Querying and Updating Probabilistic Information in XML

Serge Abiteboul Pierre Senellart

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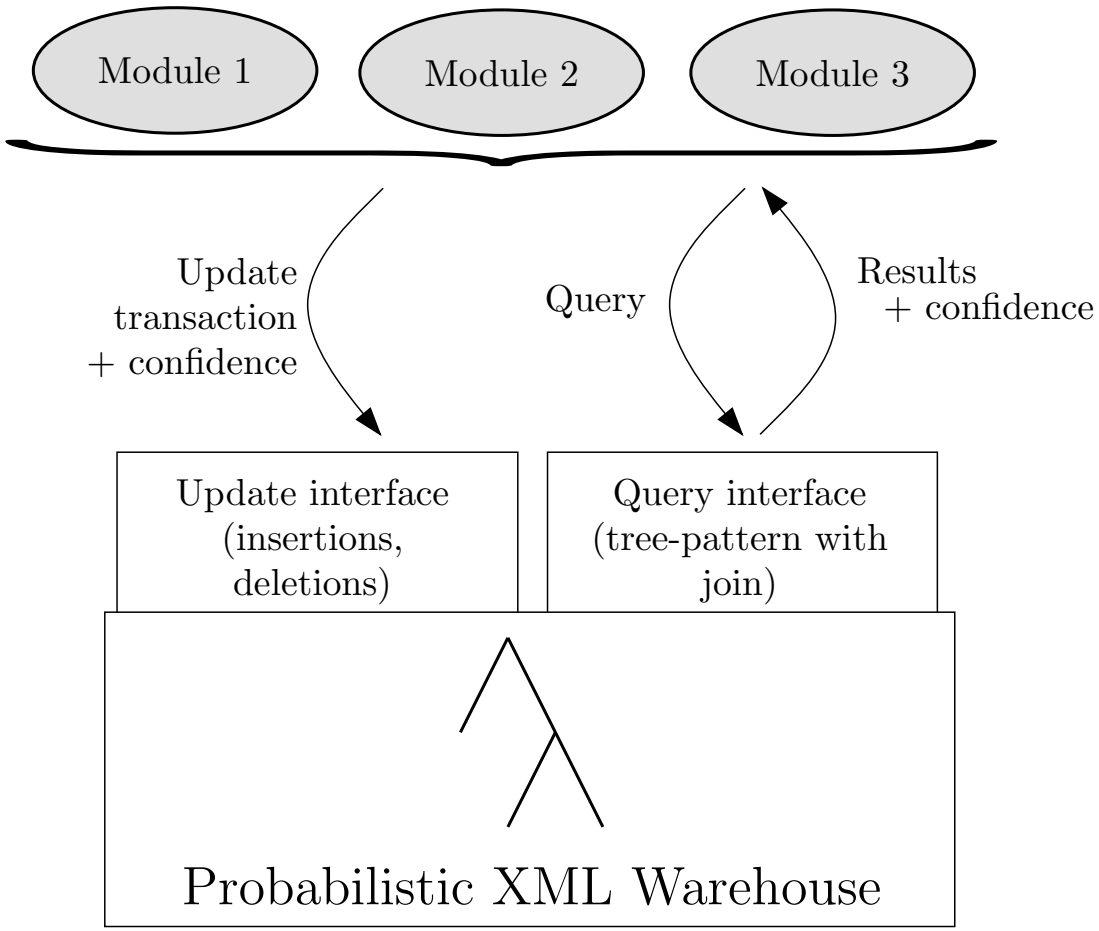
- Need for a way to manage this imprecision, to work with it throughout an entire complex process.

