Introduction to the SELMAS 2006

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ABSTRACT

This paper is intended to introduce the Fifth International Workshop on Software Engineering for Large-Scale Multi-Agent Systems (SELMAS 2006) held in Shanghai, China, May 22-23, 2006, as part of the International Conference on Software Engineering (ICSE 2006). The main purpose of this workshop is to set up working groups that will address methodological aspects involved in developing practices for building dependable multi-agent systems. The research track paper solicitation process resulted in fourteen accepted papers. The workshop program will include five technical sessions of paper presentations, keynote talks, panels and discussion groups. The workshop website can be found at <http://www.teccomm.les.inf.puc-rio.br/semas2006>. We begin by presenting an overview of the workshop objectives and format, and then focus on the workshop technical program.

1. INTRODUCTION

Software is becoming present in every aspect of our lives, pushing us inevitably towards a world of ambient computing systems. Multi-agent systems (MAS) are becoming a prominent technology to facilitate the development of large-scale distributed systems. MAS are intrinsically designed as open systems and they consist of several cooperating entities, the so-called software agents. They employ semantically sophisticated interaction protocols as the flexible control layer that binds the pieces together into a reliable system of systems. However, the specific properties of MAS, such as autonomy, pro-activeness and self-adaptation, can hinder the satisfaction of dependability requirements if proper techniques are not applied.

Dependability of a computing system is its ability to deliver service that can be justifiably trusted. Making large-scale complex systems maximally dependable is still an open issue. These systems are becoming far more prevalent, and our society increasingly relies on them. Multi-agent systems may comprise a large number of software agents, which are built with different requirements. Agents may have varied skills and may also be self-interested, unpredictable, and mobile. Thus, the challenges posed by the agent paradigm require the development and refinement of new techniques, practices, and tools that build upon sound engineering principles. Without adequate development techniques and methods, supporting particularly such dependability means as fault avoidance, fault tolerance, fault removal and fault forecasting, such systems will not be sufficiently robust, trustworthy, secure, safe and extensible.

Consequently, there will be a steadily increasing demand for distributed software systems with substantial scalability and performance requirements, demanding reliability specifications, and critical security requirements. This is a singular time for dependable distributed systems. Commercially, there is significant and growing demand for this kind of systems.

2. OBJECTIVES

The above considerations motivated the organization of the SELMAS 2006 workshop. SELMAS 2006 intended to set up working groups that will address methodological aspects involved in developing practices for dependable MAS. Other general goals are as follows.

1. Understand the issues in the agent technology that improve or hinder the production of large dependable systems.

2. To identify existing software engineering techniques that may be successfully applied to deal with the complexity associated with dependable multi-agent systems.

Other particular interests of the workshop were to collect experience reports regarding empirical studies, identify best practices for MAS development and to establish a research agenda for dependable MAS engineering. The workshop wishes to bring together researchers interested in pushing the frontier in this important area, and practitioners who have experience with MAS and/or dependable systems development that can help guide this research.

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3. PAPER SOLICITATION PROCESS

The workshop invited participants to submit position papers, of up to seven pages, that described experiences in the development of dependable MAS and other practices in software engineering for agent-oriented development. The following issues were considered to be particularly significant to stimulate the research and development of software engineering techniques that will place value upon the development of dependable MAS.

- Aspect-oriented techniques to MAS development
- Coordination architectures, infrastructures, and tools
- Dependable agent systems
- Design patterns, design principles, and architectural styles
- Domain-specific languages
- Exception handling and fault-tolerance techniques
- Experiments and case studies
- Formal methods for MAS
- Frameworks and software architectures
- Governance for MAS
- Methodologies for agent-oriented analysis and design
- Mobility and security issues
- Modeling languages
- Ontologies for MAS
- Pitfalls and learned lessons in the construction of large MAS
- Reflective software architectures
- Requirements engineering
- Software development environments
- Software engineering techniques for resource-bounded MAS
- Software reliability engineering
- Testing and metrics
- Trustability issues
- Verification and validation techniques

4. PROGRAM COMMITTEE

A program committee was formed to select relevant material for the workshop program, to enhance the number of submissions, and to increase the quality of the accepted papers. We would like to thank all program committee members for their contribution in putting together a high quality workshop program.

