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Supporting Privacy Protection in Personalized Web Search

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Abstract: Personalized web search (PWS) has demonstrated its effectiveness in improving the quality of various search services on the Internet. However, evidences show that users' reluctance to disclose their private information during search has become a major barrier for the wide proliferation of PWS. We study privacy protection in PWS applications that model user preferences as hierarchical user profiles. We propose a PWS framework called UPS that can adaptively generalize profiles by queries while respecting user-specified privacy requirements. Our runtime generalization aims at striking a balance between two predictive metrics that evaluate the utility of personalization and the privacy risk of exposing the generalized profile. We present two greedy algorithms, namely GreedyDP and GreedyIL, for runtime generalization. We also provide an online prediction mechanism for deciding whether personalizing a query is beneficial. Extensive experiments demonstrate the effectiveness of our framework. The experimental results also reveal that GreedyIL significantly outperforms GreedyDP in terms of efficiency.

Keywords: Personalized web search (PWS), UPS.

I. INTRODUCTION

The web search engine has long become the most important portal for ordinary people looking for useful information on the web. However, users might experience failure when search engines return irrelevant results that do not meet their real intentions. Such irrelevance is largely due to the enormous variety of users' contexts and backgrounds, as well as the ambiguity of texts. Personalized web search (PWS) is a general category of search techniques aiming at providing better search results, which are tailored for individual user needs. As the expense, user information has to be collected and analyzed to figure out the user intention behind the issued query. The solutions to PWS can generally be categorized into two types, namely click-log-based methods and profile-based ones. The click-log based methods are straightforward— they simply impose bias to clicked pages in the user's query history. Although this strategy has been demonstrated to perform consistently and considerably well, it can only work on repeated queries from the same user, which is a strong limitation confining its applicability. In contrast, profile-based methods improve the search experience with complicated user-interest models generated from user profiling techniques.

Profile-based methods can be potentially effective for almost all sorts of queries, but are reported to be unstable under some circumstances. Although there are pros and cons for both types of PWS techniques, the profile-based PWS has demonstrated more effectiveness in improving the quality of web search recently, with increasing usage of personal and behavior information to profile its users, which is usually gathered implicitly from query history, browsing history, click-through data bookmarks, user documents, and so forth. Unfortunately, such implicitly collected personal data can easily reveal a gamut of user's private life. Privacy issues rising from the lack of protection for such data, for instance the AOL query logs scandal, not only raise panic among individual users, but also dampen the data-publisher's enthusiasm in offering personalized service. In fact, privacy concerns have become the major barrier for wide proliferation of PWS services.

II. PROPOSED SYSTEM

This paper proposes a privacy preserving personalized web search framework called UPS i.e User customizable Privacy preserving Search, that generalize profile for every query as per user privacy specification. Based on personalization and privacy risk metric, this paper formulate Risk Profile Generation, with its NP hardness proved. It develops two simple but effective generalization algorithms, Greedy DP and Greedy IL, to support runtime profiling Greedy DP maximize the discriminating power (DP) while Greedy IL minimize the information loss (IL).This paper also provide a mechanism for the client to decide whether or not to personalize a query in UPS. This decision is made before each runtime profiling to enhance the stability of the search results.

A. Advantages

1. It enhances the stability of the search quality.
2. It avoids the unnecessary exposure of the user profile.
3. The framework allowed users to specify customized privacy requirements via the hierarchical profiles. In addition, UPS also performed online generalization on user profiles to protect the personal privacy without compromising the search quality.

B. Methodology

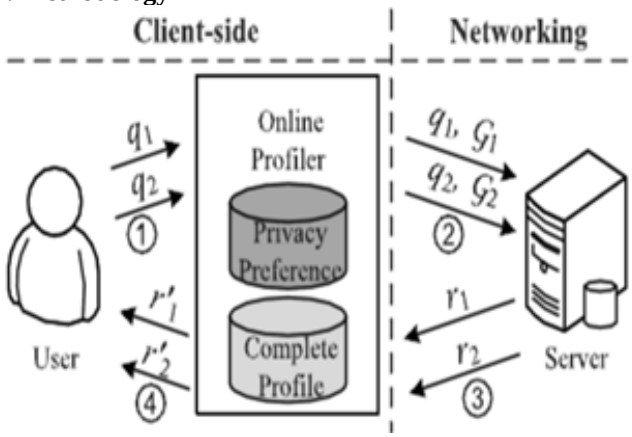

Fig 1: System architecture of UPS.

As shown inFigure-1]UPS consists of number of clients/users and a server for fulfilling the clients request. In client's machine, the online profiler is implemented as search proxy which maintains users profile in hierarchy of nodes and also maintain the user specified privacy requirement as a set of sensitive nodes. There are two phase, namely Offline and Online phase for the framework. During Offline, a hierarchical user profile is created and user specified privacy requirement is marked on it. The query fired by user is handled in the online phase as: When user fires a query on the client, proxy generates user profile in run time. The output is generalized user profile considering the privacy requirements. Then, the query along with generalized profile of user is sent to PWS server for personalized web search. The search result is personalized and the response is sent back to query proxy. Finally, the proxy presents the raw result or re ranks them with user profile.

III. GREEDY ALGORITHM

A greedy algorithm is an algorithm that follows the problem solving Heuristic of making the locally optimal choice at each stage with the hope of finding a global optimum. Greedy algorithm considers easy to implement and simple approach and decides next step that provide beneficial result. In many problems, a greedy strategy does not produce an optimal solution, but a greedy heuristic yields locally optimal solutions that approximate a global optimal solution in a reasonable time.

IV. CONCLUSION

This system presented a client-side privacy protection framework called UPS for personalized web search. UPS could potentially be adopted by any PWS that captures user profiles in a hierarchical taxonomy. The framework allowed users to specify customized privacy requirements via the hierarchical profiles. In addition, UPS also performed online generalization on user profiles to protect the personal privacy without compromising the search quality. We proposed two greedy algorithms, namely GreedyDP and GreedyIL, for the online generalization. Our experimental results revealed that UPS could achieve quality search results while preserving user's customized privacy requirements. The results also confirmed the effectiveness and efficiency of our solution. For future work, we will try to resist adversaries with broader background knowledge, such as richer relationship among topics (e.g., exclusiveness, sequentiality, and so on), or capability to capture a series of queries (relaxing the second constraint of the adversary in Section 3.3) from the victim. We will also seek more sophisticated method to build the user profile, and better metrics to predict the performance (especially the utility) of UPS.

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