ETAPP: A Framework of Agent Collaboration under Conditions of Uncertainty Regarding Team Members *

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ABSTRACT

In this thesis, we define a framework for agent collaboration, and offer various guidelines for agent collaboration supported by empirical studies. Central to our research is the issue that agents may have incomplete and incorrect models of the real capabilities of team members, and use these models to assess which agents should perform a task. We address the problems of modelling agents' capabilities and coping with decisions made in an unreliable manner.

Categories and Subject Descriptors

I.2.11 [**Computing Methodologies**]: *Multiagent systems*

General Terms

Performance, Design, Reliability

Keywords

Agent Collaboration, Agent Modelling, Reliable Decision Making

1. SUMMARY OF THESIS

Knowledge of collaborators' capabilities and reliable decision making processes are important factors when a team collaborates to reach a goal. In this thesis, we investigate these factors in the context of a collaborative activity – the assignment of team members to tasks.

Many collaboration theories assume that knowledge of collaborators' capabilities is correct and complete, and that agents make decisions in a reliable manner. Making reliable decisions means that agents make decisions to optimize utility according to the criteria of a task rather than an agent's own criteria. An example of a task criterion is to reduce the time spent to achieve a task. We argue that these assumptions simplify the problem of agent collaboration.

According to our view of collaboration, knowledge of team members' capabilities can be incorrect and incomplete, and team members can make decisions in an unreliable manner. This view of collaboration raises several issues and questions addressed as part of the research in this thesis. For example, how do the limited reasoning capabilities and non-deterministic performance of agents influence the accuracy of models of team members' capabilities? If a team makes group decisions, then which group decision procedures improve the quality of collaborative activities?

The goal of our research is to analyze agent behaviour in a collaborative setting in order to determine the factors that influence team performance, make predictions of the outcome of team performance, and offer guidelines for efficient collaboration. To this end, we offer two contributions to research in agent collaboration.

First, we propose a framework called *ETAPP (Environment-Task-Agents-Policy-Protocol)* [1, 2, 3]. This framework expresses the collaboration of a team in terms of five operating parameters: Environment, Task, Agents, Policy and Protocol. Briefly, the *Task* given to a group is to be performed in the *Environment*, and the *Policy* and *Protocol* are procedures performed by the group. The *Agents* component describes a group of agents where each agent stores models of team members' capabilities in order to estimate the value of contributions of team members to a task. Central to the ETAPP framework is the issue that these models may be wrong and incomplete because of various reasons (*e.g.*, agents have limited memory and cannot store models of all team members).

Second, our research offers several insights, predictions and guidelines of agent collaboration based on empirical studies. We developed a simulation testbed designed according to the ETAPP framework. In our studies, we found that memory and the ability to learn are the most influential factors of team performance and transaction costs [1]. We also found that appropriate group decision policies should be used to improve the performance of a team which include selfish, conservative, lazy, and corrupt members (*e.g.*, if team members propose decisions in a reliable manner, the team should select the most optimistic decision) [2]. Variability of individual agent performance influences team performance (*e.g.*, the more variable the agent performance the worse the team performance) [3].

We propose the following extensions to our research: models of team performance (currently, we model only the performance of a single agent); decentralization of performance evaluation, meaning that each team member evaluates observed performance differently (currently, all team members use one evaluation method); investigation of the team performance based on decisions made by a leader, and decisions derived from voting and auctioning.

2. REFERENCES

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