An Approach to a Multi-agent Based Scheduling System Using a Coalition Formation

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ABSTRACT

In this paper, we propose methods for multi-agent scheduling based on a coalition game and two mechanisms called "nemawashi" and "settoku." The "nemawashi" and "settoku" mechanisms facilitate reaching a consensus among agents. We show the effect of these mechanisms in a practical scheduling system.

1. SCHEDULING SYSTEM

In this paper, we propose a multi-agent scheduling system based on the coalition game[Zl93] in game theory and the mechanisms of "nemawashi" (maneuvering behind the scenes) and "settoku" (persuasion). In the coalition game, an agent calculates his utility by means of a characteristic function, and participates in a coalition that increases his utility. We define the characteristic function $v(S)$ as being based on event size $|S|$, private events U_e, human relations $\mathcal{H}$, and agents relations $\mathcal{A}$ as follows.

$$v(S) = |S| - U_e + \mathcal{H} + \mathcal{A}$$

A scheduling system is used to make a schedule which is agreed on by most members in an organization. In this system, an agent is assigned to an user, and the agent knows his/her user's private schedule. Instead of a human user, agents negotiate by playing the coalition games. In practical applications, it is difficult to reach a consensus if only conventional negotiation protocols are used. To solve this problem, we use "nemawashi" and "settoku" mechanisms to facilitate reaching a consensus among agents.

2. NEGOTIATION PROCESS

In a negotiation process, the agents' preferences are collected by a circulation board protocol[Ki89] used to collect preferences of agents by sending a notice in circulation. In order to reach a consensus effectively in the process, we divide a negotiation process to a fundamental negotiation and a soft "settoku" mechanism. These are done by turns until agents reach a consensus or make no change in their preferences. The fundamental negotiation is done by free agents (who have no private events scheduled on candidate days). The soft "settoku" mechanism is done by busy agents (who do have a private events scheduled on candidate days).

In the fundamental negotiation, the free agents declare preferences based on the characteristic function $v(S)$ (in this case, agents consider human relations $\mathcal{H}$ and agent relations $\mathcal{A}$ only). Next, based on these preferences, the busy agents declare their preferences based on the characteristic function $v(S)$ in the process of the soft "settoku" mechanism.

In the process of the "nemawashi" mechanism, one agent collects information of the other agents' preferences for candidate days. According to the information, the agent can narrows down candidate days effectively. When the agents' preferences do not tend to reach a consensus, a forced "settoku" mechanism forces the agents in the minority to unselect their most preferable candidate days. These agents must then reselect an alternative day from the preferable candidate days, and can receive rewards that make the agents more influential in the next negotiation process. The system improves the relations $\mathcal{A}$ for the agents received rewards. And, the agents get higher priority to access information of the notice in the circulation board protocol.

3. CONCLUSIONS

In this paper, we propose a method for negotiation among agents based on a coalition game, as well as "settoku" and "nemawashi" mechanisms. By using this method and these mechanisms, we promote the reaching of a consensus among agents.

REFERENCES

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