Future Research Issues: Recommending Tasks to Search Engine Users

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Claudio Lucchese, Salvatore Orlando, Raffaele Perego, Fabrizio Silvestri, Gabriele Tolomei. **Beyond Query Suggestions: Recommending Tasks to Search Engine Users.** submitted paper

Background

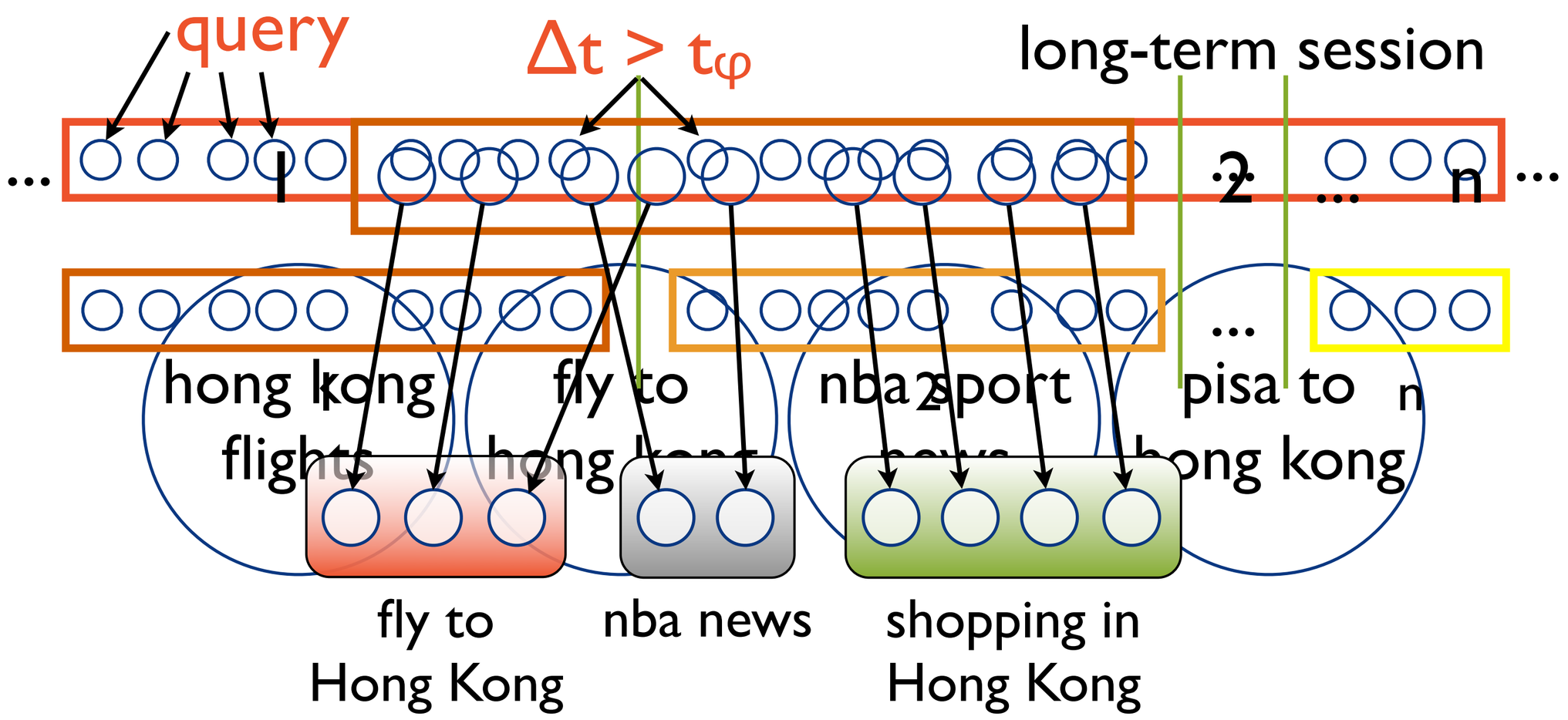
- From Web task
  - A "template" for representing any (atomic) activity that can be achieved by exploiting the information available on the Web, e.g., "find a recipe", "book a flight", "read news", etc.
- To Web mission
  - Each single search task may subsume a complex task, namely a mission, that the user aims to accomplish throughout the SE.
- Task/Query Recommendation
  - Common query suggestions can be classified as intra-task recommendations (query rewriting, specialization, generalization, etc.)
  - We argue that people are also interested in task-oriented (query) suggestions, which can bring us to provide inter-task recommendations, i.e. related to another task in a given mission

R. Jones and K.L. Klinkner. 2008. **Beyond the session timeout: automatic hierarchical segmentation of search topics in query logs.** In CIKM '08. ACM, 699–708.

