

Querying and Updating Probabilistic Information in XML

Serge Abiteboul **Pierre Senellart**



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The Hidden Web

Definition (Hidden Web)

The set of webpages (which may or may not be dynamically generated) not accessible from the **hyperlinked structure** of the World Wide Web.

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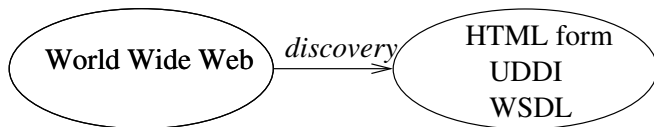
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How to understand it and benefit from its content?

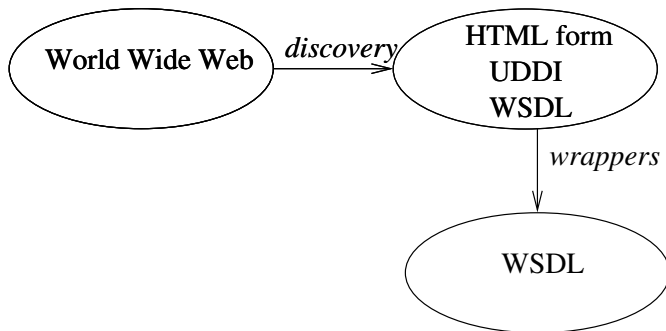
Semantic Interpretation of the Hidden Web

World Wide Web

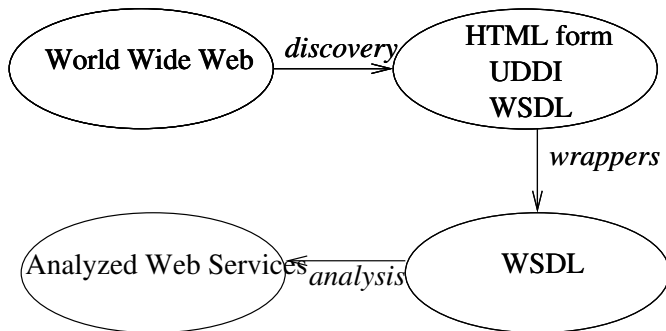
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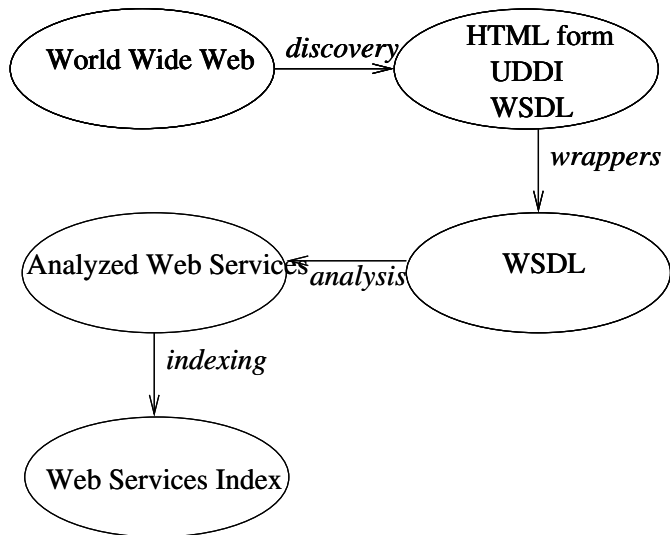
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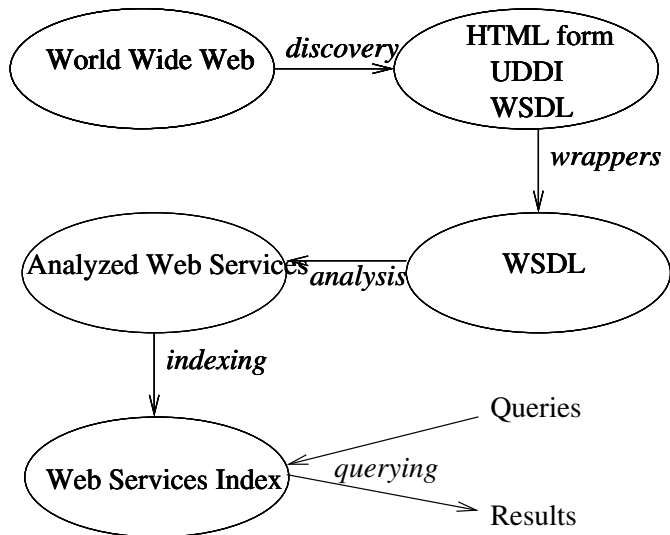
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Imprecise data

