A New Migration Algorithm of Mobile Agent Based on Ant Colony Algorithm in P2P Network

Shaozi Li[1,2], Yang Cao[1], and Huowang Chen[2]

[1] Department of Computer Science, Xiamen University, Xiamen, 361005, China
[2] School of Computer, National University of Defence Technology, Hunan, 410073, China
szlig@xmu.edu.cn

Abstract. This paper presents our recent research work on Peer to Peer distributed information sharing based on mobile agent. From various perspectives, our work focuses on how to improve information retrieval efficiency in a P2P distributed information sharing system. A new model based on mobile agent is proposed and the new migration algorithm of mobile agent based on ant colony algorithm (ACA) is presented to implement P2P information retrieval. In order to evaluate and validate the model, we built a simulated P2P prototype consisting of a network of peer nodes; mobile agent migrating in the network, making peer nodes communication with each other. The results show some advantages of the proposed approach for the P2P distributed information sharing based on mobile agent.

1 Introduction

With the dramatic increase of services and information on the Internet, an effective technology is demanded for retrieving useful information from huge distributed data sources. The traditional information retrieval technology is based on client/server model, in which all the information is stored in central servers. But in fact, the information is almost in distributed environment, such as Internet or Intranet. In this case, every user can have the information in his computer. So, it is very convenient to construct the platform based on peer to peer(P2P) to share the information between two users.

P2P technology has recently received a lot of attentions, and many P2P platforms have been built for file sharing, distributed computing and storage, search engineering, collaborative working, etc. Different from the traditional client-sever structure, P2P networks are more scalable, cost-effective and fault-tolerant. Existing P2P searching systems are usually based on the following techniques: Centralized indexing[1], Flooding[2], Distributed Hash Table[3,4], Semantic routing[5].

Unfortunately, the P2P systems mentioned above are considered inefficient, although they have gained much success. At first, they don't pay enough attention to peers' interests or even completely ignore, which means peers cannot recommend information to others, even though they have known others' needs by the retrieval history. Then, it generates a significant amount of unnecessary traffic due to little utilization of the retrieval data. As a new paradigm, mobile agent technology is

Y. Luo (Ed.): CDVE 2006, LNCS 4101, pp. 107 – 114, 2006.

expected to reduce network traffic and to enhance efficiency of information retrieval by moving code to remote data centers, filtering them locally in parallel, and returning with a comparatively small result.

In this paper, we present a new approach to mobile agent based P2P information retrieval, using ant colony algorithm and information recommendation services to improve the search efficiency. Ant colony algorithm could help mobile agent make migrating decisions, and information recommendation services could raise the file-sharing level. The remainder of this paper is organized as follows. In Section 2, we introduce the related work. The details of a new migration algorithm based on ACA are presented in Section 3. In Section 4, we describe the simulating results.

2 Related Work

2.1 Problem Description

An important problem about mobile agent-based information retrieval in P2P systems is how to effectively transfer agents to remote place. One possible way is to traverse the remote peers one after another. In this scenario, deciding the optimal migration path is reduced to a traveling salesman problem (TSP). But in practice, we cannot assume that every remote peer provides an agent platform. A more practical alternative is to search for an optimal migration tree rooted at the local peer such that the communication cost is minimized while a user-specified limit of task completion time remains unviolated. Each node on the migration tree represents an agent platform that the agent will visit. Each edge corresponds to a transfer of the agent code. The non-leaf nodes are responsible for spawning agent code and transferring the replicas to their children. The agent replica will examine the data in remote peer and return useful results to the users. Unfortunately, it can be proved that the latter scenario is NP-hard. Computing the exact optimal solution is therefore too computationally intensive to be useful in practice.

In this paper, we formulate the migration problem (MP) of mobile agents as an optimization problem, which searches for an optimal migration tree rooted at the client such that the communication cost is minimized while the task completion time is subject to a user-specified limit.

In this paper we attempt to employ Ant Colony Algorithm (ACA) to obtain an optimal or sub-optimal solution for the migration problem (MP) of mobile agents. We develop a new ACA, and a series of simulations are performed to test the effectiveness and the efficiency of the algorithm.

2.2 Ant Colony Algorithm

In nature ants are seen creating “highways” to and from their food, often using the shortest route. They are able to find the best path between food and their nest by a chemical substance called pheromone. Ants leave pheromone on their trails while moving, and they are able to detect the pheromone concentration. If a path has more pheromone on it, then it will attract more ants, and furthermore, the pheromone will be reinforced. If no pheromone is detected, ants move randomly. Thus, if an ant finds a good path from food to its nest, other ants will eventually follow the path.