Example

- Example of inter-task suggestion
  - Alice starts interacting with her favorite SE by submitting the query "new york hotel", i.e. a query belonging to a simple search task related to *the booking of a hotel room in New York*.
  - Current query suggestion mechanisms provide alternative related queries, by only focusing on the task behind this original single query (intra-task query suggestions), such as "cheap new york hotels", "times square hotel", "waldorf astoria", etc.
  - Assume that you can recognize that the current Alice's task is included in a mission, including more tasks, concerned with "planning a travel to New York"
  - This means to recommend to Alice other tasks whose underpinning queries look like: "mta subway", or "broadway shows", or "JFK airport shuttle" (inter-task query suggestion)

QC-htc: from long-term sessions to task-based sessions



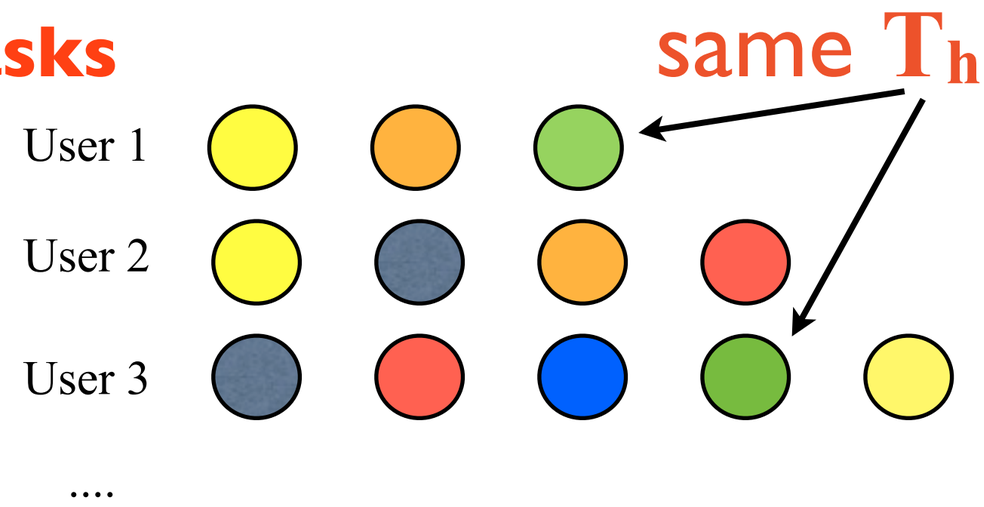
Claudio Lucchese, Salvatore Orlando, Raffaele Perego, Fabrizio Silvestri, Gabriele Tolomei. **Identifying Task-based Sessions in Search Engine Query Logs.** ACM WSDM, Hong Kong, February 9-12, 2011.

Crowd-based Task Synthesis

- We already used an unsupervised strategy to identify tasks in the long-term sessions of the different users
- We still use an unsupervised method to identify tasks common to many users
  - we further use a cluster tool to identify "similar" tasks performed by distinct users just identified by the previous method
  - eventually replacing each task $\theta_i^j \in \Theta_i$ in a long-term session of a user with a synthesized task $\mathbf{T_h}$

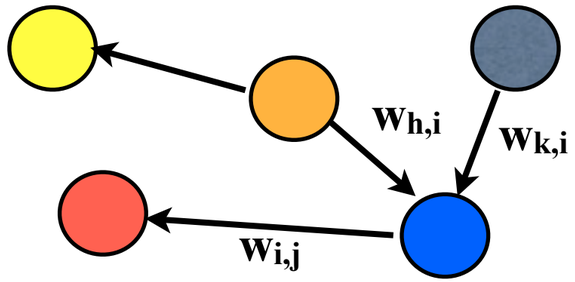
Crowd-based Task Synthesis

- Each **synthesized task T_h** can be considered as a representative for an aggregation composed of similar tasks, performed by several distinct users
  - We can rewrite each task-oriented session in terms of the new tasks identifiers: T_h
    where $T_h = \{T_1 , \dots , T_K\}$
- The various long term sessions thus become **sets/sequences of synthesized tasks**



