Chapter 2.14
A Service Discovery Model for Mobile Agent-Based Distributed Data Mining

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ABSTRACT

Mining information from distributed data sources over the Internet is a growing research area. The introduction of mobile agent paradigm opens a new door for distributed data mining and knowledge discovery applications. One of the main challenges of mobile agent technology is how to locate hosts that provide services requested by mobile agents. Traditional service location protocols can be applied to mobile agent systems to explore the service discovery issue. However, because of their architecture deficiencies, they do not adequately solve all the problems that arise in a dynamic domain such as database location discovery. From this point of view, we need some enhanced service discovery techniques for the mobile agent community. This chapter proposes a new model for solving the database service location problem in the domain of mobile agents by implementing a service discovery module based on search engine techniques. As a typical interface provided by a mobile agent server, the service discovery module improves the decision ability of mobile agents with respect to information retrieval. This research is part of the IMAGO system—an infrastructure for mobile agent-based data mining applications. This chapter focuses on the design of an independent search engine, IMAGOSearch, and discusses how to integrate service discovery into the IMAGO system, thus providing a global scope service location tool for intelligent mobile agents.

INTRODUCTION

Mobile agent systems bring forward the creative idea of moving user defined computations–agents towards network resources, and provide a whole

new architecture for designing distributed systems. An agent is an autonomous process acting on behalf of a user. A mobile agent roams the Internet to access data and services, and carries out its assigned task remotely. Distributed data mining (DDM) is one of the important application areas of deploying intelligent mobile agent paradigm (Park & Kargupta, 2002; Klusch et al., 2003). Most existing DDM projects focus on approaches to apply various machine leaning algorithms to compute descriptive models of the physically distributed data sources. Although these approaches provide numerous algorithms, ranging from statistical model to symbolic/logic models, they typically consider homogeneous data sites and require the support of distributed databases. As the number and size of databases and data warehouses grow at phenomenal rates, one of the main challenges in DDM is the design and implementation of system infrastructure that scales up to large, dynamic and remote data sources. On the other hand, the number of services that will become available in distributed networks (in particular, on the Internet) is expected to grow enormously. Besides classical services such as those offered by printers, scanners, fax machines, and so on, more and more services will be available nowadays. Examples are information access via the Internet, E-commerce, music on demand, Web services and services that use computational infrastructure that has been deployed within the network. Moreover, the concept of service in mobile agent systems, which will be described in this chapter, has recently come into prominence.

Mobile agents must interact with their hosts in order to use their services or to negotiate services with other agents (Song & Li, 2004). Discovering services for mobile agents comes from two considerations. First, the agents possess local knowledge of the network and have a limited functionality, since only agents of limited size and complexity can efficiently migrate in a network and have little overhead. Hence specific services are required which aim at deploying mobile agents efficiently in the system and the network. Secondly, mobile agents are subject to strong security restrictions, which are enforced by the security manager. Thus, mobile agents should find services that help to complete security-critical tasks, other than execute code that might jeopardize remote servers. Following this trend, it becomes increasingly important to give agents the ability of finding and making use of services that are available in a network (Bettstetter & Renner, 2000).

Some of the mobile agent systems developed in the last few years are Aglets (Lange & Ishima, 1998), Voyager (Recursion Software Inc, 2005), Grasshopper (Baumer et al., 1999), Concordia (Mitsubishi Electric, 1998), and D'Agents (Gray et al., 2000). Research in the area of mobile agents looked at languages that are suitable for mobile agent programming, and languages for agent communication. Much effort was put into security issues, control issues, and design issues. Some state of the art mobile agent systems focus on different aspects of the above issues, for example, Aglets on security, D'Agents on multi-language support, Grosshopper on the implementation of the FIPA (FIPA, 2002) and MASIF (Milojicic et al., 1998) standard. However, few research groups have paid attention to offering an environment to combine the concept of service discovery and mobile agent paradigm. Most existing mobile agent systems require their programmer to specify agent migration itinerary explicitly. This makes mobile agents the weak ability to sense their execution environment and react autonomously to dynamic distributed systems. The objective of our research is to equip mobile agents with system tools such that those agents can search for data sites, move from hosts to hosts, gather information and access databases, carry out complex data mining algorithms, and generate global data model or pattern through the aggregation of the local results.

In this chapter, we propose a new service discovery model DSSEM (discovery service via search engine model) for mobile agents. DSSEM