

Individual Beliefs and Group Acceptances within Agent Organizations

Ioannis Partsakoulakis and George Vouros
Department of Information and Communication Systems Eng.
University of the Aegean, 83200 Karlovassi, Samos, Greece
{jpar,georgev}@aegean.gr

ABSTRACT

Groups of collaborative agents within organizations need to create group awareness in order to act as a single entity. The notion of collective belief, which has been used extensively to cope with group awareness, is not appropriate in organized settings where group members *accept* that certain states hold based on shared practices, even if some members of the group do not believe that these states hold. This paper distinguishes between individual beliefs and group acceptances and introduces state recognition recipes that drive groups within organizations to create common awareness.

Categories and Subject Descriptors

I.2.11 [Artificial Intelligence]: Distributed Artificial Intelligence – multiagent systems, languages and structures, coherence and coordination, language, intelligent agents.

General Terms

Algorithms, Management, Design,

Keywords

Acceptance, multiagent systems, group awareness, agent organizations.

1. INTRODUCTION

The ability to interact with others is one of the fundamental characteristics of agency. However, to form collaborative groups that act as meta-agents, the exchange of bit streams is not enough. Agents must share knowledge and practices and must be able to build and maintain models of their peers.

This paper deals with groups that follow a pre-specified organizational model stated in terms of roles. Participating in a group, agents must reconcile between their individual beliefs and group's views, creating group awareness independently of their perceptual and cognitive abilities, permissions to access information sources, knowledge that they possess, preferences etc.

Theoretical models of collaborative decision making [2, 3, 6] adopt the notion of collective or mutual belief to cope with group

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

AAMAS'05, July 25-29, 2005, Utrecht, Netherlands.

Copyright 2005 ACM 1-59593-094-9/05/0007 ...\$5.00.

awareness. The definition of collective belief requires agents to have the same view; however, in organized settings where information is inherently distributed and access restrictions to information sources apply, this rarely happens.

The above introduces the problem of representing and exploiting the policies for building and maintaining common awareness within groups. For instance, in certain settings, group members must be able to exploit a policy that states that the group shall accept something only if the majority of the group members believe it, although there may be some group members with a different opinion. More than policies, the above example reveals the necessity for agents to clearly distinguish between their beliefs and their acceptances as group members.

Concluding the above, based solely on the notion of collective belief, agents can not tolerate different beliefs towards group awareness, leaving outside many interesting group settings. This paper distinguishes between acceptances and beliefs [7, 5, 1], and proposes state recognition recipes for the representation of group policies towards forming group acceptances [4].

2. ORGANIZATIONAL STRUCTURE

Dealing with acceptances in organized settings, we specify the structure of organizations in terms of roles. Roles specify the normative behavior of individuals by means of responsibilities and recipes. Roles are distinguished into *atomic roles*, that do not contain other roles and are played by individuals, and *composite roles* that contain at least one role and are played by groups of agents. As Figure 1 shows, the association between agents and roles is done through positions.

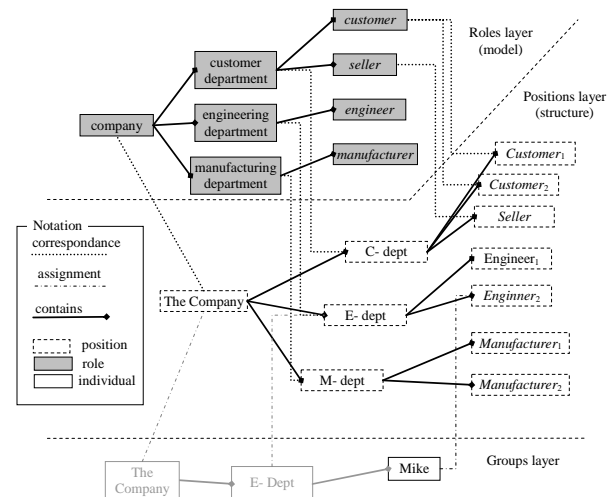


Figure 1. Part of the organization that represents a company.

Positions inherit responsibilities and recipes from their corresponding roles as well as from the positions in which they are contained, and they can have additional ones. Recipes are distinguished into state achievement recipes (a-recipes) and state recognition recipes (r-recipes).

3. R-RECIPES

R-recipes are the building blocks of organizational policies for the formation of acceptances. They specify the group members that are authorized/expected to disseminate beliefs/information within a group and how the combination of these beliefs yields to acceptances for the group members.