Task-based Model Generation

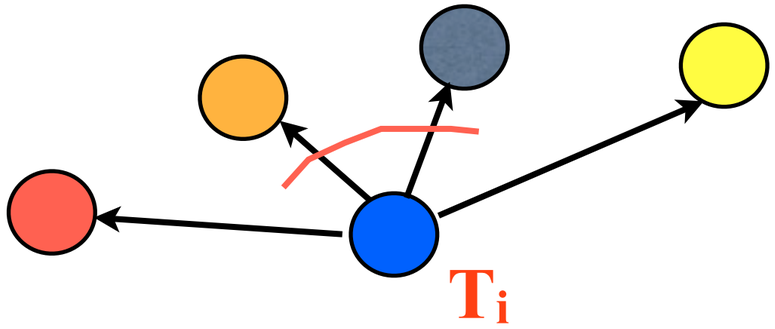
- Produce a Task Recommendation Model
  - a weighted directed graph $G_T = (T, E, w)$, where the weighting function $w(.)$ measures the "inter-task relatedness"
  - if they are related, they are probably part of the same mission



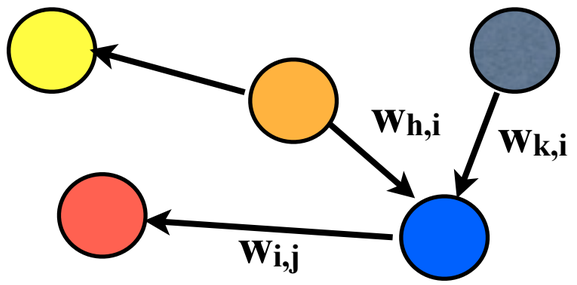
$$G_T = (T, E, w)$$

Task-based Recommendation

- Generate a Task-oriented Recommendations
  - given a user who is interested in (has just performed) a task T_i
  - retrieve from G_T the set $R_m(T_i)$, which includes the **m-**top related nodes/ tasks to T_i
    - the graph nodes in $R_m(T_i)$ are directly connected to node T_i and are the m ones labeled with the highest weights



How to Generate the Model



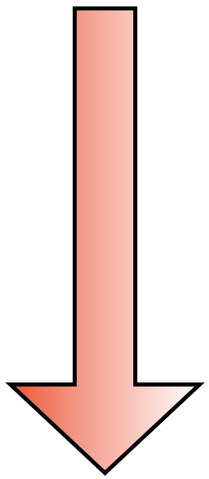
$G_T = (T, E, w)$

- Various methods to generate edges in G_T and the associated weights
  - Random-based (baseline): an edge for each pair, whose weights are uniform
  - Sequence-based: the frequency of the pairs wrt a given support threshold, by considering the relative order in the original sequences

- Association-Rule based (support): the frequency of the rule wrt a given support threshold. We do not consider the relative order in the original sequences to extract the rules
- Association-Rule based (confidence): the confidence of the rules wrt a given confidence threshold. We do not consider the relative order in the original sequences to extract the rules

Data Set: AOL 2006 Query Log

Original Data Set



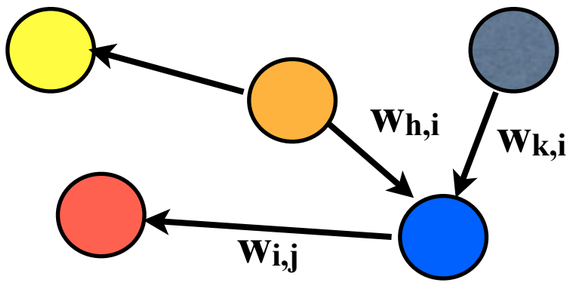
Sample Data Set

- ✓ 3-months collection
- ✓ ~20M queries
- ✓ ~657K users

- ✓ Top-600 longest user sessions
- ✓ ~58K queries
- ✓ avg 14 queries per user/day
- ✓ two subsets A and B

- ✓ A : 500 user sessions (**training**)
- ✓ B : 100 user sessions (**test**)

