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EFFICIENT SEARCH ALGORITHM DESIGN FOR UNSTRUCTURED PEER-TO-PEER NETWORKS

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Abstract: Peer-to-peer systems are becoming increasingly popular, with millions of simultaneous users and a wide range of applications. Understanding existing systems and devising new peer-to-peer techniques relies on access to representative models derived from empirical observations. Due to the large and dynamic nature of these systems, directly capturing global behavior is often impractical. Sampling is a natural approach for learning about these systems, and most previous studies rely on it to collect data. This paper addresses the common problem of selecting representative samples of peer properties such as peer degree, link bandwidth, or the number of files shared. A good sampling technique will select any of the peers present with equal probability. However, common sampling techniques introduce bias in two ways. First, the dynamic nature of peers can bias results towards short-lived peers, much as naively sampling flows in a router can lead to bias towards short-lived flows. Second, the heterogeneous overlay topology can lead to bias towards high-degree peers. We present preliminary evidence suggesting that applying a degree-correction method to random walk-based peer selection leads to unbiased sampling, at the expense of a loss of efficiency.

Keywords: Peer-to-peer, performance analysis, search algorithm

1. INTRODUCTION

Peer-to-peer (P2P) systems are becoming increasingly popular, with millions of simultaneous users [1] and covering a wide range of applications, from file-sharing programs like LimeWire and eMule to Internet telephony services such as Skype. Understanding existing systems and devising new P2P techniques relies on having access to representative models derived from empirical observations of existing systems. However, due to the large and dynamic nature of P2P systems, it is often difficult or impossible to directly capture global behavior. Sampling is a natural approach for learning about these systems using light-weight data collection, relied on by most previous studies (e.g., [4]). One challenge, however, is ensuring that the samples are representative (or unbiased).

This paper addresses the common problem of selecting representative samples of peer properties such as peer degree, link bandwidth, or the number of files shared [4]. To examine peer properties, any sampling technique needs to locate a set of peers in the overlay and gather data from them. Initially, the sampling program is aware of a handful of peers and leveraging them to learn about additional peers. Typically, the sampling program queries known peers to learn about their neighbors, incrementally exploring a fraction of the overlay graph.1 A good sampling technique will select any of the peers present with equal probability. However, as we will show, commonly used sampling techniques can easily introduce significant bias in two ways. The first cause of bias is the highly dynamic nature of these systems. It is easy to imagine the overlay as a static graph from which we want to collect a set of peers. However, gathering a set of samples takes time, and during that time the graph will change. In Section II-A, we show how this often leads to bias towards short-lived peers and explain how to overcome this difficulty. The second significant cause of bias is the graph properties of the P2P topology. A naive approach will be heavily biased towards high-degree peers. As the sampling program explores the graph, each link it traverses is much more likely to lead to a high-degree peer than a low-degree peer. We describe different techniques for traversing the overlay to select peers in Section II-B and evaluate them in Section III via simulation. In this preliminary work, we simulate using two types of graphs: ordinary random graphs and an actual snapshot of the Gnutella graph topology [22]. In our ongoing work, we are adding other types of random graphs, such as certain power-law random graphs and small-world graphs, to explore the robustness of the considered techniques to different types of graph structures. By comparing and contrasting the performance of different techniques in different settings, we can gain a better understanding of the most efficient techniques to consistently yield unbiased (or only slightly biased) samples.

In summary, bias in sampling from P2P systems can be introduced along two axes: (i) temporal (due to differences in peer lifetimes) and (ii) topological (due to differences in peer degree). Our findings show that these factors cause heavy bias in commonly used techniques such as breadth-first search and random walks. We present preliminary evidence suggesting that applying a degree-correction method to random walk leads to unbiased sampling, at the expense of a loss of efficiency. Section IV discusses related work,

and Section V concludes the paper with a summary of our findings and plans for future work.