Each r-recipe belongs to a specific composite role, which is called the *relevant role*. Each group that plays the relevant role is a *relevant group* for this recipe. An r-recipe is associated to a specific state, which is called the *recipe state*. The body of an r-recipe comprises elements of the form $\rho_{ind}.s$, where ρ is a recipe contained in the recipe role, *ind* an indicator, and *s* is a subsidiary state of recipe's state. The indicator is a quantifier for the players of ρ and can take the value *all* or *one*, indicating *all* the players of ρ , or at least *one* of them, respectively. The following is an example of an r-recipe:

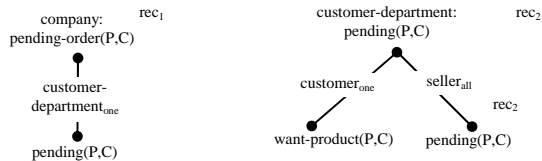


Figure 2. Examples of state recognition recipes (r-recipes).

For example, the r-recipe *rec2* in Figure 2 belongs to the role “customer-department” and states that the members of a customer department shall accept that a specific product *P* for a customer *C* is pending, when at least one customer believes that it wants the product *P* and that all sellers believe that the product order is pending.

Sharing the above recipe, each group member is aware of the information needed towards accepting an instance of the recipe state and can proactively offer this information. The above recipe is a policy for any group that plays the role “customer-department” towards the acceptance of the state “pending(P,C)”.

To specify a *complete policy* for a group more than one r-recipe may be necessary. For example, to specify whether a state shall be accepted by all company members, we can first specify how this state can be decomposed to subsidiary states that shall be accepted by “company” subsidiary roles and continue the “decomposition” hierarchically until states for atomic roles are reached. Generally, a complete policy for the acceptance of a state *s* by a group is a tree that we call *r-tree for s*. Figure 3(a) shows a complete policy for “The company” that results from the combination of recipes in Figure 2.

4. FORMING ACCEPTANCES

A *potential contribution* to a state *s* of an agent is a path from *s* to a leaf node in an r-tree for *s*, where this node corresponds to an atomic role played by the agent. Each agent computes its *personal contributions* by identifying its potential contributions and by unifying the leaf states with its beliefs. In other words, personal contributions are instantiated potential contributions identified by

individuals. Personal contributions must be communicated between agents that play the same atomic role (e.g. sellers). Personal contributions that are identified by a sufficient number of agents (according to recipes’ specifications) are called *group contributions* because they can affect the acceptances of a group. Finally, group contributions must be communicated between the agents that share the same policy. This makes possible for agents to check whether the requirements of the policy are satisfied. This is done by checking whether the potential contributions of a policy are unifiable to the set of group contributions (as Figure 3(b) shows).

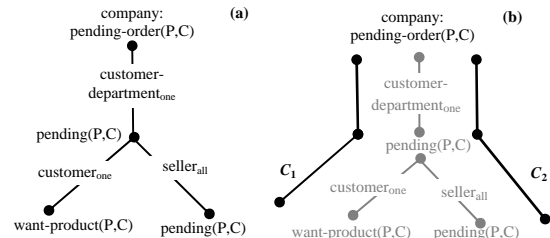


Figure 3. An r-tree and contributions.

5. CONCLUDING REMARKS

This paper focuses on the specification of group policies for forming acceptances in organized settings by means of state recognition recipes. According to our knowledge, the concept of acceptance has not been used for creating awareness in multi-agent systems.

Future work concerns the extension of set of constructs for building organization models and structures. Furthermore, extending the expressiveness of r-recipes is a major point of future research.

6. ACKNOWLEDGMENTS

This research is supported by the Pythagoras grand no. 1349 under the Operational Program for Education and Initial Training.

7. REFERENCES

- [1] L. J. Cohen. Belief and Acceptance. *Mind*, 391, pp 367 – 389, 1989.
- [2] P. R. Cohen and H. J. Levesque. Teamwork. *Nous*, 25, 487 – 512, 1991.
- [3] P. Panzarassa, N. R. Jennings, and T. J. Normal. Formalizing Collaborative Decision-making and Practical Reasoning in Multi-agent Systems. *Journal of Logic and Computation*, 11(6), 1 – 63, 2001.
- [4] I. Partsakoulakis and G. Vouros. Building Common Awareness in Agent Organizations. In *Proc. of AMKM’05 AAMAS’05 workshop*.
- [5] R. Tuomela. Group Knowledge Analyzed. *Episteme* 1(2), 2004.
- [6] M. Wooldridge and N. R. Jennings. Cooperative problem solving. *Journal of Logic and Computation*, 9, 563 – 592, 1999.
- [7] K. Brad Wray. Collective Belief and Acceptance. *Synthese* 129, pp. 319 – 333, 2001