September 2010

SQL QueRIE Recommendations: a query fragment-based approach

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Recommended Citation

Jayad Akbarnejad, Magdalini Eirinaki, Suju Koshy, Duc On, and Neoklis Polyzotis. "SQL QueRIE Recommendations: a query fragment-based approach" *4th International Workshop on Personalized Access, Profile Management, and Context Awareness in Databases* (2010).

SQL QueRIE Recommendations: A Query Fragment-based Approach

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SAN JOSÉ STATE
UNIVERSITY

THE UNIVERSITY OF CALIFORNIA
LET THERE BE LIGHT
1868

Motivation

- Scientific disciplines use relational DBMS for storage and retrieval of information
  - Biologists (e.g. UCSC Genome, BMRB)
  - Astronomers (e.g. Skyserver)
  - Chemists (e.g. PubChem)
- DBs are accessible online by users with diverse information needs
- Typical users do interactive exploration

Motivation (cont'd)

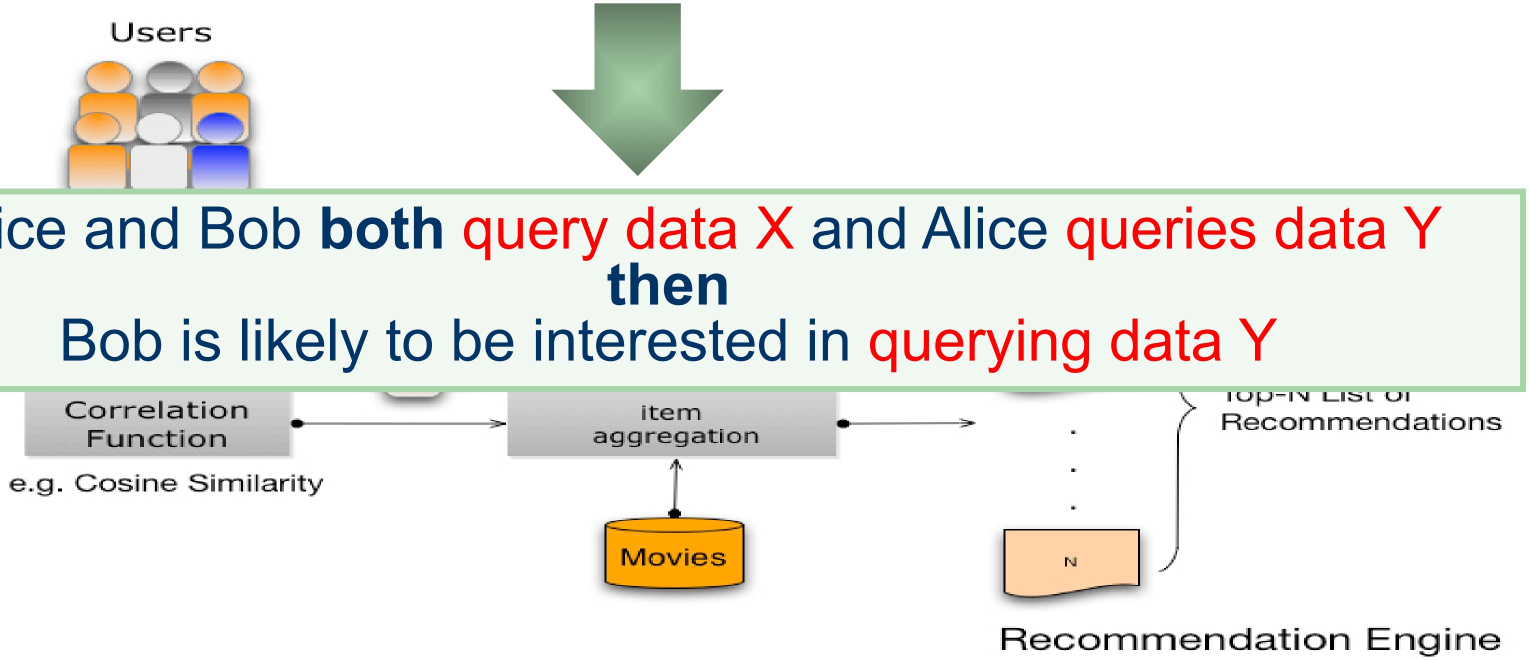
- Typical users are not SQL experts
- Scientific datasets increase in size
- Users may miss interesting information
  - They do not write the "right" query
  - They are not aware of all parts of the database