Experimental results

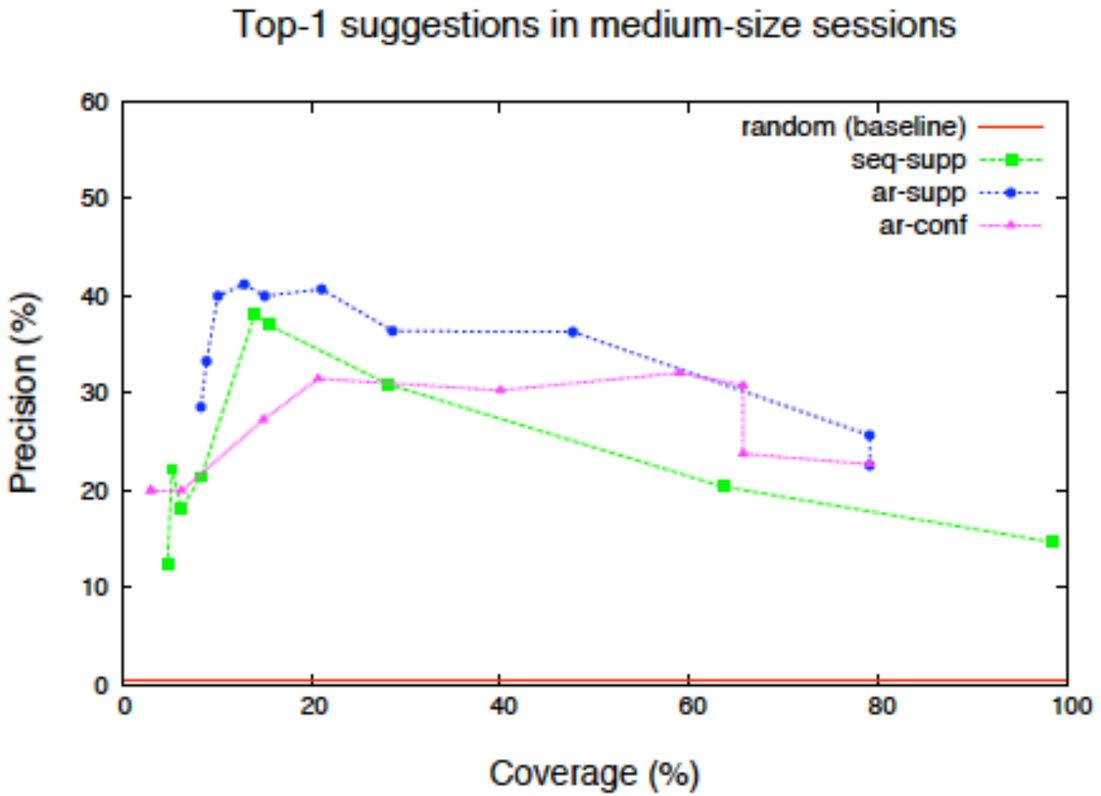


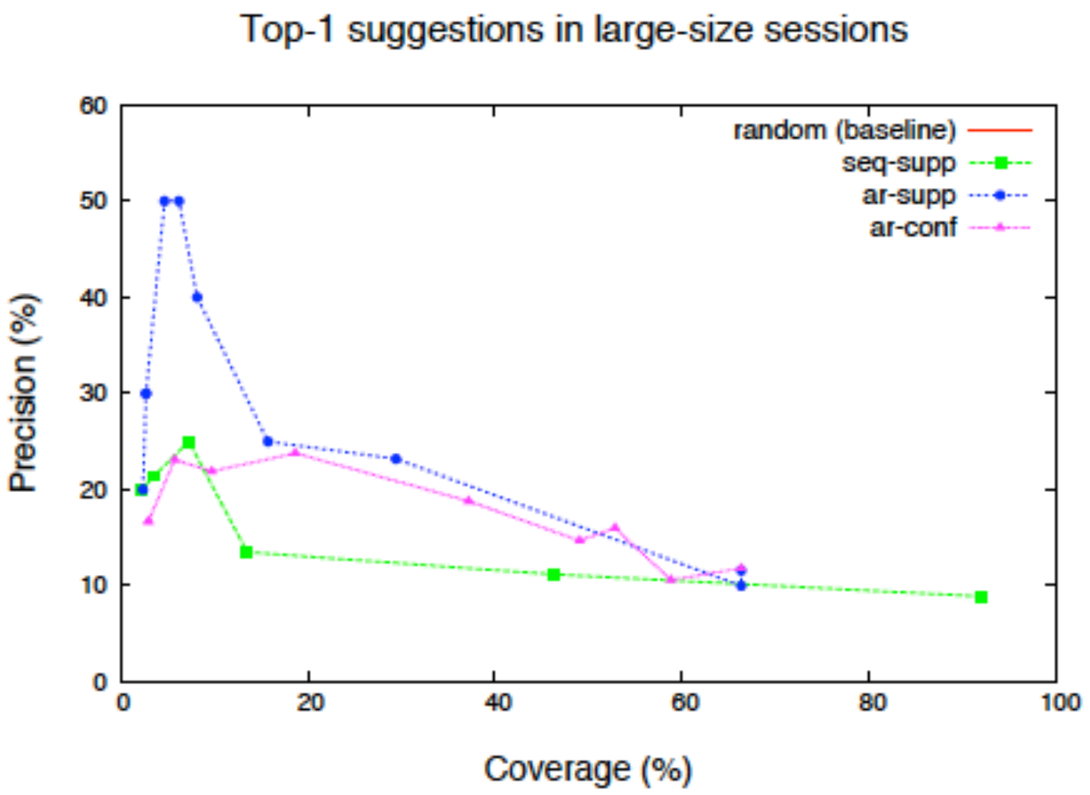
$G_T = (T, E, w)$

- We used the log subset B for evaluation (test query log)
  - we divided each long term session in B (with synthesized tasks) into a **1/3 prefix** and **2/3 suffix**
  - the prefix is used to retrieve from G_T the sets $R_m(T_i)$
  - for each T_i belonging to the 1/3 prefix of each session in S in B, retrieve $R_m(\{T_i \mid T_i \text{ in } S\})$

