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SOCIALQ&A: AN ONLINE SOCIAL NETWORK BASED QUESTION AND ANSWER SYSTEM

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ABSTRACT

Question and Answer (Q&A) systems play a vital role in our daily life for information and knowledge sharing. Users post questions and pick questions to answer in the system. Due to the rapidly growing user population and the number of questions, it is unlikely for a user to stumble upon a question by chance that (s)he can answer. Also, altruism does not encourage all users to provide answers, not to mention high quality answers with a short answer wait time. The primary objective of this paper is to improve the performance of Q&A systems by actively forwarding questions to users who are capable and willing to answer the questions. To this end, we have designed and implemented Social Q&A, an online social network based Q&A system. Social Q&A leverages the social network properties of common-interest and mutual-trust friend relationship to identify an asker through friendship who are most likely to answer the question, and enhance the user security. We also improve Social Q&A with security and efficiency enhancements by protecting user privacy and identifies, and retrieving answers automatically for recurrent questions. We describe the architecture and algorithms, and conducted comprehensive large-scale simulation to evaluate Social Q&A in comparison with other methods. Our results suggest that social networks can be leveraged to improve the answer quality and asker's waiting time. We also implemented a real prototype of Social Q&A, and analyze the Q&A behavior of real users and questions from a small-scale real-world Social Q&A system.

1. INTRODUCTION

The Internet is an important source of information, where the amount of data is vast and constantly growing. Users rely on search engines to find specific information in this knowledge base. Search engines such as Google and Bing use keywords provided by the users to perform searches. Recently, industrial research and development activities, such as Microsoft and Facebook's social-featured Bing search endeavor, try to combine search engines and online social networks for higher search performance. As previous research has indicated [1, 2], search engines perform well in indexing web pages and providing users with relevant content to their search but are not suited for non-factual questions such as "Which is the best local auto shop?". To address this particular class of non-factual questions, many Question and Answer (Q&A) systems such as Yahoo! Answers, Baidu Zhidao, StackExchange, Quora and Ask have been developed. Since their inception, Q&A systems have proved to be a valuable resource for sharing expertise and consequently are used by a large number of Internet users. For example, Yahoo! Answers was launched at the end of the year 2005 and attracted more than 10 million users in February of 2007 [3], and hit 200 million users in December of 2009 [4, 5]. Q&A systems also preserve all questions and answers, thus acting as a repository for information retrieval. They are not only important for sharing technical knowledge, but also as a source for receiving advice and

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satisfying one's curiosity about a wide variety of subjects [6]. With a vast population in a Q&A system, a large number of questions are posed online every day. For example, there are 823,966 questions and answers posed to Yahoo! Answers per day. Then, when a user intends to answer a question, he may be overwhelmed by the plethora of questions. Moreover, simply relying on altruistic users to provide answers cannot encourage all users to provide answers and to answer questions quickly. To locate appropriate answer providers, current Q&A systems allow users to choose tags (i.e., interest categories) for their questions. However, it may not be easy to determine the appropriate tag(s) for a question such as "how is the computer organization class at our university?". As a result, current Q&A systems may not meet the requirement of providing high quality answer with a short answer wait time, though users wish to receive satisfactory answers quickly. This is confirmed by the study in [5]. It found that for Yahoo! Answers, only 17.6% of questions were answered satisfactorily; for the remaining 82.4%, one fifth of the questions remained unanswered. For Baidu Zhidao, 22.7% of questions were successfully answered, and 42.8% of the unresolved questions were not answered at all. Thus, there is an increasing need for an advanced Q&A system that can decrease the number of unanswered questions, enhance the answer quality and decrease the response time.

In addition, the privacy of the Q&A system is very important nowadays. Many users may ask or answer questions related to sensitive topics such health problem, political activism or even sexual orientation. Although the user may want the response as soon as possible, he/she still needs the privacy protection to avoid potential disclosure of personal information [8]. Since Social Q&A is built upon social networks. The asker and answerer are social close to each other. Therefore, protecting the privacy is important and challenge.

2. PROBLEM STATEMENT

GOALS

- The system forwards the question to the accurate and willing person and we also analyze the appropriate TTL (Time to Live) value.
- We propose SocialQ&A, an online social network based Q&A system, that actively forwards questions to those users with the highest likelihood (capability and willingness) of answering them with expertise and interest in the questions' subjects.
- We introduce security and efficiency enhancement to protect users privacy while users using social network answering questions.

ALGORITHMS USED:

The Design of Social Q&A

User Interest Analyzer Q/A Repository Question Categorizer Question- User Mapper Category Synset Social Info. SocialQ&A User Interface Fig. 1: The architecture of SocialQ&A. Like all online social networks, the one in SocialQ&A has user profiles that record users' interests, education, hobbies and etc. Like Yahoo! Answers, SocialQ&A also predefines interest categories and subcategories. A total of 4 categories (music, movies, television, and books) and 32 subcategories (e.g., books: novel, drama) derived from Yahoo! Answers were used to implement SocialQ&A. We used these 4 categories as an example and will add more categories in our future work. Figure 1 shows the high-level architecture of SocialQ&A and the interaction between the core components: User Interest Analyzer, Question Categorizer, and Question-User Mapper.