Our goal: Assist users in finding useful information

Web Collaborative Filtering

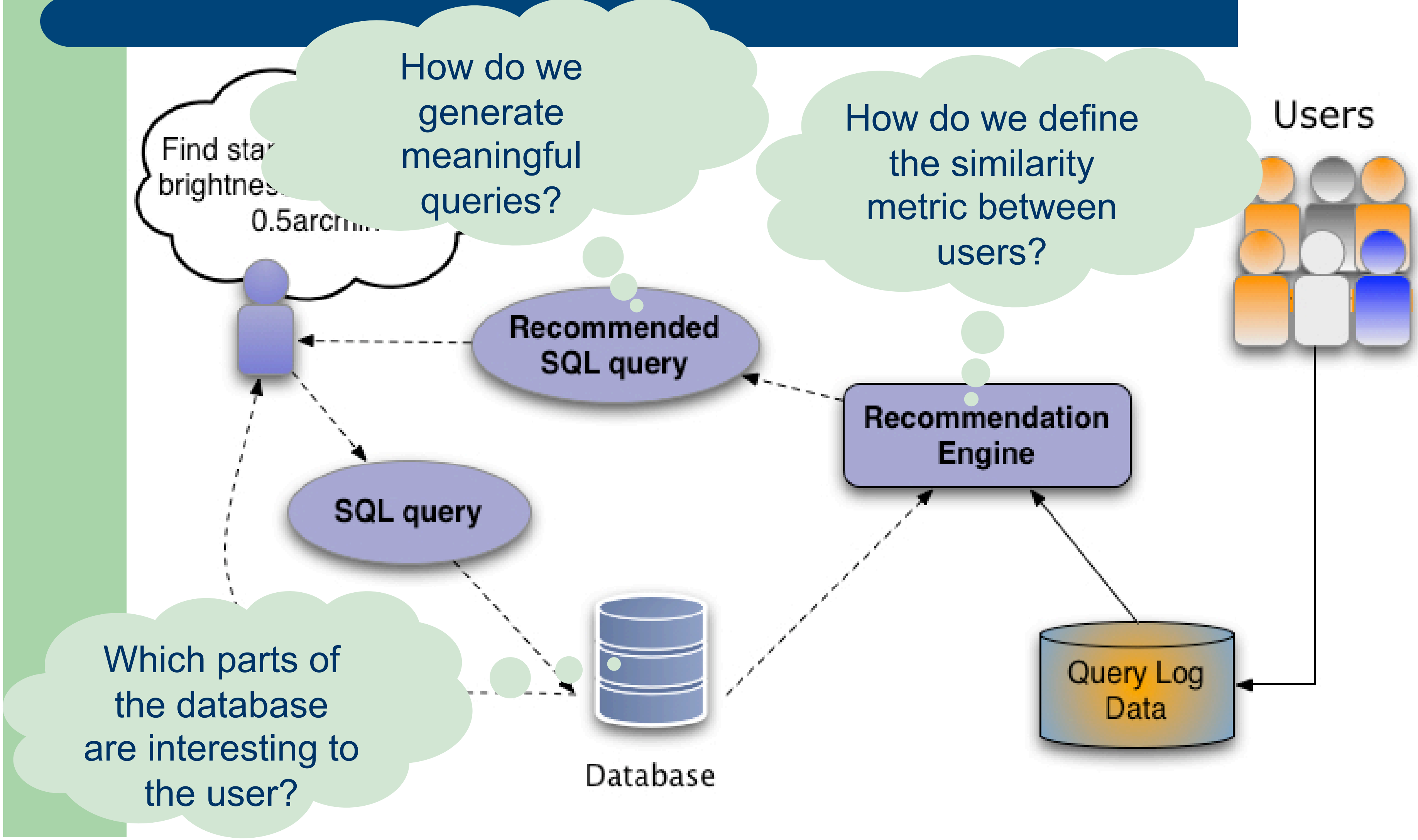
Example: Movie Recommendations

If Alice and Bob **both** like movie X and Alice likes movie Y
then
Bob is likely to be interested in seeing movie Y



If Alice and Bob **both** query data X and Alice queries data Y
then
Bob is likely to be interested in querying data Y

System Architecture



How do we generate meaningful queries?

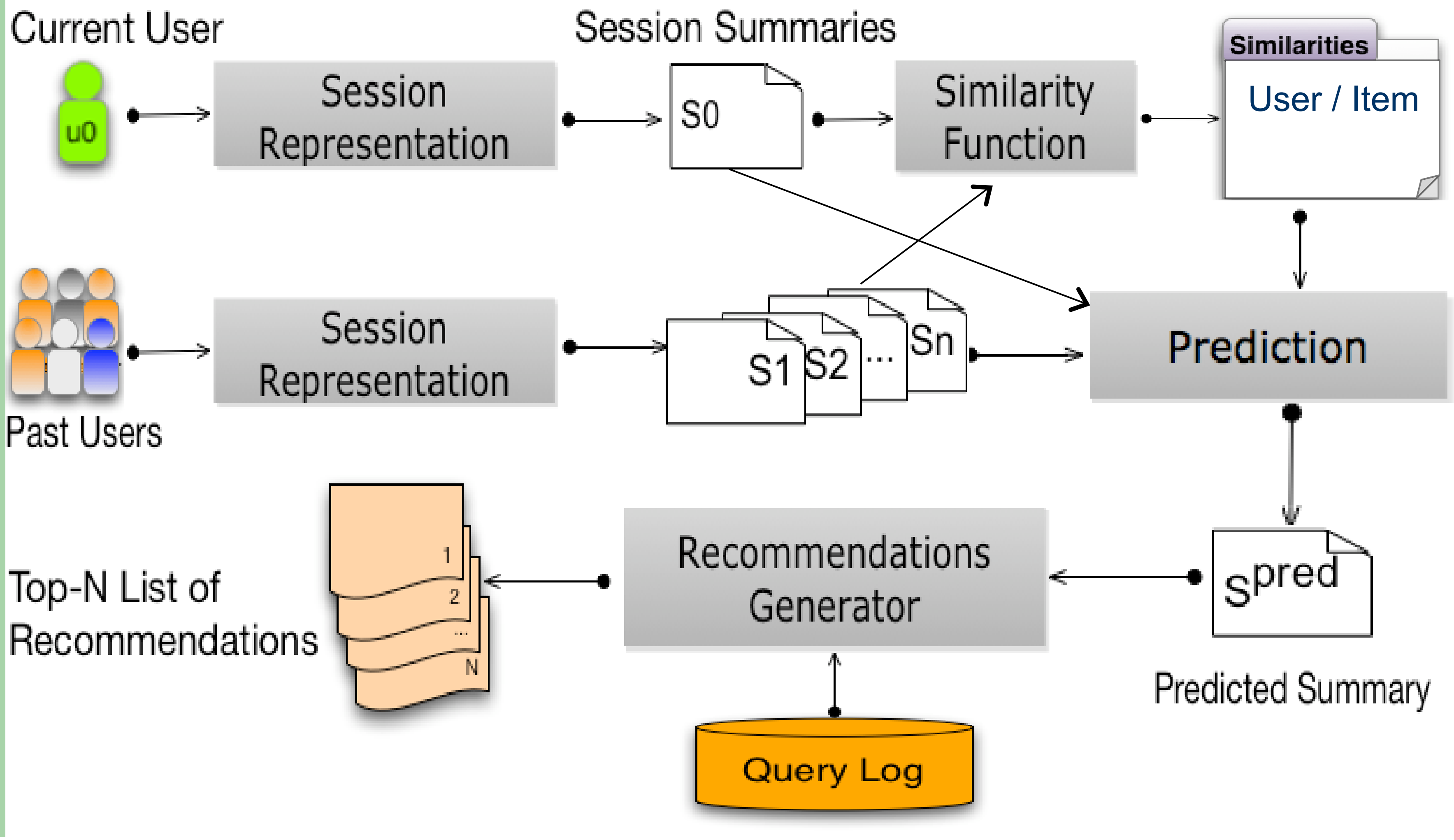
How do we define the similarity metric between users?