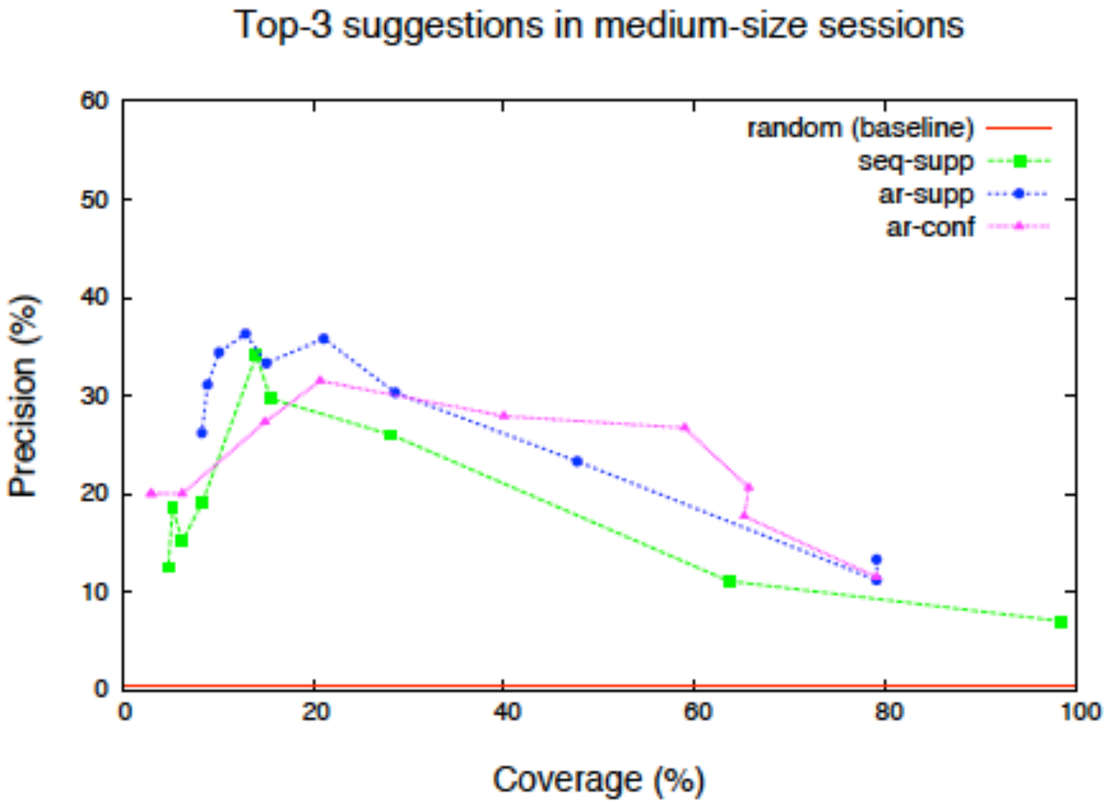
- We measured ***precision*** (proportion of suggestions that actually occur in the 2/3 suffix) and ***coverage*** (proportion of tasks in the 1/3 prefix that are able to provide at least one suggestion)
  - changing the weighting in each model, by tuning the corresponding parameters, modifies the coverage ...
  - we thus plot precision vs coverage to permit the different models to be fairly compared

