Incremental Evaluation of a Monotone XPath Fragment

Japan Advanced Institute for Science and Technology

Hidetaka Matsumura, Keishi Tajima
Why incremental evaluation?
• incremental maintenance of materialized views
• continuous queries, subscription queries

Monotone XPath:
• deletion from DB  ➔ deletion from query ans
• insertion to DB ➔ insertion to query ans
We store information on:

which elements were contributing
to which query answers

By using this information:

upon deletion of elements:
  • we identify the answers to which the deleted element
    was contributing

upon insertion of elements:
  • we can skip a part of computation of elements that
    newly become answers
Those matching steps outside predicates:
• when they are deleted, the corresponding answer elements are also deleted
  ➞ no need to monitor them

Those matching steps within predicates:
• there may be many elements matching the same step for each answer ➞ we need counters
• they indirectly contribute to answers through the joint step of that predicate
Q1: /⋯/ a [ b [ c ] ] / d

matching information:
- \((e_1, s_1, e_7)\)
- \((e_2, s_2, e_1)\)
- \((e_3, s_3, e_2)\)
- \((e_4, s_3, e_2)\)
- \((e_5, s_2, e_1)\)
- \((e_6, s_3, e_5)\)

counter:
- \((e_7, Q1, [s_1=1, \ldots])\)
- \((e_1, s_1, [s_2=2])\)
- \((e_2, s_2, [s_3=2])\)
- \((e_5, s_2, [s_3=1])\)
If $e_3$ has been deleted:
1. search the matching information for $e_3$
2. $(e_3, s_3, e_2)$ was found
3. decrement the counter $s_3$ for $e_2$:
   $$(e_2, s_2, [s_3=1]) \rightarrow (e_2, s_2, [s_3=0])$$
4. If the counter reaches 0:
   $e_2$ no longer matches $s_2$
   ⊗ search the matching information for $e_2$  ⋯ ⋯
If it does not reach 0
   $e_2$ still matches $s_2$
   ⊗ stop
If $e_8$ is inserted:
1. identify which steps in which queries it may match
2. we find it may match the step “d” of Q1
3. we go upward and examine ancestor steps one by one
4. we find $(e_1, s_1, e_7)$

→ now we know $e_8$ matches Q1 without evaluating the rest of Q1
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