Which parts of the database are interesting to the user?

Roadmap

- Introduction
- QueRIE Recommendation Framework
- Experiments
- QueRIE Prototype
- Conclusion

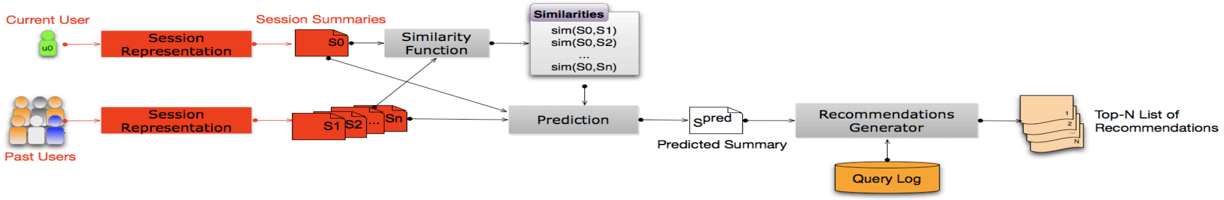
QueRIE Conceptual Framework



QueRIE Recommendation Engines

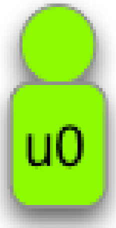
1. Tuple-based recommendations [SSDBM09, ICDM09]
   - Sessions represented by the tuples “touched” by respective queries
   - User-based similarity: 2 users are similar if they explore the same parts of the DB
   - Predict which parts of DB will interest the user and recommend queries that “touch” them

2. Query fragment-based recommendations



Session Representation

Relations: R(a,b,c)
S(d, e, f)



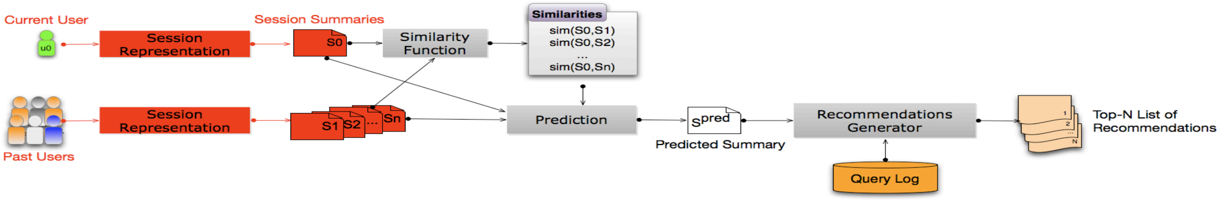
Q_1: SELECT R.a, R.b FROM R WHERE R.b = 2

Q_2: SELECT R.a, R.b, S.e FROM R, S WHERE R.a = S.f AND R.b < 3

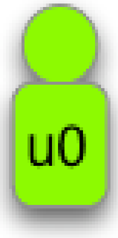
Query parsing & relaxation

Q_1: SELECT R.a, R.b FROM R WHERE R.b EQU NUM

Q_2: SELECT R.a, R.b, S.e FROM R, S WHERE R.a EQU S.f AND R.b COMPARE NUM



Session Representation (cont’d)



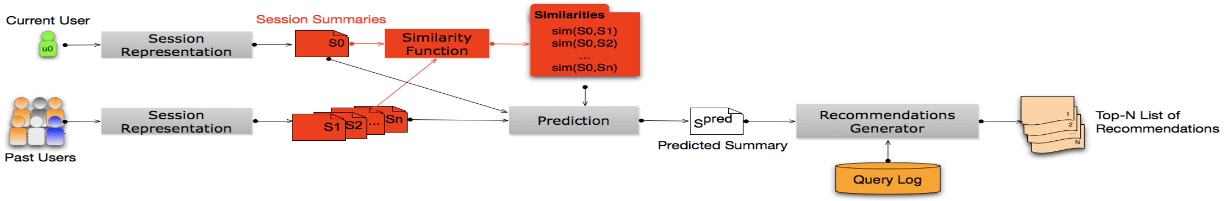
Q_1: SELECT R.a, R.b FROM R WHERE R.b EQU NUM

Q_2: SELECT R.a, R.b, S.e FROM R, S WHERE R.a EQU S.f AND R.b COMPARE NUM

QF = {R, S, …, R.a, R.b, S.e, …, R.b EQU NUM, R.b COMPARE NUM, R.a EQU S.f }

Binary Scheme
Q_1 = <1, 0, …,1,1,0,…,1,0,0>
Q_2 = <1,1,…,1,1,1,…,0,1,1>
S_0 = <1,1,…,1,1,1….,1,1,1>

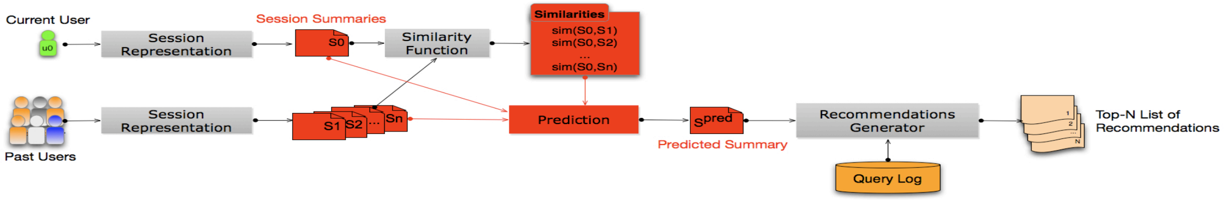
Weighted Scheme
Q_1 = <1, 0, …,1,1,0,…,1,0,0>
Q_2 = <1,1,…,1,1,1,…,0,1,1>
S_0 = <2,1,…,2,2,1….,1,1,1>