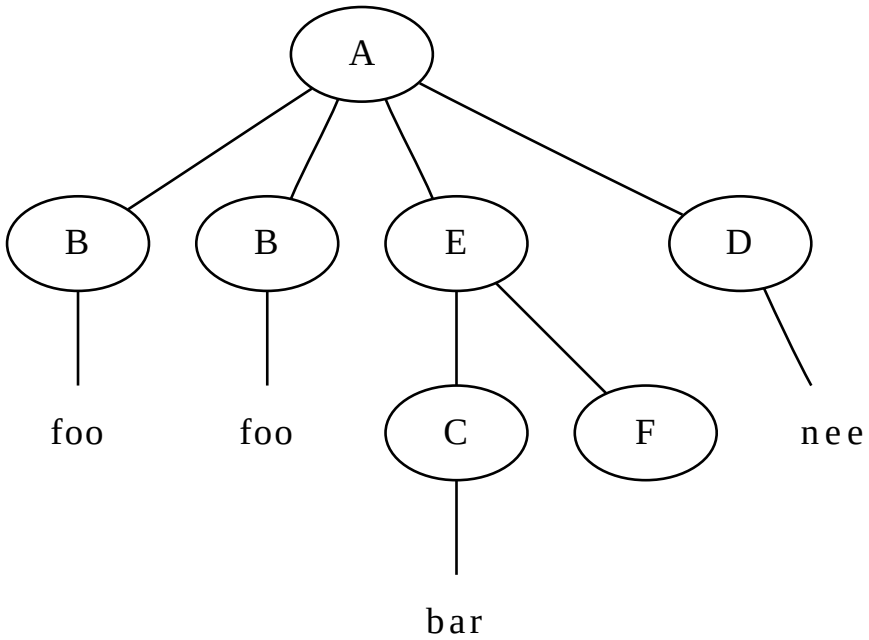
A Probabilistic XML Warehouse



Outline

Data Trees

- Finite, unordered, trees.



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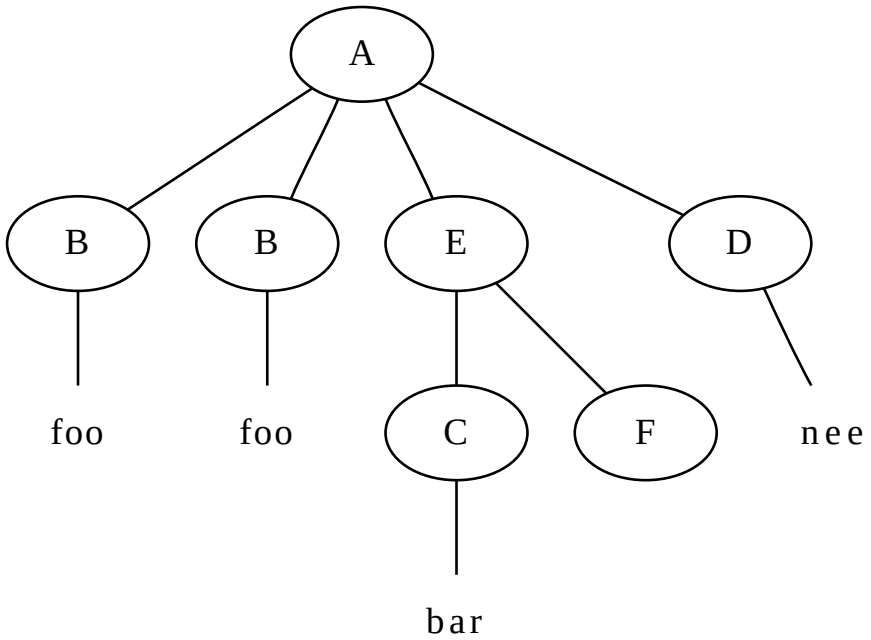