- Gul Agha, University of Illinois at Urbana-Champaign (USA)
- Natasha Alechina, University of Nottingham (UK)
- Carole Bernon, IRIT – U. Paul Sabatier Toulouse (France)
- M. Brian Blake, Georgetown University (USA)
- Rafael Bordini, University of Durham (UK)
- Giacomo Cabri, Università di Modena e Reggio Emilia (Italy)
- Jaelson Castro, UFPE (Brazil)
- Mehdi Dastani, Utrecht University (The Netherlands)
- John Debenham, U. Technology, Sydney (Australia)
- Rogerio de Lemos, University of Kent (UK)
- Scott DeLoach, Kansas State University (USA)
- Chiara Ghidini, ITC-irst (Italy)
- Paolo Giorgini, University of Trento (Italy)
- Mark Greaves, Vulcan, Inc. (USA)
- Nicolas Guelfi, University of Luxembourg (Luxembourg)
- Zahia Guessoum, LIP6 (France)
- Giancarlo Guizzardi, University of Twente (The Netherlands)
- Brian Henderson-Sellers, U. Technology, Sydney (Australia)
- Tom Holvoet, Katholieke Universiteit Leuven (Belgium)
- Alexei Iliasov, University of Newcastle upon Tyne (UK)
- Manuel Kolp, ISYS – University of Louvain (Belgium)
- Viviana Mascardi, Università degli Studi di Genova (Italy)
- Haralambos Mouratidis, University of East London (UK)
- Andrea Omicini, Università di Bologna (Italy)
- Juan Pavón, Universidad Complutense de Madrid (Spain)
- Omer Rana, Cardiff University (UK)
- Gustavo Rossi, Universidad Nacional de La Plata (Argentina)
- Ichiro Satoh, National Institute of Informatics (Japan)
- John Shepherdson, British Telecommunications plc (UK)
- Anand Tripathi, University of Minnesota (USA)
- Danny Weyns, Katholieke Universiteit Leuven (Belgium)
- Michael Winikoff, RMIT University (Australia)

5. WORKSHOP PROGRAM

The research track received 21 submissions from all around the world. From this set, 14 papers were selected for presentation in the workshop. Each paper was reviewed by at least three members of the program committee; the final selection was made by the workshop organizers based on the evaluation forms. The papers were chosen because they offered different or novel perspectives on the workshop topics and because they had a high potential for generating issues that would stimulate the discussions.

5.1 Technical Sessions

The workshop will include five technical sessions of presentations and discussions. The sessions are directly related to dependability issues for MAS. Each session was organized according to common themes in the position papers. The sessions are:

Fault tolerance. In MAS, every software agent assumes the responsibility to provide some functionality, making the system more complex. The cost and the consequences of a MAS failing can be catastrophic. Fault tolerance techniques are employed during the system development to enable software to tolerate faults remaining in the system after its deployment; and they encompass a set of activities whose goal is to remove errors and their effects from the computational state before a failure occurs. Error detection is part of the fault tolerance process and it refers to

the mechanisms that identify an invalid or erroneous system state. The papers dealing with fault tolerance are:

1. *Applying Feedback Control in Adaptive Replication Mechanisms in Fault Tolerant Multi-Agent Organizations*, by Sebnem Bora and Oguz Dikenelli.

2. *DimaX: A Fault-Tolerant Multi-Agent Platform*, by Nora Faci, Zahia Guessoum and Olivier Marin.

3. *On Fault Tolerance in Law-Governed Multi-Agent Systems*, by Maíra Gatti, Carlos Lucena and Jean-Pierre Briot.

Exception handling. In MAS, the relationships between agents are not always fully understood early in the development life cycle. Thus it is very difficult to specify all the possible events that may take place in the system. An exception is an event (which occurs during the system execution) that disrupts its expected normal flow. Techniques should guarantee that exceptional events in specific agents will not be propagated to others. Exception handling is the process of managing atypical events that occur during the system execution and it is critical in automated processes. The papers dealing with exception handling are:

1. *On Using the CAMA Framework for Developing Open Mobile Fault Tolerant Agent Systems*, by Budi Arief, Alexei Iliasov and Alexander Romanovsky.

2. *Context-Aware Exception Handling in Mobile Agent Systems: The MoCA Case*, by Karla Damasceno, Nelio Cacho, Alessandro Garcia, Alexander Romanosky and Carlos Lucena.

3. *Challenges in Exception Handling in Multi-Agent Systems*, by Eric Platon, Nicolas Sabouret and Shinichi Honiden.