Session Similarity

- Based on the item-based approach
  - Construct *fragment x fragment* similarity matrix offline
  - More efficient than the user-based approach
- Vector-space similarity functions can be used
- High similarity means that the query fragments co-appear frequently in sessions

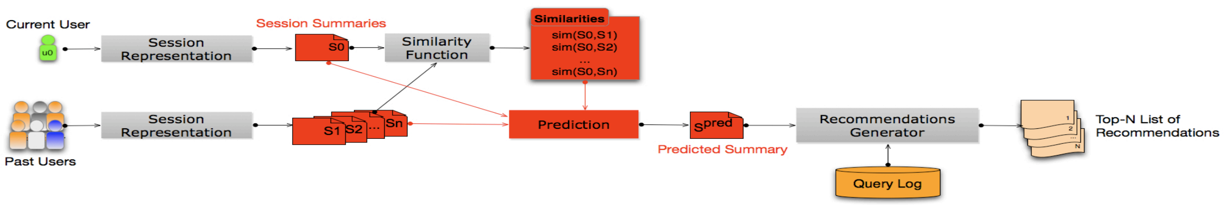
=> the active user might also like to use them



Prediction

- For each fragment ϕ, select top-k similar fragments $\rho \in$ R
- Then compute “predicted summary”:

$$S_0^{pred}[\phi] = \frac{\sum_{\rho \in R} S_0[\rho] * sim(\rho,\phi)}{\sum_{\rho \in R} sim(\rho,\phi)}$$


Current User

u0

Session Representation

Session Summaries

S0

Similarity Function

Similarities

sim(S0,S1)

sim(S0,S2)

...

sim(S0,Sn)

Past Users

Session Representation

S1 S2 ... Sn

Prediction

S^{pred}

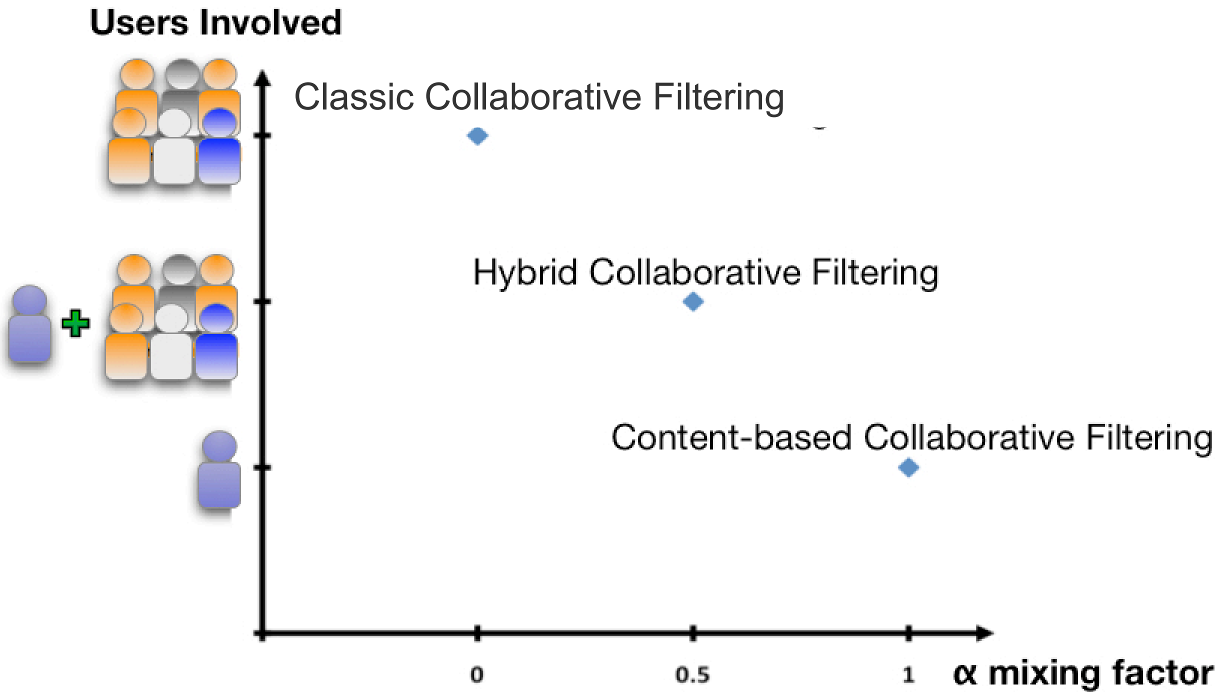
Predicted Summary

Recommendations Generator

Query Log

Top-N List of Recommendations

Prediction – the α factor

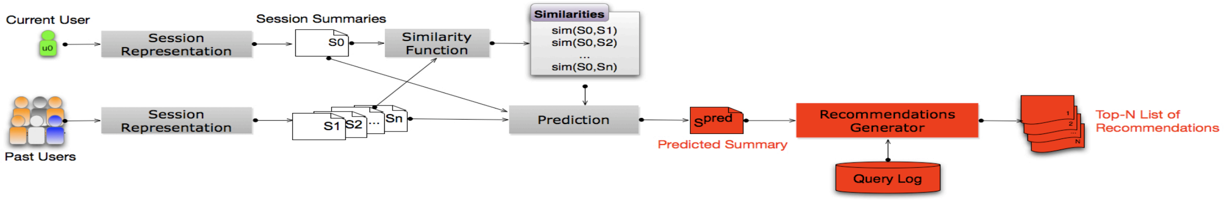


S_0^{pred} contains:

- Only other users’ fragments

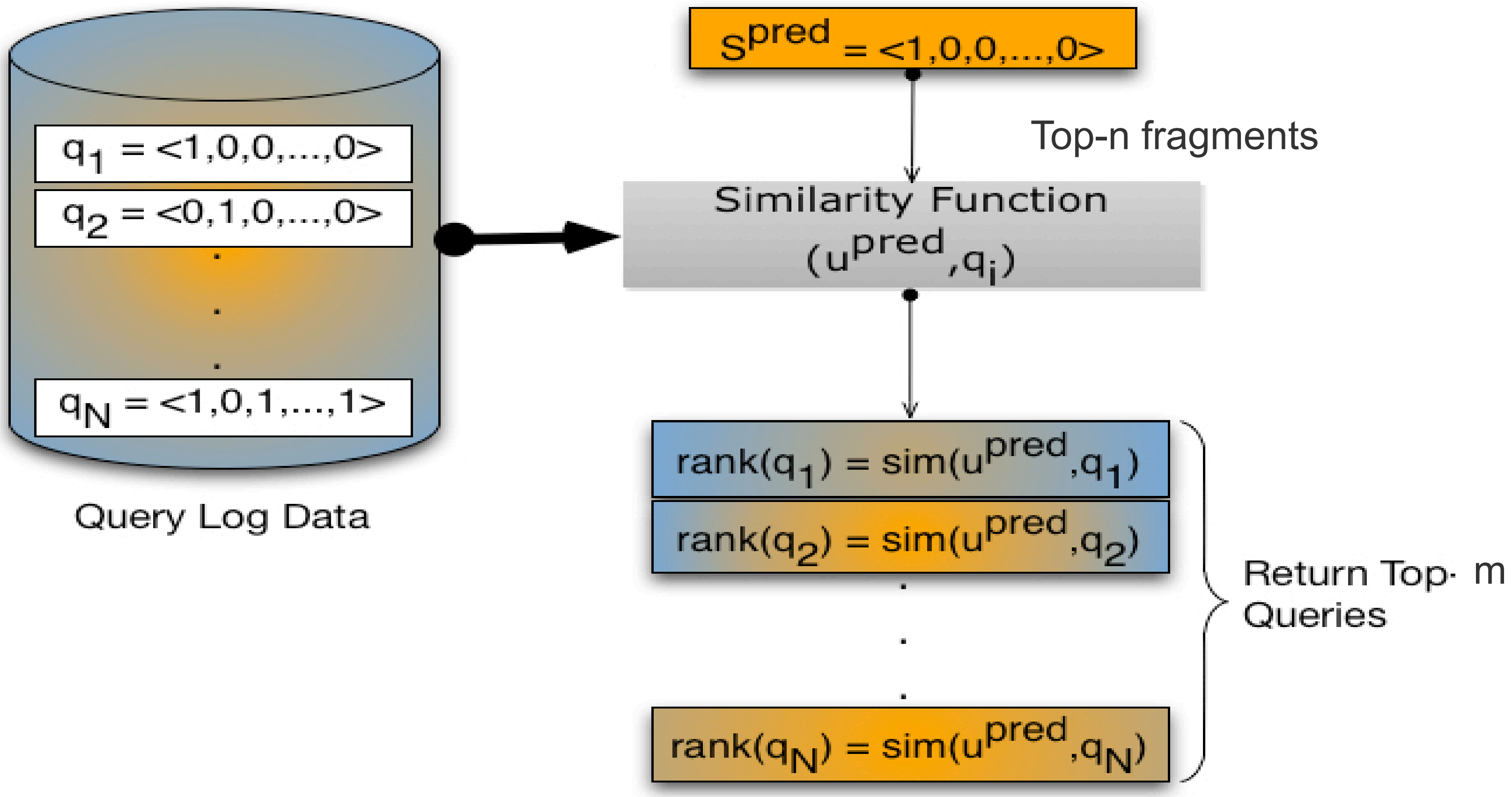
- Both S_0 and other users’ fragments

- Only S_0 fragments



Recommendations Generator

- Use queries of past users



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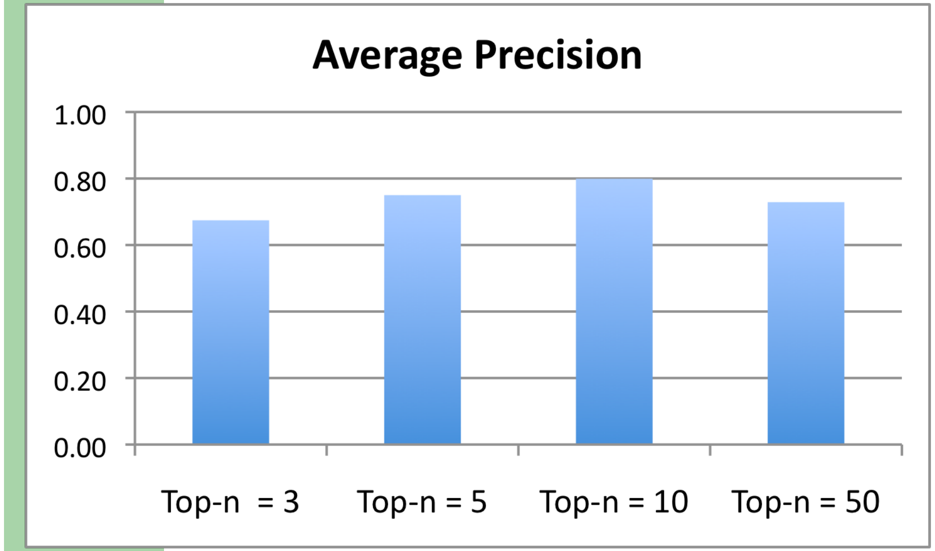
Experimental Setup