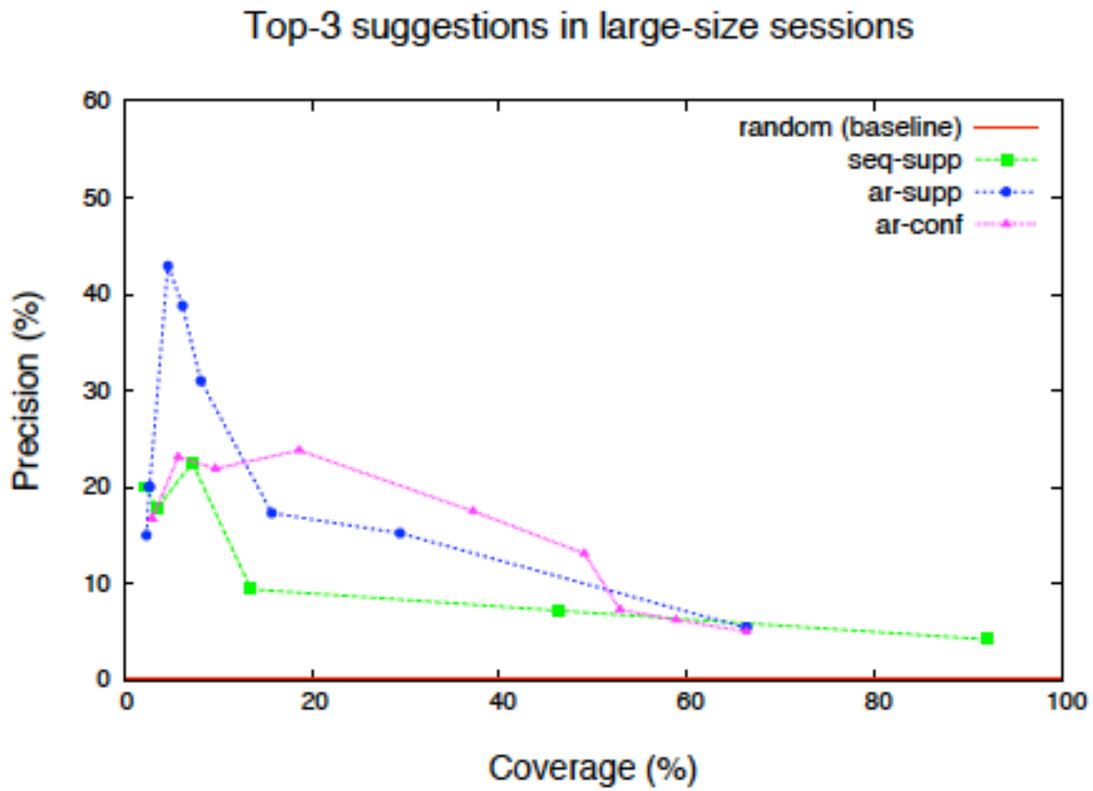
Experimental results Recommendation Models





Experimental results Recommendation Models





Anecdotal Evidence

Performed Task/Query	Recommended Tasks
Home Furnitures	**Home Gardening**
	cottage garden
beach house	cottage garden roses
...	*decor garden*
...	*best garden blogs*
beach house vanity	*vegetable garden ideas*
	open garden
	antiques store*
	book stores*
Kitchen Decor	**Kitchen Supplies**
dining room	stoves
...	*country stoves*
...	*country cooking stoves*
	country music gossips*
	canyon country parkway*

Table 1: Recommended and performed tasks.

actually performed queries

Anecdotal Evidence

Performed Task/Query	Recommended Tasks
Child Entertainment	**Child Games**
	baby shower games
fables	*baby horse*
...	**Child Clothes**
...	*baby gap*
baby fables	**Child Health**
	baby emotional disease
	cuddling couch picture*
	husband became parents boy*
University	**University Sports**
university	*university sports*
...	*university basketball*
...	**University Information**
duke university	*university tuition*

Table 2: Recommended and *surprising* tasks.

Questions?