Data Trees

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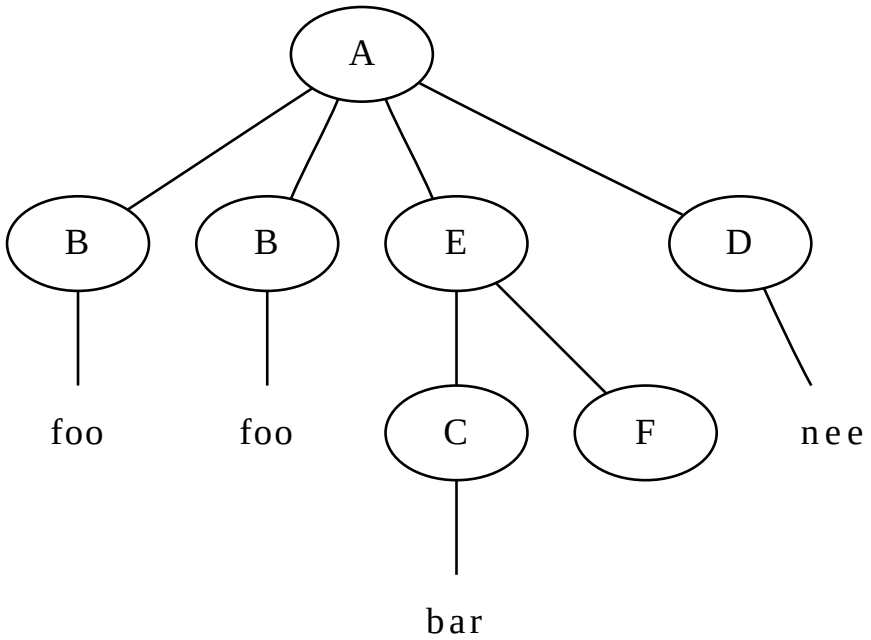
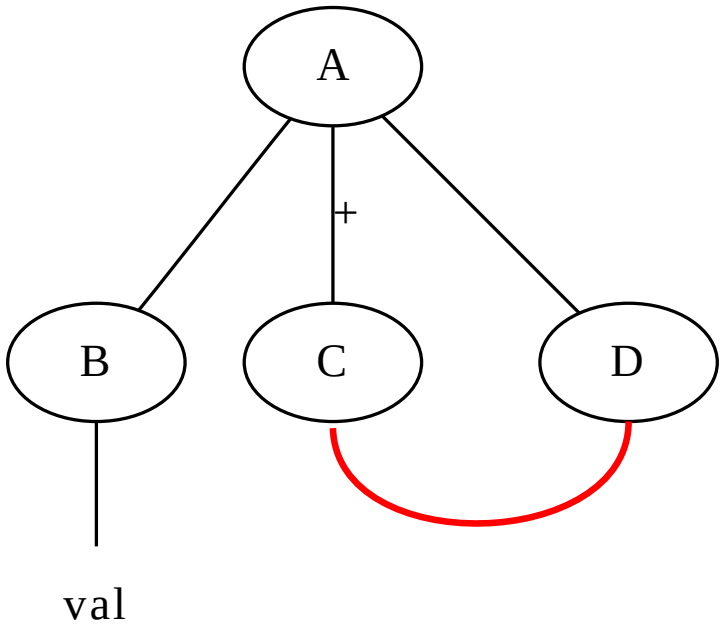
- No distinction between attribute and element nodes.
- No mixed content.



Tree-Pattern With Join Queries

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



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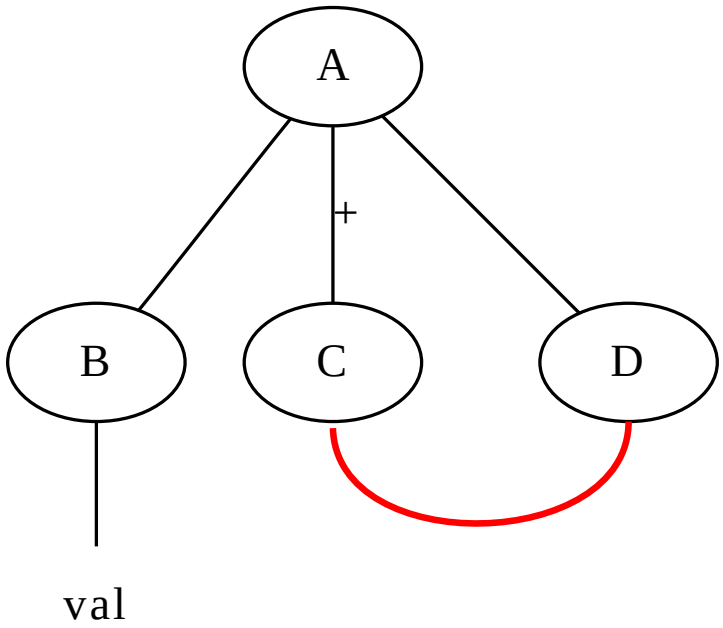

Tree-Pattern With Join Queries

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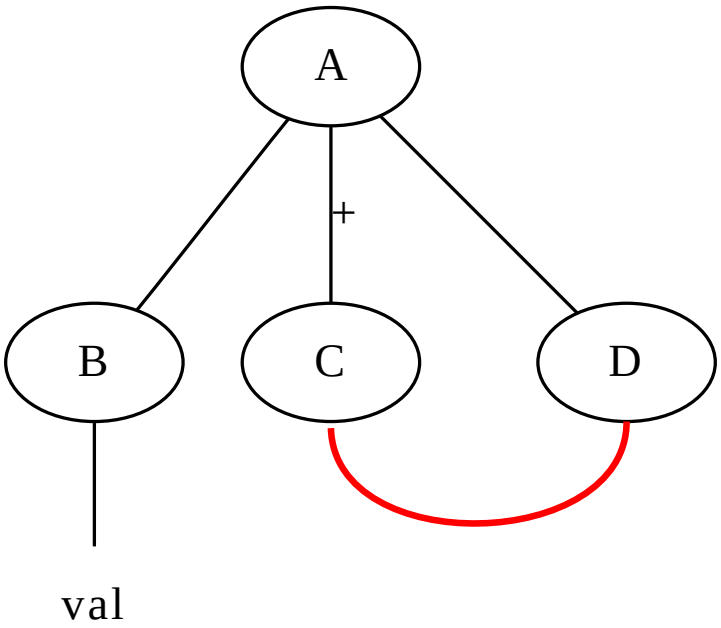
- Join: by value
- Result: minimal subtree containing all the nodes mapped by the query



