Explaining & Reformulating Authority Flow Queries

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Roadmap

- Motivation
- Explaining Query Results
- Query Reformulation
- Experimental Results
- Related Work
- Conclusions

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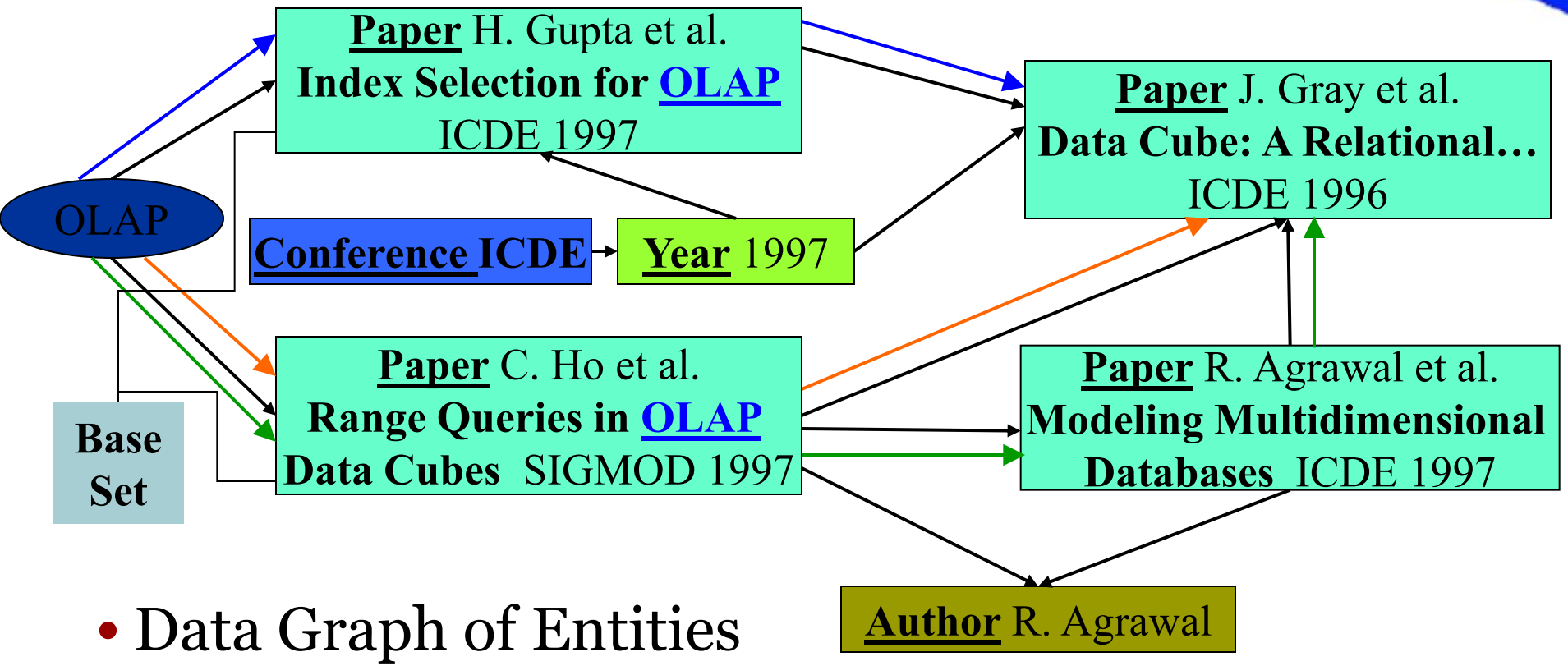
Motivation – Authority Flow Queries

- Authority Flow – Effective Ranking Mechanism
- Authority originates from the authority sources and flows according to the semantic connections.
- Follows the Random Surfer Model.
- At any time step, the random surfer either:
  - Moves to an adjacent node
  - Randomly jumps to some node (different in Personalized PageRank and ObjectRank)
- Applications:
  - Web [unstructured] (PageRank, Personalized-PageRank)
  - Databases [structured] (ObjectRank)