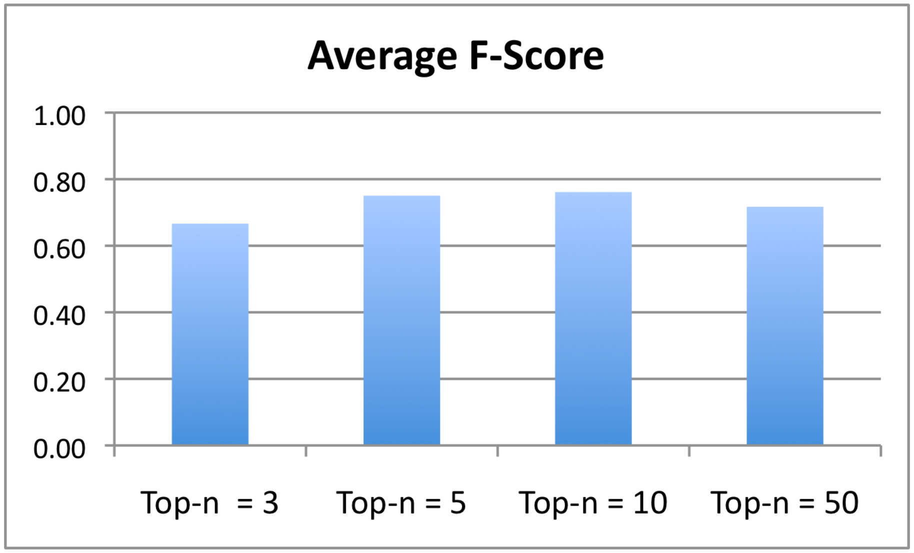
- SkyServer Dataset

#Sessions	180
#Distinct Queries	1400
#Distinct query fragments	755
#Non-zero pair-wise fragment similarities	30436
Avg. number of queries per session	9.3
Min. number of queries per session	3

- Validation method: Holdout Set
- Evaluation Metrics: Precision, Recall, F-Score

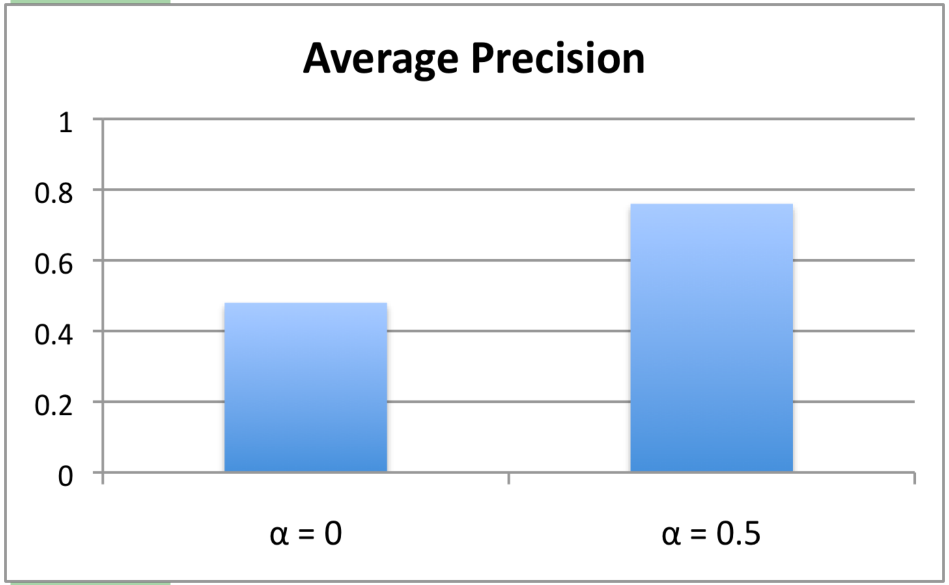
Experimental evaluation – top-n

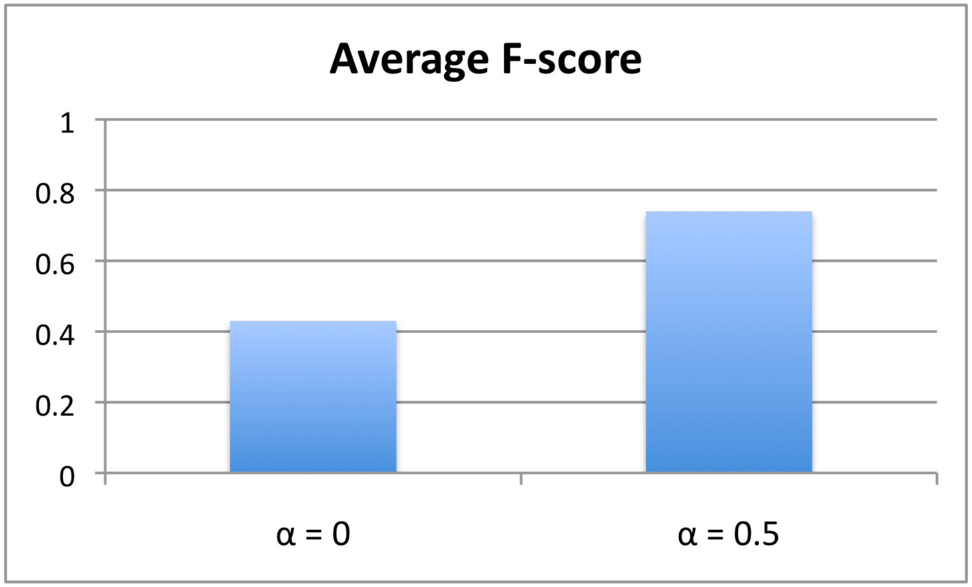




- Precision and recall drop for large *n.*
- More fragments with low similarity included in the mix