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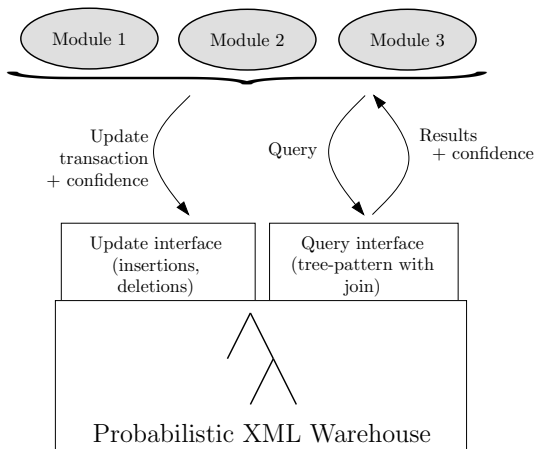
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 - ...
- Need for a way to manage this imprecision, to work with it throughout an entire complex process.

A Probabilistic XML Warehouse



Outline

1 Introduction

2 **Framework**

- Data Trees
- Queries
- Updates

3 Possible Worlds Model

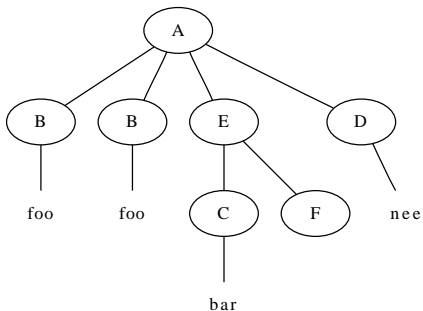
4 Simple Probabilistic Model

5 Fuzzy Tree Model

6 Conclusion

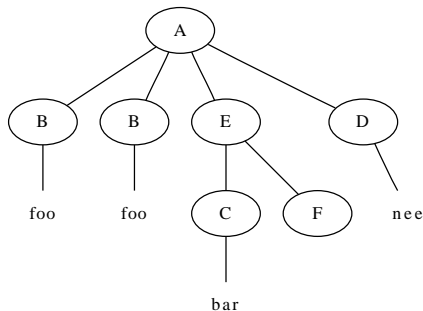
Data Trees

- Finite, **unordered**, trees.



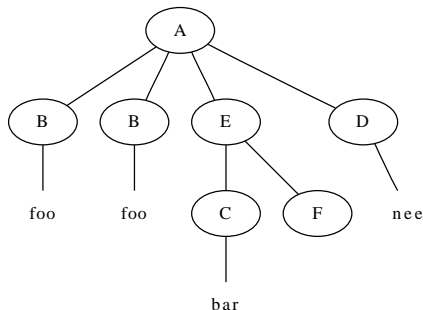
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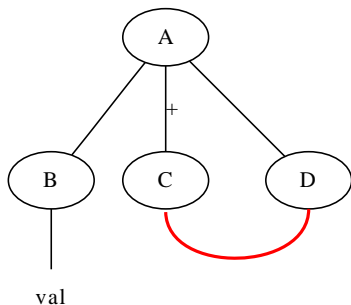
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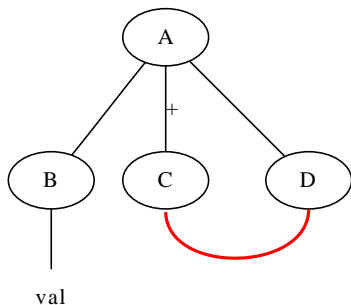
Tree-Pattern With Join Queries

- Queries: **Tree-Pattern With Join** (TPWJ)
(standard subset of XQuery)