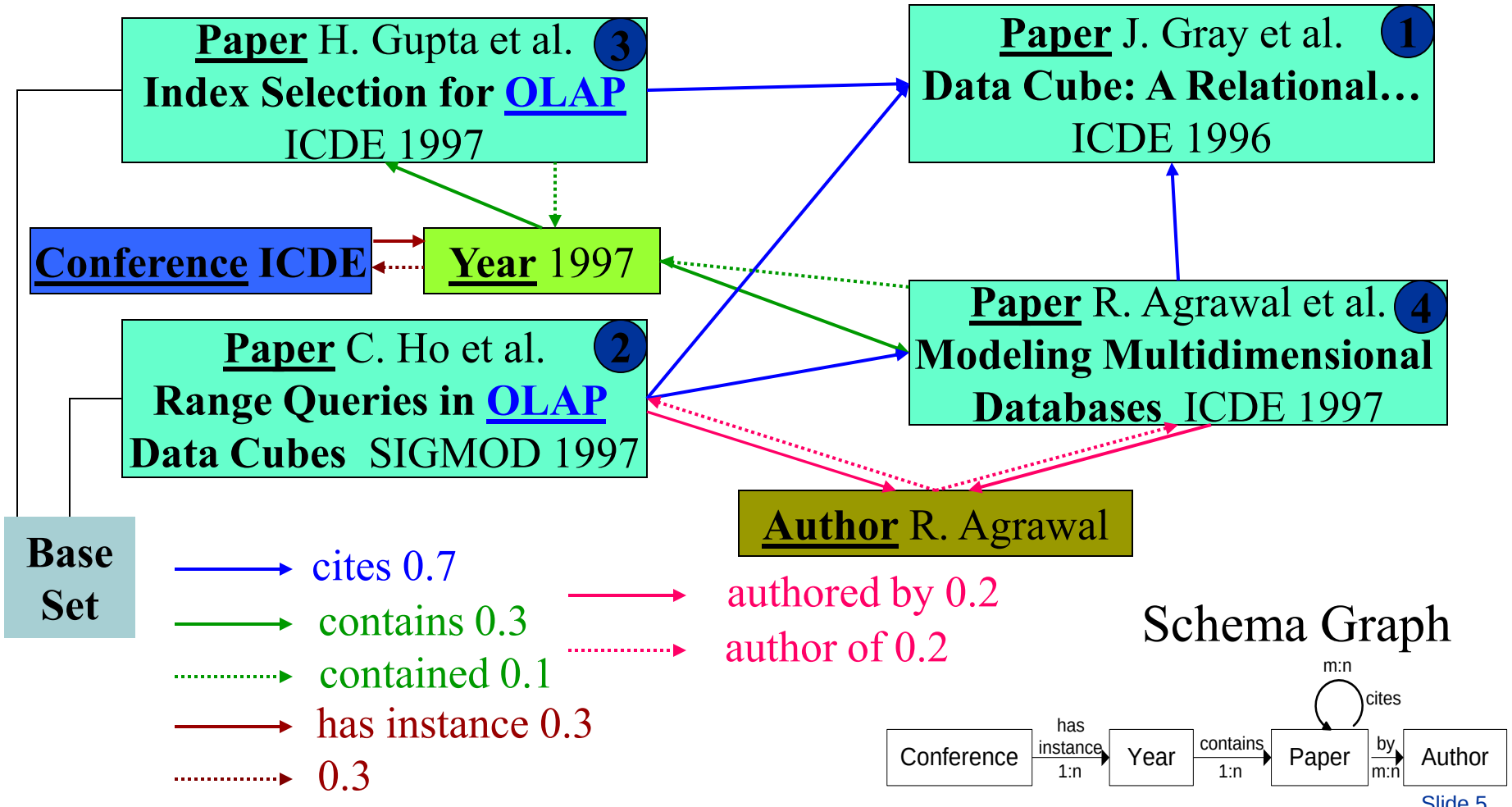
Motivation – ObjectRank [VLDB04]



- Data Graph of Entities
- **ObjectRank** Ranks Objects According to Probability of Reaching Result Starting from Base Set

Motivation - ObjectRank

Authority Transfer Data Graph (Keyword Query: [OLAP])



Motivation

Limitations of ObjectRank **:**

- No way to *explain* to the user why a particular result received its current score.
- Authority transfer rates have to be set manually by a domain expert.
- No *query reformulation* methodology to refine results.