2. RELATED WORK

In this paper, addresses the common problem of selecting representative samples of peer properties such as peer degree, link bandwidth, or the number of files shared. A good sampling technique will select any of the peers present with equal probability. However, common sampling techniques introduce bias in two ways. First, the dynamic nature of peers can bias results towards short-lived peers, much as naively sampling flows in a router can lead to bias towards short-lived flows second, the heterogeneous overlay topology can lead to bias towards high-degree peers. Present preliminary evidence suggesting that applying a degree-correction method to random walk-based peer selection leads to unbiased sampling, at the expense of a loss of efficiency.

We quantify performance in terms of number of hits, network overhead, and response time. Our schemes combine flooding and random walks, look ahead and replication. Consider both regular topologies and topologies with super nodes. Introduce a general search scheme, of which flooding and random walks are special instances, and show how to use locally maintained network information to improve the performance of searching. Our main findings are: (a)A small number of super nodes in an otherwise regular topology can offer sharp savings in the performance of search, both in the case of search by flooding and search by random walk, particularly when it is combined with 1-step replication. (b)There is a generalization of search, of which flooding and random walk are special instances, which may take further advantage of locally maintained network information, and yield better performance than both flooding and random walk in clustered topologies. The method determines edge criticality and is reminiscent of fundamental heuristics from the area of approximation algorithms.

Using the model we obtain analytical expressions for the performance metrics of random walk search in terms of the popularity of the resource being searched for and the parameters of random walk. Propose an equation based adaptive search mechanism that uses estimate of popularity of a resource in order to choose the parameters of random walk such that a targeted performance level is achieved by the search. Propose a low-overhead method for maintaining an estimate of popularity that utilizes feedback (or lack there-off) obtained from previous searches. Simulation results show that the performance of equation based adaptive search is significantly better than the non-adaptive random

Present simulation results on a distributed replication strategy proposed. Finally, in this paper find that among the various network topologies, uniform random graphs yield the best performance.

In the scheme, each peer keeps track of the connectivity's of every immediate and next indirect neighbor peers, which can be acquired locally. LightFlood identifies the neighbor with the highest connectivity and uses the link to that neighbor to form a sub overlay within the existing P2P overlay. In LightFlood, flooding is divided into two stages. The first stage is a standard flooding with a limited number of TTL hops, where a message can spread to a sufficiently large scope with a small number of redundant messages. In the second stage, message propagating is only conducted along the sub overlay, significantly reducing the number of redundant messages. Our analysis and simulation experiments show that the LightFlood scheme provides a low-overhead broadcast facility that can be effectively used in P2P search.

3. SYSTEM DESIGN

Design and Testing is the actual process of producing a solution according to the specification derived from the analysis stage.

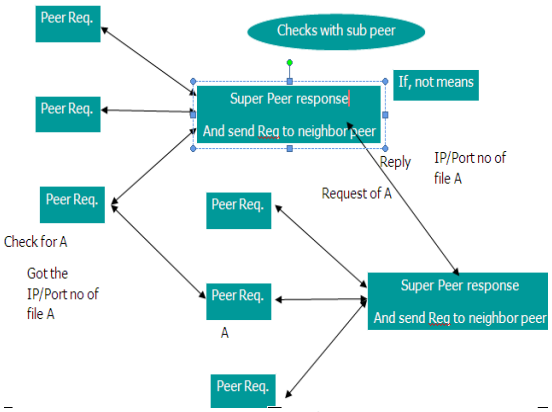


Figure 1: Preliminary design of the proposed model

4. SIMULATION RESULTS

Initially a source peer send request to all of it neighboring peers until reach the destination depends on the network size. Depend on the network size the proposed model switches to the required algorithm.

A data-flow diagram (DFD) is a graphical representation of the "flow" of data through an information system. DFDs can also be used for the visualization of data processing (structured design).

On a DFD, data items flow from an external data source or an internal data store to an internal data store or an external data sink, via an internal process DFD provides no information about the timing of processes, or about whether processes will operate in sequence or in parallel.