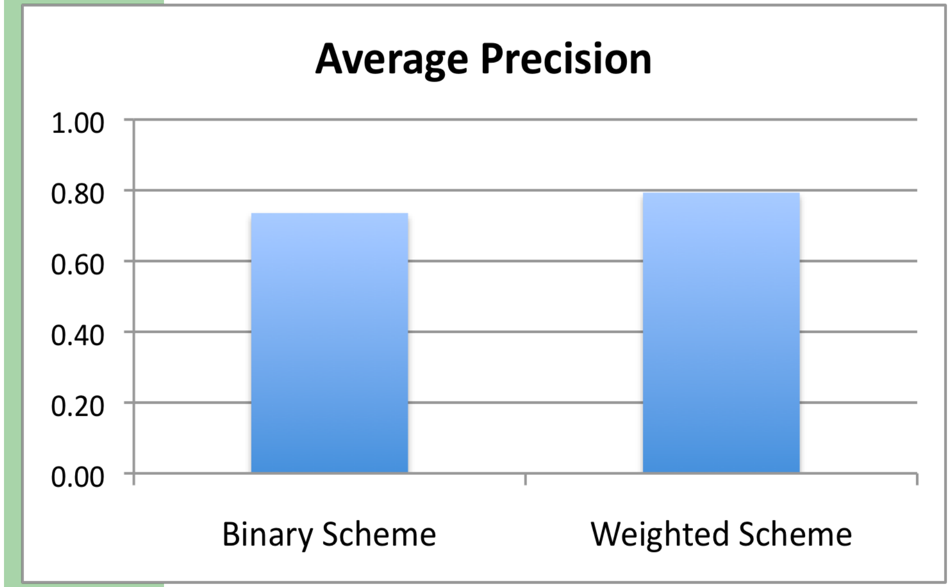
Experimental Evaluation - *α*

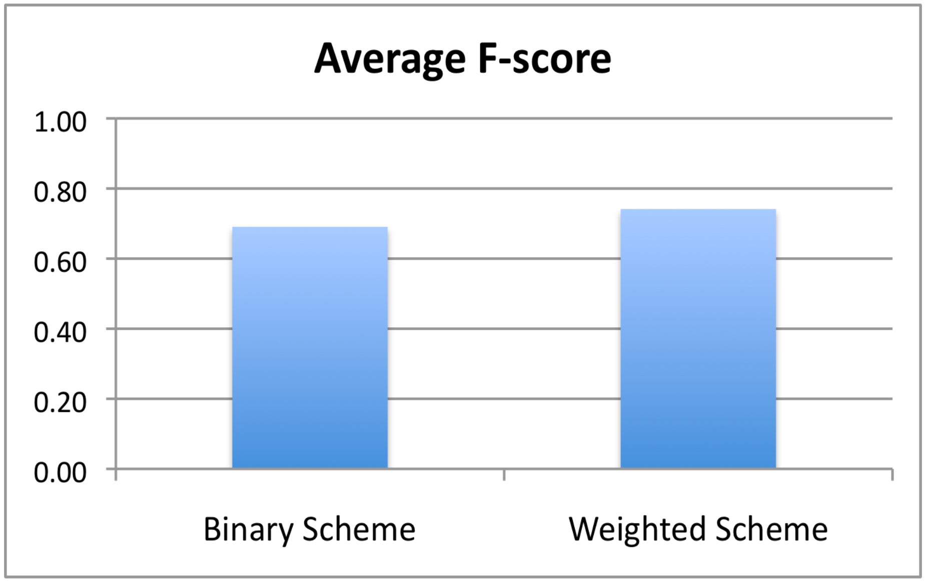




- Including user’s current session fragments is beneficial
- Expansion/Restructuring of posted queries

Experimental Evaluation – Weighting Scheme





Weighted scheme slightly outperforms the binary

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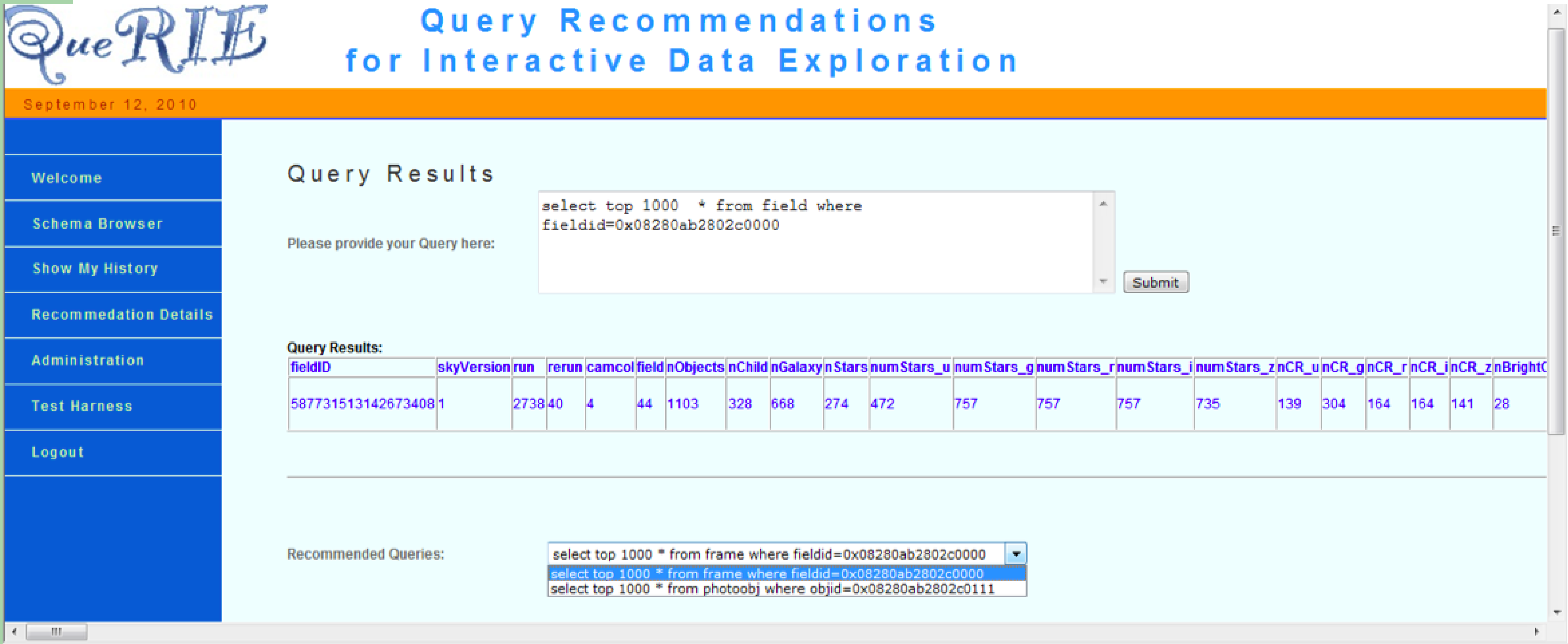
QueRIE Prototype