Update Transactions

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- Probabilistic update: update + confidence

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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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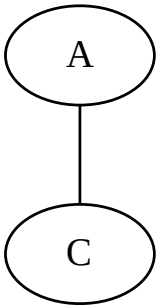
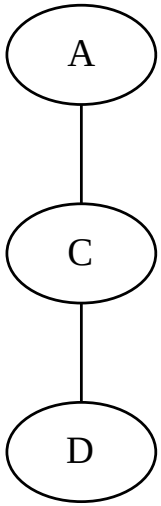
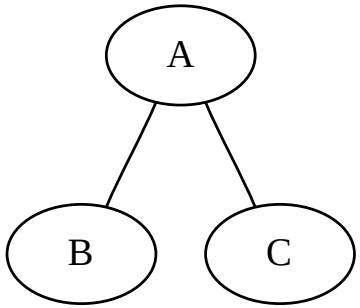


$P = 0.06$



$P = 0.14$



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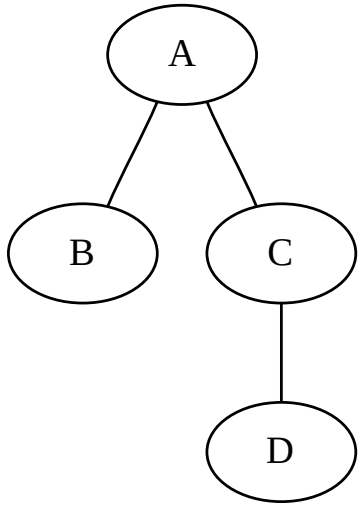

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Queries, Updates: Semantic Foundation

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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 $\{(t, p_i) | t \in Q(t_i)\}$

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The result of an update t with confidence c on a Possible Worlds set T is the normalization of:

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

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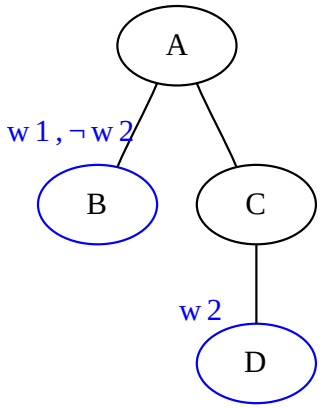
Fuzzy Trees

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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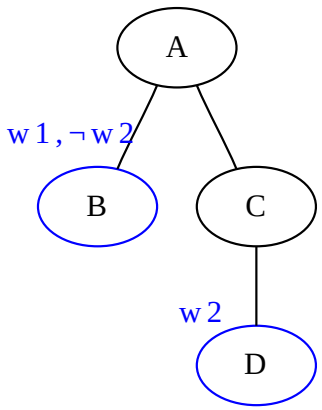

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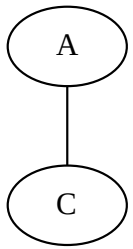

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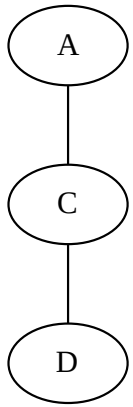

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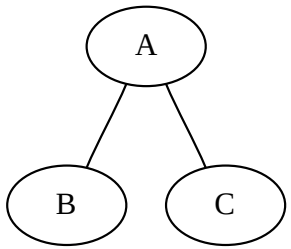

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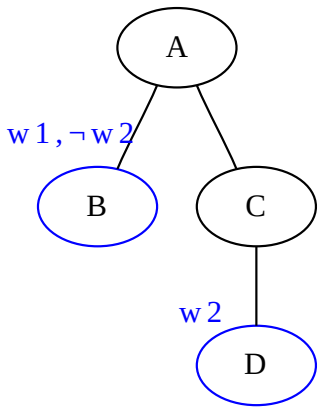

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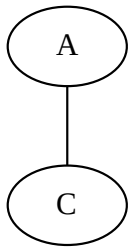

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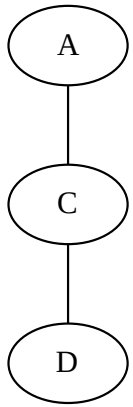

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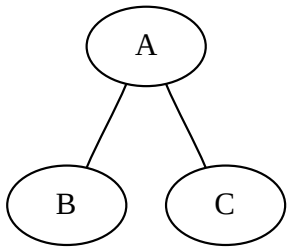

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Theorem

The fuzzy tree model is as expressive as the Possible Worlds model.