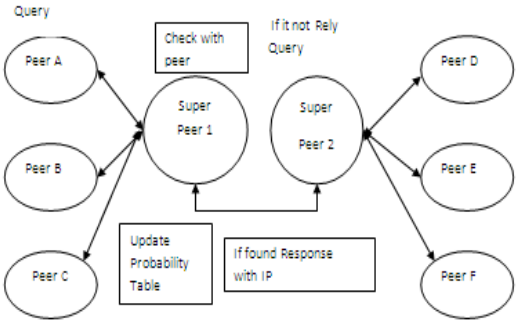


Figure 2: Data Flow Diagram

5. SYSTEM TESTING

In a software development project, errors can be injected at any stage during development. The development of software involves a series of production activities where opportunities for injection of human fallibility's are enormous. Because of human inability to perform and communicate with perfection, software development is accomplished by a quality assurance activity.

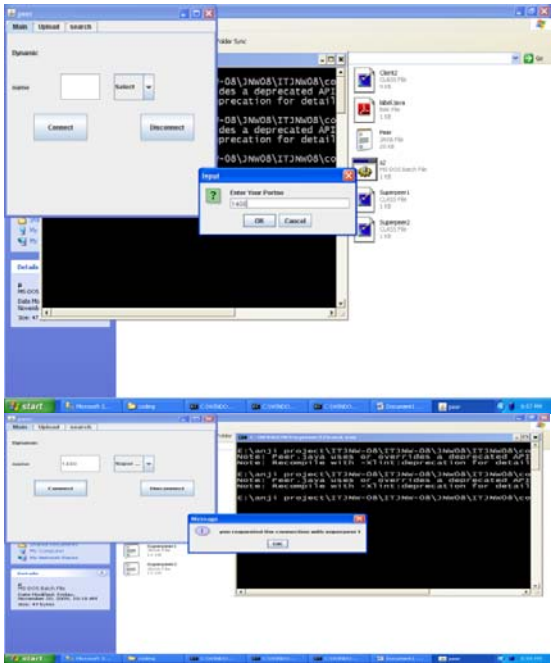
Software testing is a critical element of software quality assurance and represents the ultimate review of specification, design and coding. Testing presents an interesting anomaly for the software engineer. The engineer creates a series of test cases that are intended to demolish the software engineer process that could be viewed as destructive rather than constructive.

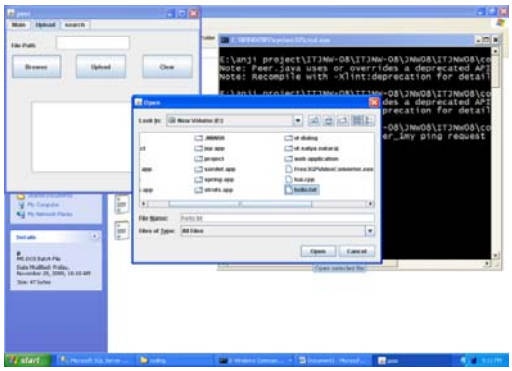
Equivalence partitioning is a black-box testing method that derives the input domain of program into classes of data from which test cases can be derived. An ideal test case single handedly uncovers a class of errors (e.g. incorrect processing of all incorrect data) that might otherwise require many cases to be executed before the general errors are observer. Equivalence partitioning strives to define a test that uncovers the class of errors, thereby reducing the total number of test cases that uncovers classes of errors, thereby reducing the total number of test that uncovers classes of errors, thereby reducing the total number of test cases that must be developed.

Testing case testing for equivalence partitioning is based on a evaluation of equivalence class for an input condition if a set of objects can be linked by relationship that are symmetric, transitive and reflexive, an equivalence is present. An equivalence class represents a set of valid or invalid states for input condition. Typically an input condition is a specific numeric value, a range of values, a set of related values, or a condition.

