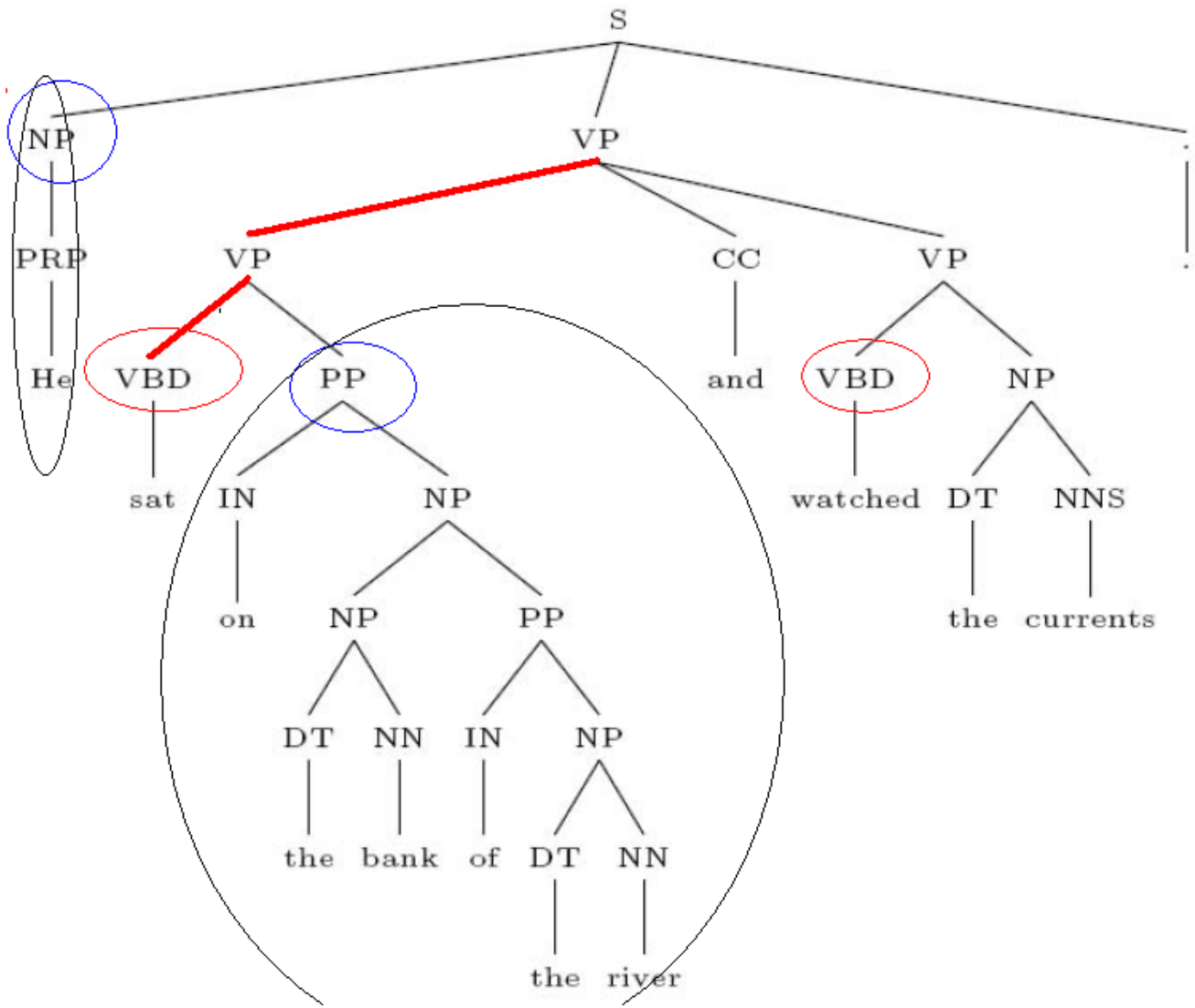

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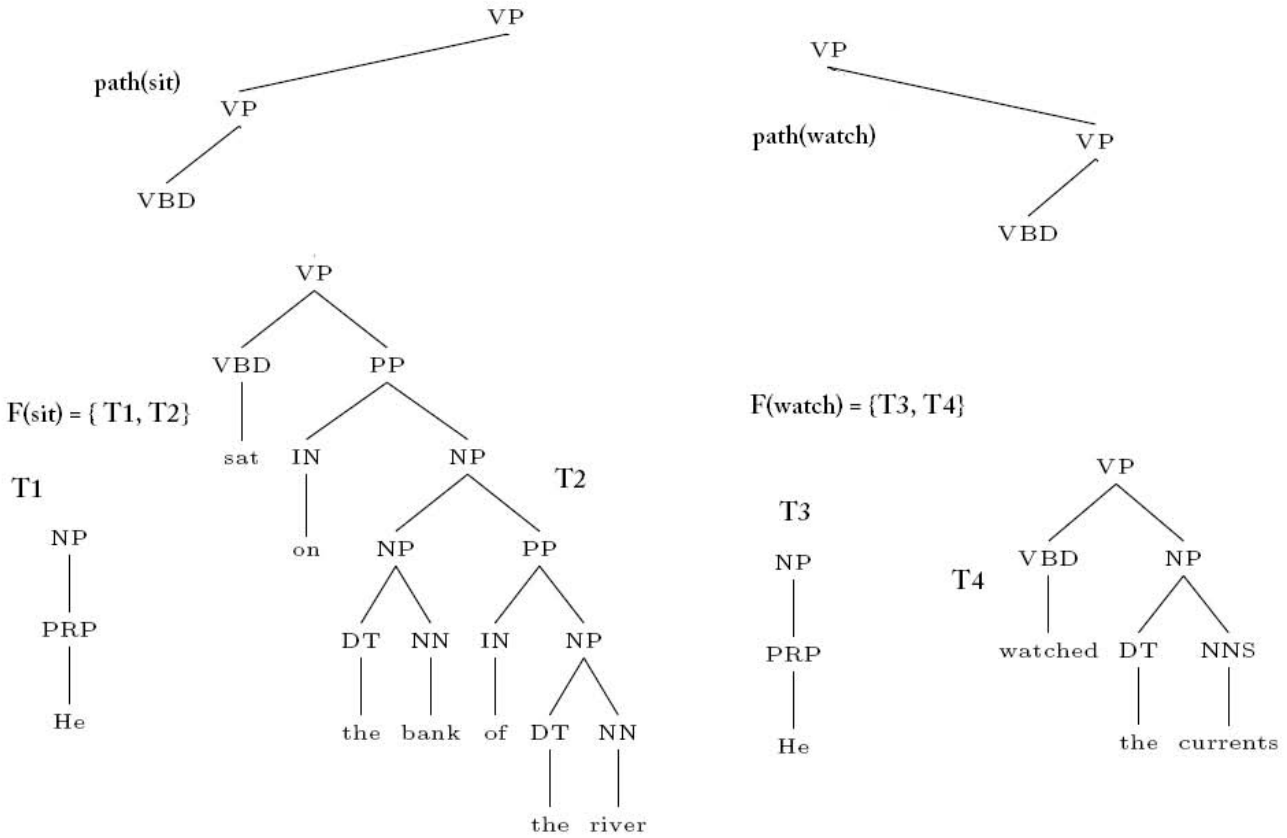

- Semantic arguments:
  - sit: *he; on the bank of the river*
  - watch: *he; the currents*

Empirical Results

- Results for identifying semantic arguments of a verb in a sentence on *WSJ* data from Penn Treebank and PropBank
- About 600 verbs associating with about 2000 semantic arguments
- 10 – *fold* cross validation technique

Files 20, 37, 49, 89	Precision %	Recall %	F-Measure %
Average	92.335	94.1675	93.2512
Standard Deviation	0.6195	0.5174	0.4605

Empirical Results

- Results for identifying the meaning of a word in a sentence on *line* data
- Results are better than those published by other researchers
- 10 – *fold* cross validation technique

	Accuracy 3 senses %	Accuracy 6 senses %	# of Context words in Training Set 6 senses k	Base Line 6 senses %
LSA [11]	75			
Bayesian [9]	76	71	8.9	16.67
Context Vector [9]	73	72	8.9	16.67
Neural Network [9]	79	76	8.9	16.67
This Method	85.25	81.12	2.45	19.09

Empirical Results

- Results for identifying noun phrases in a sentence on *CoNLL* – 2000 data
- Results are better than *The-Context-Independent-Bayes* model
- Results are better than those published by other researchers

Method	Recall %	Precision %	F-measure %
Role Based Learning [12]	92.03	91.05	91.54
HMM [1]	93.52	93.43	93.48
Naive Bayes			93.69
MEMM [13]	–	–	93.70
Voted perceptrons [14]	93.29	94.19	93.74
CRF [13]	–	–	94.38
SVM [15]	94.38	94.52	94.45
our method [16]	95.31	96.36	95.74