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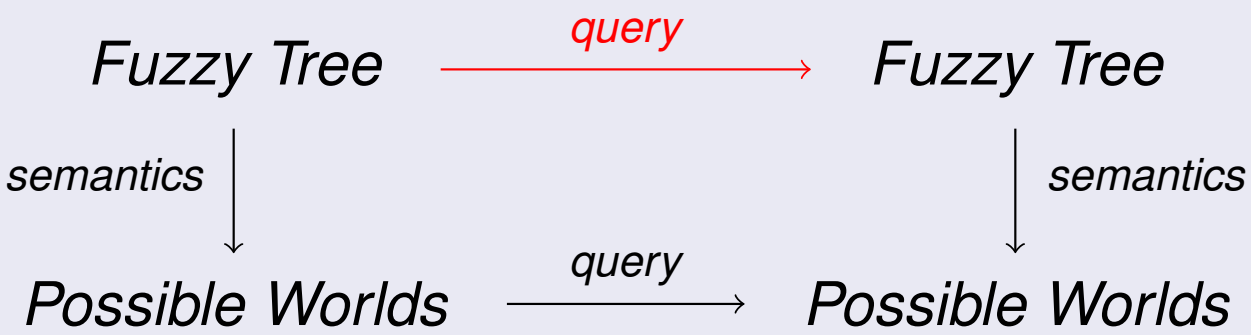

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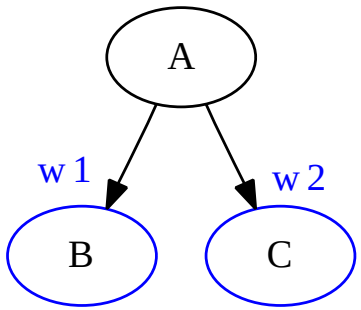
Replacement of *C* by *D* if *B* is present, with confidence 0.9.



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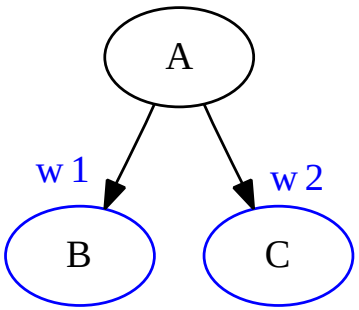

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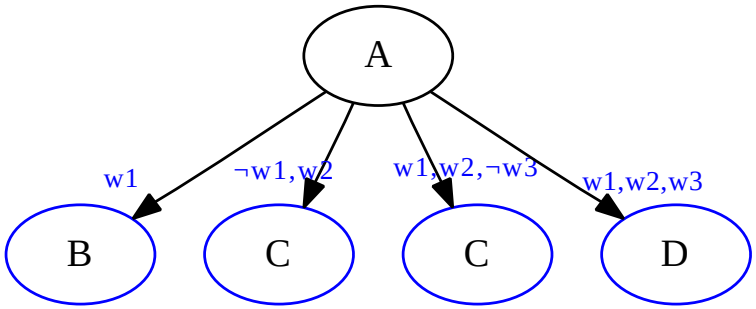

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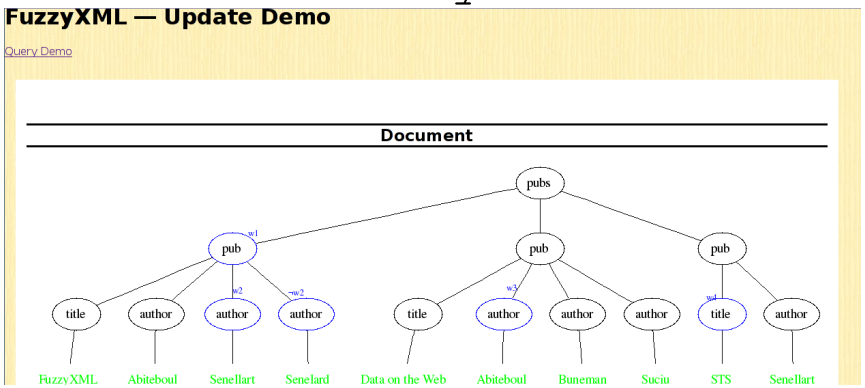

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- An implementation based on compilation to XQuery/XUpdate.

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- Extensions: negation, some limited order.