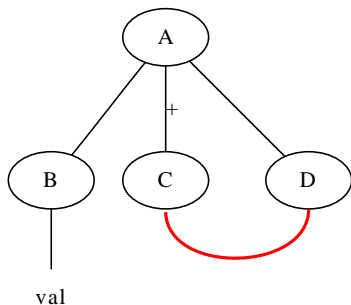
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Tree-Pattern With Join Queries

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- Join: by value
- Result: minimal subtree containing all the nodes mapped by the query



Update Transactions

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- Update Transaction: TPWJ query + mapping, stating **where** to perform operations.
- **Probabilistic update**: update + **confidence**

Outline

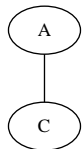
- 1 Introduction
- 2 Framework
- 3 Possible Worlds Model**
 - Model
 - Semantic Foundation
- 4 Simple Probabilistic Model
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- 6 Conclusion

Possible Worlds Model

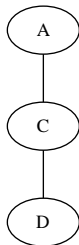
Semantic foundation for probabilistic data: possible worlds model.
Set of **tree/probability pairs**, one for each **possible world**.

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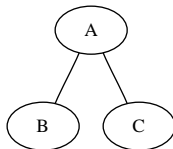
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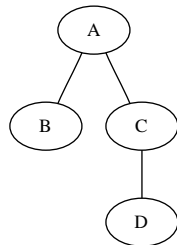
$$P = 0.06$$



$$P = 0.14$$



$$P = 0.24$$



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Queries, Updates: Semantic Foundation

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If $T = \{(t_i, p_i)\}$, the result of query Q over the Possible Worlds set T is the normalization of $\{(t, p_i) \mid t \in Q(t_i)\}$

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The result of an update τ with query Q and confidence c on a Possible Worlds set T is the normalization of:

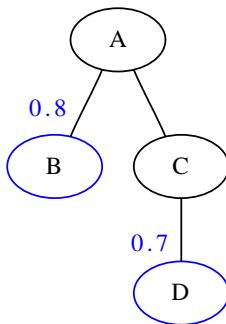
$$\begin{aligned} & \{(t, p) \in T \mid t \text{ is not selected by } Q\} \\ \cup & \{(\tau(t), p \cdot c) \mid t \text{ is selected by } Q\} \\ \cup & \{(t, p \cdot (1 - c)) \mid t \text{ is selected by } Q\} \end{aligned}$$

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 - Model and Possible Worlds Semantics
 - Incompleteness
- 5 Fuzzy Tree Model
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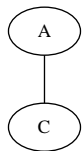
SP Trees

Data tree with **probability assigned to each node**.

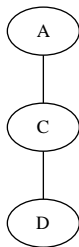


PW Semantics of SP Trees

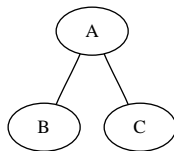
A node is assigned the probability p : means that the probability the node is **in the tree** if **its parent is in the tree** is p .



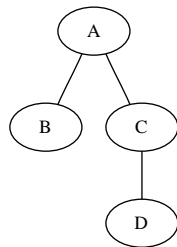
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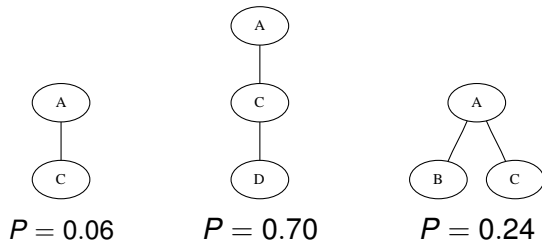


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Incompleteness of SP Trees

Theorem

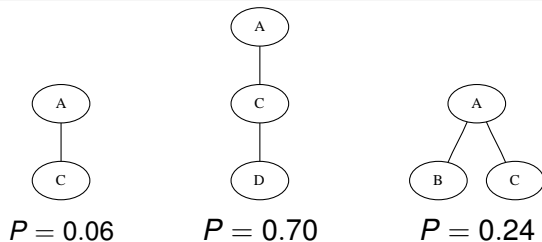
The SP tree model is incomplete.



