Learning agent organisations: studies on collaborative modelling, performance management and learning capacities of networks of collaborative agents
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SUMMARY

This dissertation is the result of several years of research into systems and organisations that consist of autonomously operating and communicating entities, called agents. The research focuses on collaborative learning mechanisms and on how local learning mechanisms can be used to improve the global performance of the networked organisations. We study the learning capacity of agent organisations and apply our results in the context of two different types of networked systems: computing grid-infrastructures and business organisation networks.

The research was driven by theoretical as well as practical motivations. We developed a method for inducing grammatical structures in events that occur in networked environments and studied how local learning mechanisms can contribute to global performance improvements. We applied our work in two case environments. In the Virtual Lab for e-Science (VL-e) project we studied the operational management of grid-infrastructures and developed software agents that support system administrators. In the European collaborative organisation leadership project (Ecolead) we looked at collaborative performance management processes and developed agents for information management purposes.

We regard both environments as organisations of agents. Describing both types of network in terms of collaborative agents allows us to study them on equal levels of abstraction. It furthermore allows us to describe the role and the influence of the software agents that also act inside these organisations.

Chapter 1 describes the motivation and scope of our research and presents the research questions. In chapter 2 we discuss the theoretical background necessary to understand the subjects described in the rest of the dissertation. Chapter 3 presents our collaborative grammar induction mechanism. We describe how various local models can be combined into global overviews.

We applied this mechanism in chapter 4, the case of managing computing grid infrastructures. The software agents observe events occurring in the various organisational domains of the network, learn patterns and exchange these patterns to map the global network behaviour. We develop learning software agents that provide real-time overviews of the task-handling behaviour of the network. The overviews obtained by the agents are used by the system administrators.

In chapter 5 we look at the distributed performance management processes in networks of business organisations. We look at network performance indicators and describe how software agents are used to measure the values of these indicators. The work in both case environments paved a way towards a more formal approach of learning in organisational networks. In chapter 6 we introduce a formal paradigm...
to study global adaptive behaviour of organisations of collaborative agents with local learning capabilities. We describe how task-handling agents that use local learning mechanisms can collaborate in their learning process in order to learn as an organisation. The framework allows us to study the conditions under which the organisation can adapt itself to structural pressure from an environment.

In chapter 7 we discuss the results of our work. We revisit our research questions and discuss our findings. Finally we discuss the valorisation of our work and provide a practical outlook on some areas of application. One of them is cloud computing, the business concept of using computing resources in a flexible manner via the internet. Another interesting domain is formed by the field of logistic networks and traffic management in which we see interesting applications of our work and possibilities for future research. The context research also led to the foundation of an expertise group at Logica that works closely with universities and research institutes.