

# Logic-based Multi-Agents in Industry

## CLIMA V Panel

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### Abstract

We believe that logic systems offer a powerful and flexible solution to many of the issues of constructing, modeling and reasoning about multi-agent systems. Numerous papers at logic and agent conferences support this claim. Unfortunately very little has yet made it to industry, if we do not consider industry sponsored research labs working on the topic.

This panel intends to discuss what should be done to disseminate this knowledge and techniques into industry. Liaisons and collaboration with industry are of interest as are wider topics on the direction of research, both in theoretical and implementational areas.

## 1 Motivation

Most research done in academia, even if it is more implementation-oriented, tends to be more theoretical inspired than required or desired for industry. Nevertheless most researchers tend or inspire to create new theories or prototypes with some application areas in mind. Research for the sake of research may be very honorable and may well lead to application in the long run, universities or funding bodies tend to favor more application inspired work than pure research. With governmental funding running thin in most if not all countries, participation from industry could be more than welcome. In an environment where profit is everything, or at least almost, how should we go about to convince that multi-agent systems (MAS) in general and more specifically logic-based multi-agent systems (LMAS) are a worthwhile technology to invest in. It is true that in the last years multi-agent systems have become more popular and have gained broader interest both in academia and outside. However, very few multi-agent systems have managed to escape research labs they were created in. Is this just the image problem every new technology has to struggle with or are there more fundamental problems? One might wonder that agent-technology is not yet in the appropriate

phase in the research and development cycle to have large scale commercial application. Are we missing the right tools/environments for industrial development? What new theories and formalisms would be critical? An other reason could be that people are uncomfortable with the idea that an autonomous agent is doing things on their behalf. This involves issues of control, trust, accountability and public relations<sup>1</sup>. Perhaps more fundamental is the lack of an agreed definition of agency. Different “application areas” use different definitions which are not semantically equivalent, leading to discussions on who are actually “agents” and who are not. If we cannot agree or agree to disagree within our own circle how can we expect that others will be able to?

Taking MAS to industry can be done in various ways and with different time frames in mind. Develop our own companies, collaboration with industry to build custom made application or we can provide appropriate tools and guidance such that industry can develop their own systems allowing us ample time for more fundamental research. Clearly decisions like this will never be clear-cut and may evolve over time.

Current research in multi-agent systems is booming, proved by the many agent conferences and the many papers non-agent conference attract. Clearly agents are hot, both for publications and funding. Will it last? Will agent systems as we know them still exist in, let say, 5 years time? Some researchers in the agent community believe that in the long run the research field or the hype will move in the direction of (web) services that a single agent can combine. So instead of a multi-agent system we would have a agent-multiple service system. If this would be case, what would be the role of logic in this?

This opens the discussion on the role of logic in current or future multi-agent systems. A large proportion of current agent research focuses on non-logic based techniques for agency. Most people in computer science when they hear agents think immediately about Jade and/or Fipa. For the ontology side things are slightly different although with the available tools it becomes easy to forget that in most cases ontologies are constructed with a variation of OWL which is based on description logic. On the other hand, this might exactly the key to its success. Too many people conceive logic as too mathematical and too difficult to handle without an appropriate hiding tool. So how can we convince first the agent community and second industry of the usefulness of logic oriented systems. What are the advantages and disadvantages of using logic in multi-agent systems, both in theory and applications.

The use of description based tools to model agent ontologies demonstrates that logic oriented components can be embedded in traditional style multi-agent implementations.

In the past multi-agent systems that used logic for their reasoning were criticized because of their complexity. Of course, complexity classes do not change, but is the criticism still valid? With better algorithms, greater computer power and more complex problems to solve, logic systems might be the most appropriate solution at hand. An other approach to this is the use of application-engineered logics that reduce the com-

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<sup>1</sup>Films from Metropolis to Terminator have shown a wide spread public misunderstanding and mistrust of autonomous, machine intelligences.

plexity or the computation time to a minimum, perhaps at the cost of some expressive power.

Currently we see the implementations of complete logic-based multi-agents systems appearing. Systems like Dali and Socs demonstrate that that MAS can be constructed using only computational logic formalisms. Results coming from this are very promising which opens the discussion whether, from an implementational point of view, we should aim from completely logic based systems or whether we should stick to hybrid systems.

The joint-venture of multi-agent systems and logic, opens not only interesting perspectives for the former but also for the latter. One way is to see LMAS as a testbed for logic formalism. But the reverse can also hold: LMAS can drive the search for or improvement of agent-tailored logic formalisms in a more client-server model. Where should the balance be between these two approaches for the successful development of our field?

We hope that this panel discussion will shed some light on the issues highlighted in this document and that a number of goals, solutions and/or different issues will be identified.

## 2 Questions

1. What is the current status of computational logic in MAS? Is there a place for logic based components in or next to systems using for example JADE and FIPA?
2. What are the advantages/disadvantage of using logical systems?
3. What is our current position within the MAS community? Where should we be?
4. Is there a future for MAS in general and more specific logical agents? Will the hype be over in 5 to 10 years? Are we evolving more to (web-based) services? If so, what could be the role of logic in this?
5. Should we aim for completely logic based systems or are hybrid systems the future?
6. What is stopping MAS/LMAS?
7. What do we need to do in order to convince industry that MAS and LMAS are worthwhile investments?
8. Should academia develop for industry or should we provide the means and tools such that they can build those systems themselves?