Code Testing: The code test has been conducted to test the logic of the program. Here, we have tested with all possible combinations of data to find out logical errors. The code testing is done thoroughly with all possible data available with library. Program Testing: Program testing is also called unit testing. The modules in the system are integrated to perform the specific function. The modules have been tested independently, later Assembled and tested thoroughly for integration between different modules. System Testing: System testing has been conducted to test the integration of each module in the system .It is used to find discrepancies between the system and its original objective. It is found that there is an agreement between current specifications and system documentation. Software Testing is carried out in three steps

The first step includes unit testing where in each module is tested to provide his correctness, validity and also determine any missing operations. Errors are noted down and corrected immediately. Unit testing is the import and major part of the project. So errors are rectified easily in particular module and program clarity is increased. In this project entire system is divided into several modules and is developed individually. So unit testing is conducted to individual modules.





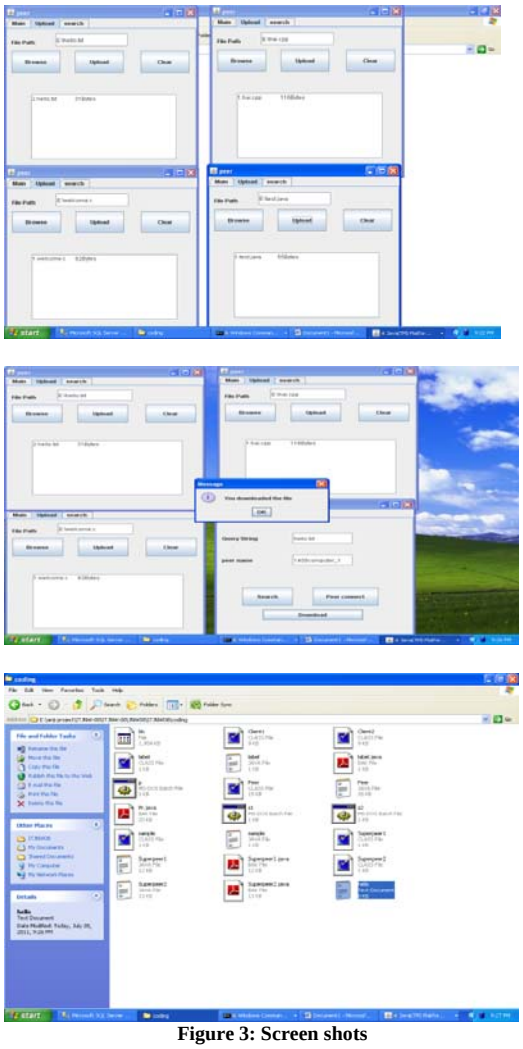


Figure 3: Screen shots

6. CONCLUSION

In this paper we have explored several techniques for sampling from P2P systems. One of our contributions is to show that unbiased sampling must allow the same peer to be selected multiple times to avoid bias correlated with peer sessions lengths.

We simulated each technique over ordinary random graphs as well as a real Gnutella topology and evaluated how much bias and correlation they introduce as well as their efficiency. We found that the commonly used BFS technique, while efficient, introduces significant sampling bias. Conducting random walks is also significantly biased and additionally is inefficient. The random stroll technique corrects the inefficiency, but remains significantly biased. Each of these techniques are biased due to the influence of the degree distribution. We describe a "degree correction" modification to the random walk and random stroll techniques that corrects the bias, resulting in samples that appear just as accurate as using an oracle. However, there is a significant decrease in efficiency when using these techniques. In our ongoing work, we are extending our study to include additional types of random graphs, such as power-law random graphs and small-world graphs. By comparing and contrasting the performance of different techniques in different settings, we can gain a better understanding of the most efficient techniques to yield unbiased samples. Additionally, we are exploring techniques for estimating global properties, such as the number of peers in a P2P system or the diameter of an overlay network by exploring only a fraction of the graph.

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