ObjectRank2 (*Slight modification of ObjectRank*)

- Random Surfer jumps to different nodes of base set with different probabilities.
- Probability for a node v is proportional to I*RScore*(v,$\boldsymbol{Q}$)

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Explaining Query Results

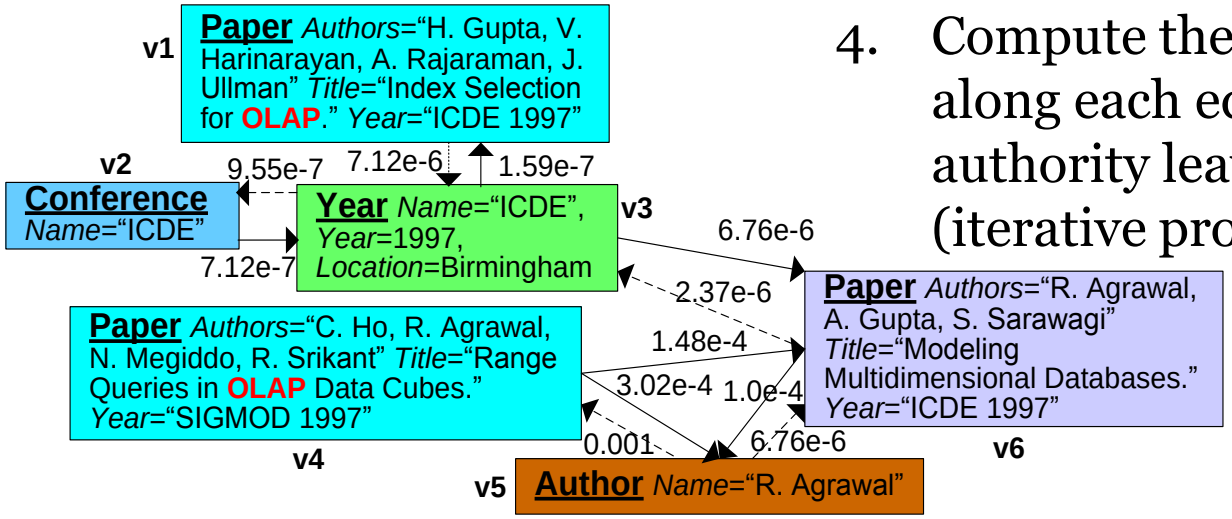
- Problem – Given a *target object T*, explain to user why it received a high score.
- Our Solution – Display an *explaining subgraph* of Authority transfer data graph, for *T*.
- Explaining subgraph contains:
  - All Edges that transfer authority to *T*.
  - Edges are annotated with amount of authority flow.
- Done in two stages:
  - **Subgraph Construction Stage**
    - ✓ Bidirectional Breadth-First Search
  - **Authority Flow Adjustment Stage**
    - ✓ Adjust original authority flows – more challenging

Explaining Query Results – Explaining Subgraph

- Target Object – "*Modeling Multidimensional databases*" paper.

Explaining Subgraph Creation

1. Perform a BFS search in reverse direction from the target object.
2. Perform a BFS search in forward direction from base set objects (authority sources).
3. Subgraph will contain all nodes/edges traversed in the forward direction.
4. Compute the explaining authority flow along each edge by eliminating the authority leaving the subgraph (iterative procedure).



TARGET OBJECT

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Query Reformulation

Motivation

- Content-based Reformulation - Well studied in Traditional IR (Salton, Buckley 1990)
  - Query Expansion is Dominant strategy
- No Method to Reformulate based on Link-Structure and Authority Flow Bounds.

STEPS:

1) System computes *Top-k objects* with high ObjectRank2 scores.
2) User marks relevant objects.
3) Compute *explaining subgraph* of feedback objects.
4) Reformulate based on (a) *Content* (b) *Structure*.
   - Content Reformulation based on traditional IR techniques on explaining subgraph
   - Structure Reformulation Achieved by Adjusting Authority Flow Bounds
5) Practically diameter is limited to a constant (L=3).