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User Interest Analyzer analyzes data associated with each user in the social network to derive user interests. Question Categorizer categorizes the user questions into interest categories based on the Category Synsets, which stores the synonyms of all categories' keywords from Word Net. Question-User Mapper connects these two components by identifying potential answerers who are most likely to be willing to and be able to provide satisfactory answers. The data from user questions and answers is stored on Q/A Repository to serve subsequent similar questions. Below, we present each component and user interface.

User Interest Analyzer

Algorithm 1 Pseudocode for the *User Interest Analyzer*.

Input: A user's profile, questions and answers
Output: The user's interest vector $V_{U_j} =< I_i, W_{I_i} >$

1: Parse the "interests" field to generate a token stream T_I
2: Parse the "activities" field to generate a token stream T_a
3: Use the inputs from the user's selection from the Music, Movie, Television and Book fields to generate token streams T_{mu}, T_{mo}, T_t and T_b
4: **for** each token stream T_x (T_x=T_I, T_a, T_{mu}, T_{mo}, T_t, T_b) **do**
5: Check each token in the Synset
6: **if** a matching interest category I_i exists **then**
7: Update interest weight: W_{I_i}++ (e.g., W_{music}++)
8: **end if**
9: **end for**
10: Keep updating W_{I_i} based on questions asked and answered and profile update
11: Periodically update W_{I_i} using $W_{I_i} = \alpha * W_{I_{i_{old}}}$

User Interest Analyzer utilizes each user's profile information in the social network and user interactions (answers provided and questions asked) to determine the interests of the user in the predefined interest categories. This is because if a user asks or answers questions in an interest category, (s)he is likely to be interested in this particular category.

Question-User Mapper

Question-User Mapper identifies the appropriate answerers for a given question. The potential answer providers are chosen from the asker's friends in the online social network. Note that the changes in a user's friends in the online social network do not affect the performance of SocialQ&A as it always uses a user's current friends. To check the appropriateness of a friend (Uk) as an answer provider for a question, two parameters are considered: i) the interest similarity between the interest vectors of the friend and the question (denoted by ΨI,Uk); and ii) the social closeness between the friend and the asker (denoted by ΨC,Uk). The former represents the potential capability of a friend to answer the question, and the latter represents the willingness of a friend to answer the question.

Algorithm 2 Pseudocode for the *Question-User Mapper*.

Input: Interest vectors of a user, his/her friends and question
Output: A list of potential answer providers

1: **for** each friend U_k in the friend set of U_j **do**
2: Compute Ψ_{I,U_k} based on Eq. (1)
3: Compute $P_{S_{U_k}}$, $P_{A_{U_k}}$ and $P_{C_{U_k}}$ based on Eq. (2)
4: Compute Ψ_{C,U_k} based on Eq. (3)
5: Compute Ψ_{U_k} based on Eq. (4)
6: **end for**
7: Order the friends in descending order of Ψ_{U_k}
8: Notify the top N friends

3. PROBLEM SOLUTION

PROPOSED SYSTEM

We propose social search on cloud based Q&A system that provides the large resources to store the information. It also provides quick response to the question and sharing questions is also feasible. We also analyze the appropriate value for the Time-To-Live (TTL) , that provides a satisfactory success ratio, it avoids redundant message overhead and reduces the waiting time . The First Order Logic Technique also been used

to calculate interest ID's and speed of the answers.SOS associates with an online social network, where nodes are socially connected. Every user has an interest ID which is created based on the profile of the user which represents the interest of the user.

The users who give answers are considered as best answerers only if the asker is satisfied with the answer to that question. The architectural diagram in above figure helps to find the answerers. When a question is posted by the user, the node processes the question using NLP (Natural Language Processing) and then represent the in first order logic format by dividing question into tokens keywords then apply inference rules on the tokens to infer the questions interest. Finally a question id is created based on the interest. This question id is compared with the friends Interest id and if the id's match, question is forwarded to those friends. When a question is posted by the user, the node processes the question using NLP (Natural Language Processing).

4. CONCLUSION

Q&A systems are used by many people for purposes such as information retrieval, academic assistance, and discussion. To increase the quality of answers received and decrease the wait time for answers, we have developed and prototyped an online social network based Q&A system, called SocialQ&A. It utilizes the properties of a social network to forward a question to potential answer providers, ensuring that a given question receives a high-quality answer in a short period of time. It removes the burden from answer providers by directly delivering them the questions they might be interested in, as opposed to requiring answer providers to search through a large collection of questions as in Yahoo! Answers or flooding a question to all of an asker's friends in an online social network. The bloom filter based enhancement methods encrypt the interest and friendship information exchanged between users to protect user privacy, and record all n-grams of answered questions to automatically retrieve answers for recurrent question. The onion routing based answer forwarding protects the identities of askers and answers. Our comprehensive tracedriven experiments and analysis results on the real-world Q&A activities from the SocialQ&A prototype show the promises of SocialQ&A to enhance answer quality and reduce answer wait time in current Q&A systems, and demonstrate the secure and efficiency improvement achieved by the enhancements. Since same questions may be presented very differently and the same question may be answered differently in different situation. In the future, we will cooperate with other techniques (e.g. topic modeling [48] and word embedding [49]) into SocialQ&A to find the redundant question with a large scale user set. Due to the dynamic of user behavior, SocialQ&A can cooperate a machine learning method to adjust three parameters appropriately, which needs a large user base and much more usage. We will conduct tests on a large user base in the real-world experiment.

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