

# Lecture Notes in Artificial Intelligence

1286

Subseries of Lecture Notes in Computer Science

Edited by J. G. Carbonell and J. Siekmann

## Lecture Notes in Computer Science

Edited by G. Goos, J. Hartmanis and J. van Leeuwen

Chengqi Zhang Dickson Lukose (Eds.)

# Multi-Agent Systems

## Methodologies and Applications

Second Australian Workshop  
on Distributed Artificial Intelligence  
Cairns, QLD, Australia, August 27, 1996  
Selected Papers



Springer

Series Editors

Jaime G. Carbonell, Carnegie Mellon University, Pittsburgh, PA, USA  
Jörg Siekmann, University of Saarland, Saarbrücken, Germany

Volume Editors

Chengqi Zhang  
Dickson Lukose  
School of Mathematical and Computer Sciences  
University of New England  
Armidale, NSW 2351, Australia  
E-mail: chengqi@neumann.une.edu.au  
lukose@peirce.une.edu.au

Cataloging-in-Publication Data applied for

**Die Deutsche Bibliothek - CIP-Einheitsaufnahme**

**Multi-agent systems : methodologies and applications ; selected papers / Second Australian Workshop on Distributed Artificial Intelligence, Cairns, QLD, Australia, August 27, 1996. Chengqi Zhang ; Dickson Lukose (ed.). - Berlin ; Heidelberg ; New York ; Barcelona ; Budapest ; Hong Kong ; London ; Milan ; Paris ; Santa Clara ; Singapore ; Tokyo : Springer, 1997**  
(Lecture notes in computer science ; Vol. 1286 : Lecture notes in artificial intelligence)  
ISBN 3-540-63412-6

CR Subject Classification (1991): I.2.11, C.2.4, I.2, D.1.3

ISBN 3-540-63412-6 Springer-Verlag Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer-Verlag. Violations are liable for prosecution under the German Copyright Law.

© Springer-Verlag Berlin Heidelberg 1997  
Printed in Germany

Typesetting: Camera ready by author  
SPIN 10547680 06/3142 - 5 4 3 2 1 0 Printed on acid-free paper

## Preface

This volume of lecture notes contains revised versions of all accepted papers presented at the Second Australian Workshop on Distributed Artificial Intelligence (DAI'96), together with a set of invited papers. The workshop was held in Cairns, Queensland, Australia on August 27, 1996. The goal of the workshop was to promote research in distributed artificial intelligence, both nationally and internationally. The workshop covers a wide range of issues in the field of distributed artificial intelligence, such as methodology, cooperation, conflict resolution, and application.

Many people have contributed to the success of this workshop. We would like to thank all the authors who submitted papers to this workshop. Many thanks also to the members of the programme committee who diligently reviewed all the papers submitted for this workshop. Special thanks to our invited speaker Professor Jörg H. Siekmann from Universität des Saarlandes, German Research Center for AI (DFKI), Germany. Finally, we thank the editorial staff of Springer-Verlag for publishing this contribution to the Lecture Notes in Artificial Intelligence series.

August 1996

Chengqi Zhang and Dickson Lukose

## Programme Committee

Dr Chengqi Zhang ( Co-Chair)  
 School of Mathematical  
 and Computer Sciences  
 University of New England  
 Armidale, NSW 2351  
 AUSTRALIA  
 Email: chengqi@neumann.une.edu.au

Dr Dickson Lukose ( Co-Chair)  
 School of Mathematical  
 and Computer Sciences  
 University of New England  
 Armidale, NSW 2351  
 AUSTRALIA  
 Email: lukose@peirce.une.edu.au

Professor Victor Lesser  
 Department of Computer Science  
 University of Massachusetts  
 Amherst, MA01003  
 U.S.A.  
 Email: lesser@cs.umass.edu

Dr Mark d'Inverno  
 School of Computer Science  
 University of Westminster  
 London, W1M 8JS  
 U.K.  
 Email: dinverm@westminster.ac.uk

Dr Toshiharu Sugawara  
 NTT Basic Research Labs  
 3-1 Wakamiya, Morinosato  
 Atsugi, Kanagawa 243-01  
 JAPAN  
 Email: sugawara@square.ntt.jp

Dr Jeffrey S. Rosenschein  
 Department of Computer Science  
 Hebrew University  
 Jerusalem  
 ISRAEL  
 Email: jeff@cs.huji.ac.il

Dr Nicholas Jennings  
 Department of Electronic Engineering  
 Queen Mary & Westfield College  
 University of London  
 Mile End Road, London E1 4NS  
 U.K.  
 Email: N.R.Jennings@qmw.ac.uk

Dr Keith S. Decker  
 Department of Computer and  
 Information Sciences  
 University of Delaware  
 Newark, DE 19716  
 U.S.A.  
 Email: decker@cis.udel.edu

Dr Norbert Glaser  
 CRIN-INRIA Lorraine  
 615, rue jardin Botanique, BP 101  
 F-54602 Villers-les-Nancy Cedex  
 FRANCE  
 Email: Norbert.Glaser@loria.fr

Dr Rose Dieng  
 ACACIA Project, INRIA  
 2004 Route des Lucioles, BP 93  
 06902 Sophia-antipolis Cedex  
 FRANCE  
 Email: dieng@sophia.inria.fr

## Table of Contents

The CoMoMAS Methodology and Environment for Multi-Agent System Development .....	1
<i>Norbert Glaser</i>	
Design Patterns for the Development of Multi-Agent Systems .....	17
<i>Elizabeth A. Kendall and Margaret T. Malkoun</i>	
Modelling Extendible Mobile Agents .....	32
<i>Dickson Lukose</i>	
Making and Breaking Engagements: An Operational Analysis of Agent Relationships .....	48
<i>Mark d’Inverno and Michael Luck</i>	
Cloning for Intelligent Adaptive Information Agents .....	63
<i>Keith Decker, Katia Sycara, and Mike Williamson</i>	
ACACIA: An Agency Based Collaboration Framework for Heterogeneous Multi-Agent Systems .....	76
<i>Wilfred C. Jamison</i>	
A Multi-Agent Cooperative Reasoning System for Amalgamated Knowledge Bases .....	92
<i>Lifeng He, Yuyan Chao, Shohey Kato, Tetsuo Araki, Hirohisa Seki, and Hidenori Itoh</i>	
Detecting Conflicts in Multi-Agent Systems .....	106
<i>Love Ekenberg</i>	
Persuasion as a Form of Inter-Agent Negotiation .....	120
<i>Chris Reed, Derek Long, Maria Fox, and Max Garagnani</i>	
Methodologies of Solution Synthesis in Distributed Expert Systems .....	137
<i>Minjie Zhang and Chengqi Zhang</i>	
Implementing an Automated Reasoning System for Multi-Agent Knowledge and Time .....	152
<i>Lifeng He, Yuyan Chao, Shohey Kato, Tetsuo Araki, Hirohisa Seki, and Hidenori Itoh</i>	

Application of MAS in Implementing Rational IP Routers on the Priced Internet .....	166
<i>Hongxia Yang and Chengqi Zhang</i>	
A Sentinel Approach to Fault Handling in Multi-Agent Systems .....	181
<i>Staffan Hägg</i>	