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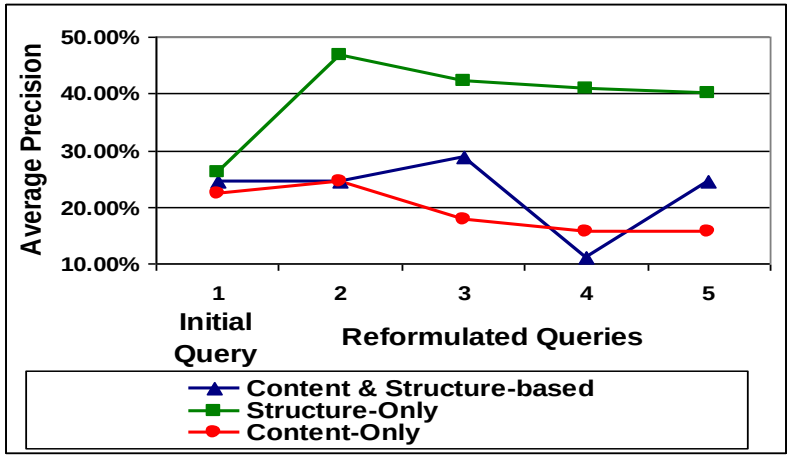
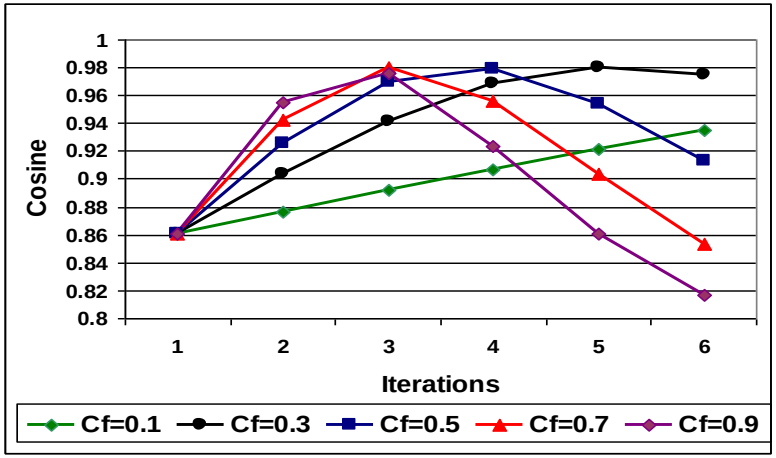
Experimental Results – Internal Survey

- Dataset: **DBLP** (Nodes - 876,110 & Edges - 4,166,626)
- Query Reformulation types tested:
  - Content-based Reformulations (C_f=0.0 & C_e=0.2).
  - Structure-based Reformulations (C_f=0.5 & C_e=0.0).
  - Content & Structure-based Reformulations (C_f=0.5 & C_e=0.2).
- 2 stages of experiments:
  - Evaluate Reformulation types (User Surveys using residual collection method).
  - Evaluate how close the trained authority transfer bounds are to the ones set by domain experts in ObjectRank [VLDB04].

