FLEXIBLE AND EFFICIENT XML SEARCH WITH COMPLEX FULL-TEXT PREDICATES

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Motivation 1

- Motivation
  - in GRID scenario, many sources and web services
    - each described by annotations (XML)
    - need information discovery and ranking; querying XML structure and text
- Problem:
  - a variety of query languages with different expressive power, semantics, and scoring methods
- Our solution:
  - unified framework for XQFT-class languages
    - formal semantics
    - enable query optimizations
    - leverage relational query evaluation techniques
  - single solution by reducing from existing languages to this framework

Full-Text Query Example 2

- A query example expressed in natural language:

  find all elements containing the terms "Jefferson" and "education" within a window of 10 words, with "Jefferson" ordered before "education"

- The same query example in XQuery Full-Text:

  //[. ftcontains "Jefferson" && "education" window 10 words ordered]*

- Its XFT algebraic expression is

$$\sigma_{ordered^{\exists}(Jefferson,education)}(\sigma_{window^{\exists}_{\leq 10}(Jefferson,education)}(get(Jefferson)\ and\ get(education)))$$

XFT Algebra 3

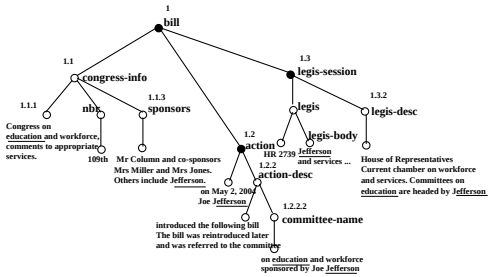
- Formalization of full-text language semantics in terms of keyword pattern matches
- XFT algebra consists of operators that manipulate pattern matches
  - conjunctions, disjunctions, difference and flexible interpretations of selection predicates (they may be satisfied by different or the same term matches within an answer)
- Algebra admits
  - Efficient algorithms for operator evaluation
    - integrate efficient LCA computation with efficient match manipulation
  - Rewritings of queries into more efficient forms
    - analogous to relational algebra rewritings
  - Extension with scoring
    - works for a large family of scoring functions that generalizes the standard vector-based model
    - incremental score computation for an element from the scores of its descendants

The XFT Algorithms 4

- Propose two evaluation strategies: AllNodes and SCU
- AllNodes algorithm
  - straight forward application from XFT operators
  - self-contained pattern match representation
- SCU algorithm combine
  - stack-based techniques to cope with element nesting
  - compute the smallest number of elements and matches that are relevant to all query answers
  - distributed pattern match representation

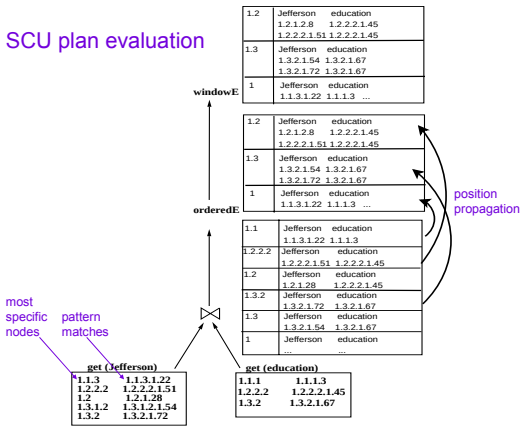
The XFT Algorithms 5

Example input XML document

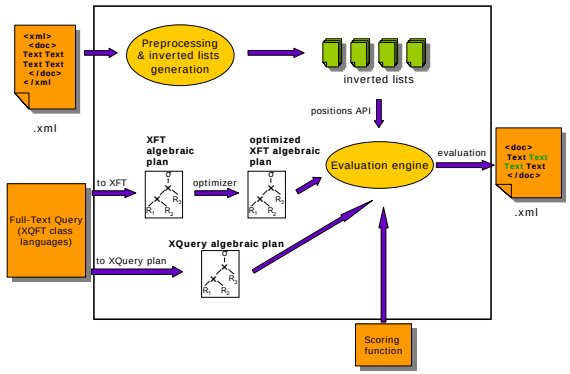


Minimize size of intermediate results by representing only the most specific nodes and by not duplicating matches across nested elements

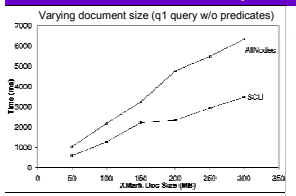
SCU plan evaluation

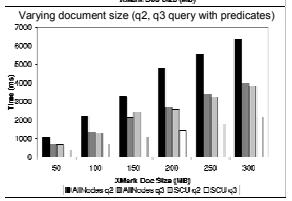


Relational-style query processor architecture 6



Experiments 7





- Queries
  - Q1= get(See) and get(internationally) and get(description) and get(charges) and get(ship)
  - $Q2=\sigma_{orderedE(See,\ internationally,\ description,\ charges,\ ship)}$ (Q1)
  - Q3= push selections in Q2
- Varying document size
  - SCU performs 30% better than AllNodes
  - 40% improvement for relational-like query rewritings
- Term frequencies used in the experimental queries are high
- Setup
  - Centrino 1.8GHz laptop, 1GB RAM

Ongoing Work 8

- GalaTex is the first complete implementation of W3C XQuery Full-Text language
  http://www.galaxquery.com/galatex
- Ongoing Work:
  - Integrate XFT algorithms into GalaTex
  - Efficient topK evaluation for XFT plans
  - Optimizations across structure navigation and text search
    - Query rewritings and minimization
    - Consistent scoring: same scores for equivalent expressions
    - Consistent ranking: same topK results for equivalent expressions