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SP trees are not closed under updates.

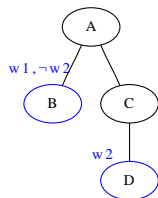
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Fuzzy Trees

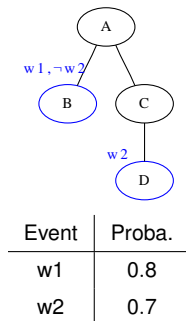
Data tree with **event conditions** (conjunction of probabilistic events or negations of probabilistic events) **assigned to each node**.



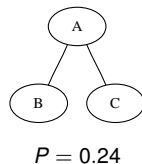
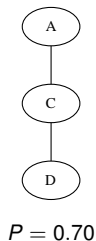
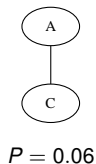
Event	Proba.
w1	0.8
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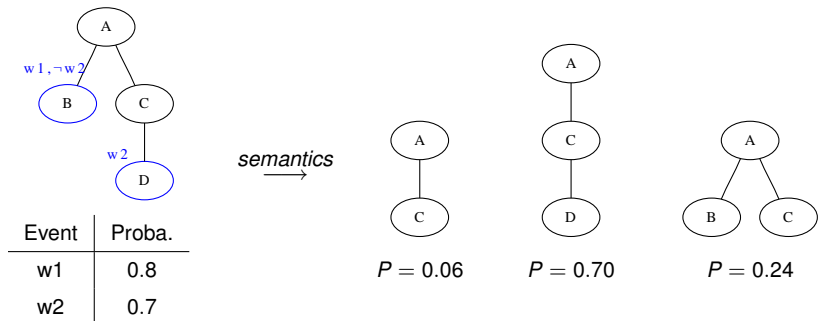


semantics
→



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The Fuzzy Tree model is as expressive as the Possible Worlds model.

Queries on Fuzzy Trees

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Queries on fuzzy trees:

- Query **on underlying tree**.
- Probabilities: probability of the conjunction of the conditions of nodes of the mapping.

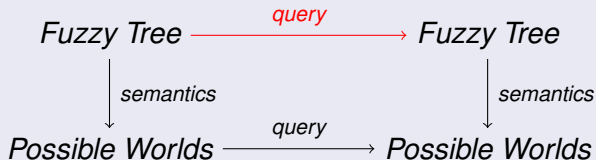
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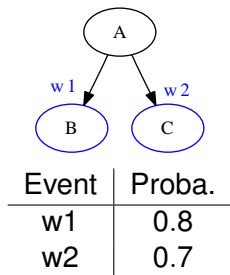
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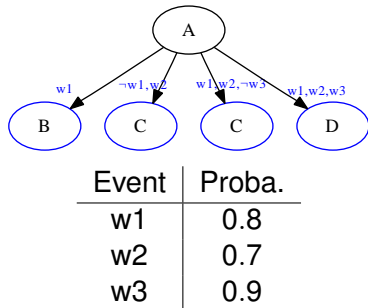
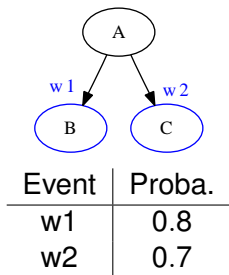
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Replacement of C by D if B is present, with confidence 0.9.



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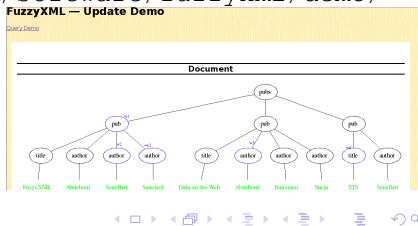
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 - Summary
 - Perspectives

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Summary

- A model for representing **probabilistic** information for **semi-structured** data.
- **Sound** and **complete** support for an important subset of XQuery.
- **Sound** and **complete** support for XUpdate-based transactions with inserts and deletes.
- An implementation based on compilation to XQuery/XUpdate.

Perspectives



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- Query **optimization**.
- Fuzzy data **simplification**.
- Extensions: negation, some limited order.