Self-organization and security. The essence of self-organization is that the agent system structure often appears without explicit involvement from outside the system. The agent organization is internal to the system, resulting from the interactions among the agents, and it evolves in time. Self-organization gives a system the ability to evolve in such a way as to approach a critical point. This critical point may present several security weaknesses. Thus self-organization and security in MAS are two concerns that are related. The papers dealing with self-organization and security are:

1. *Building Reliable Systems based on Self-Organizing Multi-Agent Systems*, by Florian Klein and Matthias Tichy.

2. *An Aspect-Oriented Approach for Modeling Self-Organizing Emergent Structures*, by Linda Seiter, Daniel Palmer and Marc Kirschenbaum.

3. *A Secure Modular Mobile Agent System*, by Adam Pridgen and Christine Julien.

Validation and verification. Validation and verification is the confirmation and the provision of evidence that the system will execute according to its specifications, i.e. to the user needs and intended uses. Software verification and validation are difficult because a developer cannot test forever, and it is hard to know how much evidence is enough. A conclusion that a system is validated is highly dependent upon comprehensive software testing, inspections, and other verification tasks. In the specific case of MAS, heterogeneous agents may enter or leave at all times the system. Heterogeneity means that software agents are possibly developed by different parties with different purposes and preferences. Thus regulations over the agents are necessary so that the system remain validated, keeping a desired trust level. The papers dealing with validation and verification are:

1. *Refinement Operators to Facilitate the Reuse of Interaction Laws in Open Multi-Agent Systems*, by Gustavo Carvalho, Carlos Lucena, Rodrigo Paes and Jean-Pierre Briot.

2. *Unit Testing in Multi-agent Systems using Mock Agents and Aspects*, by Roberta Coelho, Uira Kulesza, Arndt Staa and Carlos Lucena.

3. *Reasoning about Willingness in Networks of Agents*, by Stephane Dehousse, Stephane Faulkner, Haralambos Mouratidis, Manuel Kolp and Paolo Giorgini.

Early-development phases. Producing accurate and complete requirements for MAS by eliciting, specifying, analyzing, and validating requirements early, reduces costly rework later in the development lifecycle and ensures quality by tracing requirements though implementation to testing. Dependability issues should be considered right from the beginning of the system development so that dependability requirements can be effectively implemented and verified in MAS. The papers dealing with dependable MAS early-development phases are:

1. *Engineering Degrees of Agency*, by Steven Fonseca.

2. *Improving the Architectural Detailed Design of Multi-Agent Systems: The Tropos Case*, by Carla Silva, Jaelson Castro, Patrícia Tedesco, João Araújo, Ana Moreira and John Mylopoulos.

5.2 Other Sessions

To foster more lively debate among the participants, the workshop program will include keynote presentations (yet to be confirmed), panels and discussion groups. The keynotes will present reports on experiences and on innovative research on dependability issues for MAS. Panelists will answer questions from the audience and promote a debate with the participants.

However, the workshop success will depend on your participation in the discussion groups. This session is entirely devoted to bring together researchers and practitioners to discuss the current state of the practice and the future research directions in software engineering for large-scale dependable MAS. We hope workshop participants improve the discussions increasing the quality of the session results.

6. CONCLUSIONS

The particular focus of this fifth meeting is on the role of dependability in MAS. Altogether, we believe the workshop will be a success due to the quality of the submitted papers and the level of the expected participants. We believe SELMAS 2006 achieved its goal in the sense it provides a forum for interactive discussions on the research issues of software engineering for dependable MAS.

Given the level of the contributions, we are confident that the workshop program will be relevant to the multi-agent software engineering community, providing original and heterogeneous perspectives on such an interdisciplinary topic as well as several

attempts to pull everything together. It is our hope that SELMAS 2006 provides the agent community with a forum where novel ideas and results can be shared by crossing the boundaries of the many research and application areas that meet in the agent field.

Finally, a high-quality set of the workshop papers and some invited papers is going to appear in a fifth edition of the Software Engineering for Large-Scale Multi-Agent Systems LNCS volume (Springer). We also look forward for the community to planning a sixth SELMAS edition for next year at ICSE 2007.

7. ACKNOWLEDGEMENTS

We extend once more our words of gratitude to all who contributed to making SELMAS 2006 a reality and we wish those present at the workshop a pleasant and stimulating experience. We hope that all of us (planners and participants) will feel that we all contributed in some way to helping improve the research and the practice on software engineering for multi-agent systems in our society.

For further details, please visit our website:

http://www.teccomm.les.inf.puc-rio.br/selmas2006/