Query Results

Please provide your Query here:

```
select top 1000  * from field where
fieldid=0x08280ab2802c0000
```

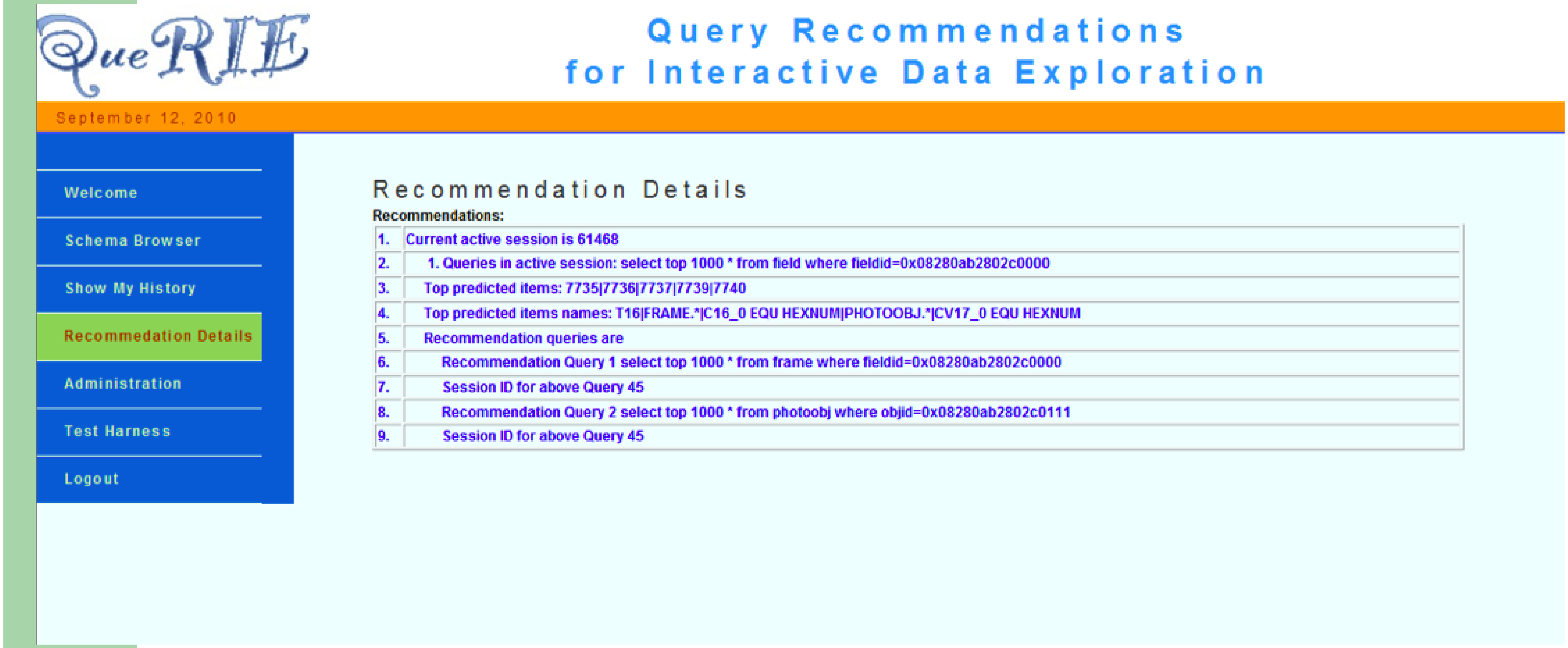
Query Results:

fieldID	skyVersion	run	rerun	camcol	field	nObjects	nChild	nGalaxy	nStars	numStars_u	numStars_g	numStars_r	numStars_i	numStars_z	nCR_u	nCR_g	nCR_r	nCR_i	nCR_z	nBrightC
587731513142673408	1	2738	40	4	44	1103	328	668	274	472	757	757	757	735	139	304	164	164	141	28

Recommended Queries: select top 1000 * from frame where fieldid=0x08280ab2802c0000

- select top 1000 * from frame where fieldid=0x08280ab2802c0000
- select top 1000 * from photoobj where objid=0x08280ab2802c0111

QueRIE Prototype (cont'd)



Query Recommendations
for Interactive Data Exploration

September 12, 2010

Recommendation Details

Recommendations:

1. Current active session is 61468
2. 1. Queries in active session: select top 1000 * from field where fieldid=0x08280ab2802c0000
3. Top predicted items: 7735|7736|7737|7739|7740
4. Top predicted items names: T16|FRAME.*|C16_0 EQU HEXNUM|PHOTOOBJ.*|CV17_0 EQU HEXNUM
5. Recommendation queries are
6. Recommendation Query 1 select top 1000 * from frame where fieldid=0x08280ab2802c0000
7. Session ID for above Query 45
8. Recommendation Query 2 select top 1000 * from photoobj where objid=0x08280ab2802c0111
9. Session ID for above Query 45

QueRIE Prototype

- Demo @ VLDB
  - Session: Data Extraction, Integration and Mining
  - Tue & Wed, 2 – 3:30 PM
  - Lyrebird room

Conclusions

- Non-expert users need help in exploring databases
- Query recommendations can be an effective tool in guiding exploration
- Collaborative filtering provides a natural method to generate recommendations
- Experiments show promising results on real-world datasets
- Ongoing & Future Work:
  - Comparison of two recommendation engines
  - Extend for form-based queries

Thank you !

Questions