(a) ***Average Precision***



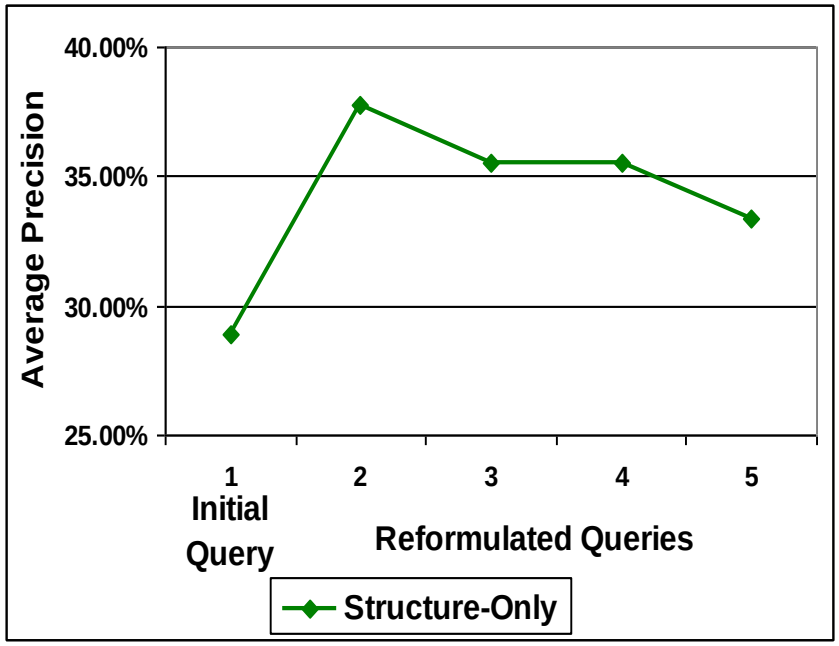
(b) ***Training transfer rates***



Experimental Results – External Survey

- External Survey – using only structure-based reformulation (as it performs the best).
- 5 iterations; 20 queries ; 10 users.

(a) ***Average Precision***



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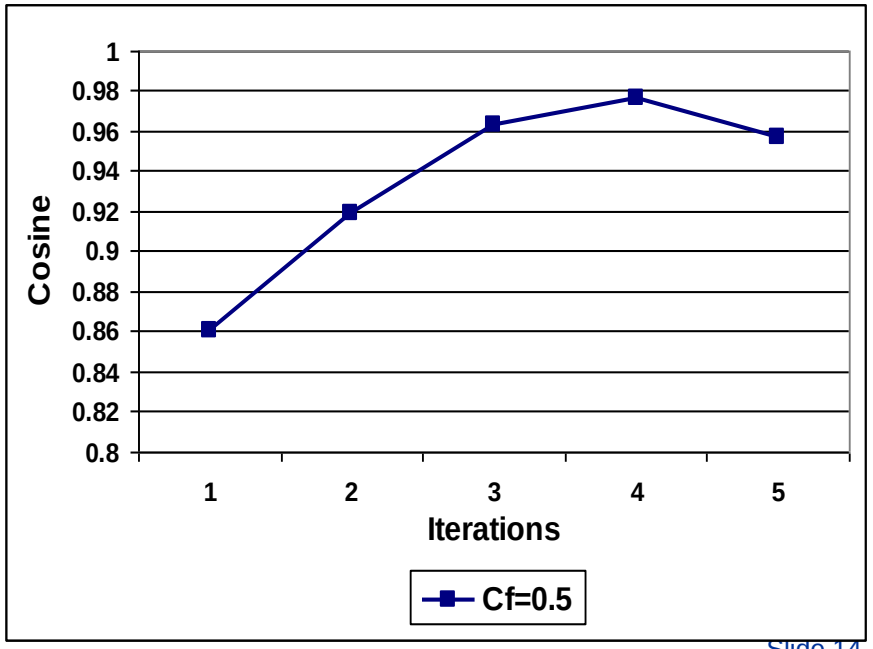

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Related Work

1) Link-Based Semantics

- PageRank [WWW98] for the Web.
- HITS [ACM Journal 99].
- Topic-Sensitive PageRank [WWW02] for the Web.
- ObjectRank for the database [VLDB02].
- XRANK [SIGMOD03] for XML databases.

2) Relevance Feedback & Query Reformulation

- Salton, Buckley introduced Relevance feedback [InformationSciences 90].
- Term selection, re-weighting, query expansion [SIGIR94, TREC95].
- Ruthven, Lalmas - Complete Relevance feedback Survey [know. Engg 2003]
- RF based on web-graph distance metrics [SIGIR06]
- Query-independent techniques to assign propagation factors -Nie et al. [WWW2005] , Agarwal et al. [SIGKDD2006]

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Conclusions

- Efficient techniques to *explain* & *reformulate* authority flow query results were presented.
- Reformulation was based on (a) Content (b) Structure of the explaining subgraph.
- Techniques to automatically *train* authority transfer rates were presented.
- User Surveys were conducted to evaluate the effectiveness of the proposed techniques.

Thank You !!!

Questions ???