Order-Preserving DAG Grammars: Parsing, Complexity and Learning

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Joint work with
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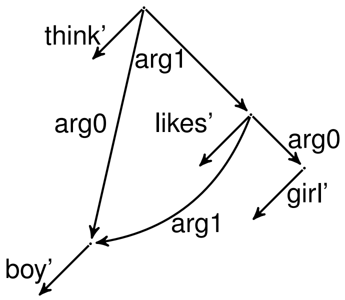
Motivation: Semantic graphs

One type of semantic grapsh: Abstract Meaning Representations



AMR for "the boy thinks that the girl likes him"

Abstract Meaning Representations

Properties of AMRs:

- Directed and acyclic
- Reentrancies (not trees)
- Any number of modifiers (i.e. no fixed rank)
- No formalized grammar

Long term goals

Parallel parsing of natural language sentences, building both syntax trees and semantic graphs.

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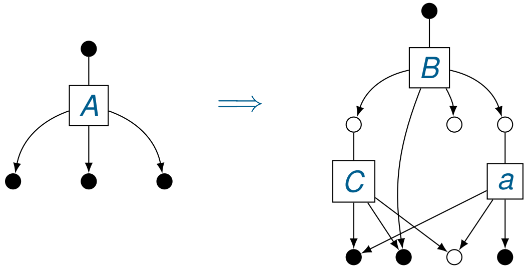
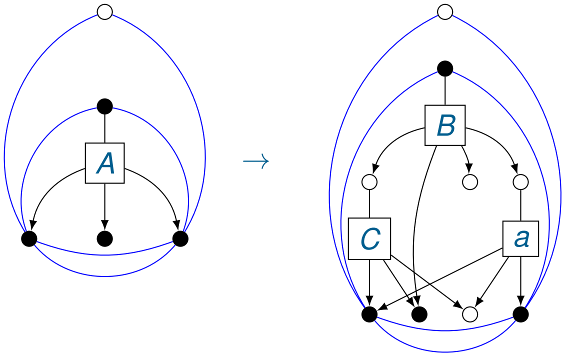
Trransformation of semantic graphs into natural language sentences.

Hyperedge replacement grammars



Hyperedge replacement grammars



Uniform vs. non-uniform parsing

For database theoreticians: Think data complexity vs. combined complexity

For verification people: Think model complexity vs. combined complexity

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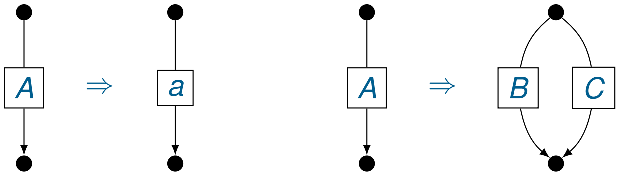
Consider a grammar where we only have rules of the following forms:



Order-preserving DAG grammars

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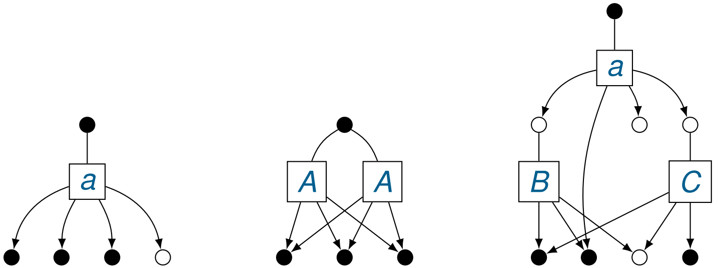


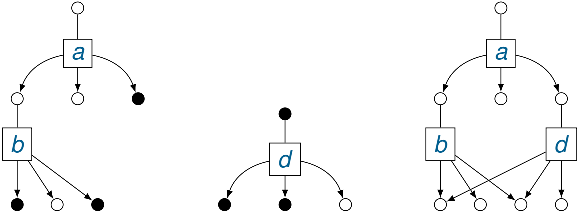
MAT-learning

We develop an algorithm for learning OPDGs from a Minimally Adequate Teacher (Angluin).

The teacher can answer

- equivalence queries (Is this the correct grammar?)
- membership queries (Does this graph belong to the language of the grammar?)

Concatenation



A Myhill-Nerode theorem

Theorem. A DAG language L can be generated by an OPDG if and only if $\equiv_L$ has finite index.
If $\equiv_L$ has finite index, there is a unique minimal unambiguous OPDG for L.

Polynomial time learning

Theorem. An OPDG G can be learned from a MAT in time polynomial in $|G|$ and the combined sizes of the counterexamples provided by the teacher.

The end

Thank you for listening!