

Lecture Notes in Artificial Intelligence 2661

Edited by J. G. Carbonell and J. Siekmann

Subseries of Lecture Notes in Computer Science

Springer

Berlin

Heidelberg

New York

Hong Kong

London

Milan

Paris

Tokyo

Pier Luca Lanzi Wolfgang Stolzmann
Stewart W. Wilson (Eds.)

Learning Classifier Systems

5th International Workshop, IWLCS 2002
Granada, Spain, September 7-8, 2002
Revised Papers



Springer

Series Editors

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

Volume Editors

Pier Luca Lanzi
Politecnico di Milano
Dipartimento di Elettronica e Informazione
Artificial Intelligence and Robotics Laboratory
Piazza Leonardo da Vinci 32, 20133 Milano, Italy
E-mail: lanzi@elet.polimi.it

Wolfgang Stolzmann
Universität Würzburg
Institut für Psychologie III
Röntgenring 11, 97070 Würzburg, Germany
E-mail: stolzmann@psychologie.uni-wuerzburg.de

Stewart W. Wilson
Prediction Dynamics, Concord MA 01742, USA
and
The University of Illinois
Department of General Engineering
Urbana-Champaign IL 61801, USA
E-mail: wilson@prediction-dynamics.com

Cataloging-in-Publication Data applied for

A catalog record for this book is available from the Library of Congress.

Bibliographic information published by Die Deutsche Bibliothek
Die Deutsche Bibliothek lists this publication in the Deutsche Nationalbibliografie;
detailed bibliographic data is available in the Internet at <<http://dnb.ddb.de>>.

CR Subject Classification (1998): I.2, F.4.1, F.1.1, H.2.8

ISSN 0302-9743

ISBN 3-540-20544-6 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 is a part of Springer Science+Business Media
springeronline.com

© Springer-Verlag Berlin Heidelberg 2003
Printed in Germany

Typesetting: Camera-ready by author, data conversion by Olgun Computergrafik
Printed on acid-free paper SPIN: 10969229 06/3142 5 4 3 2 1 0

Preface

The 5th International Workshop on Learning Classifier Systems (IWLCS 2002) was held September 7–8, 2002, in Granada, Spain, during the 7th International Conference on Parallel Problem Solving from Nature (PPSN VII). We have included in this volume revised and extended versions of the papers presented at the workshop.

In the first paper, Browne introduces a new model of learning classifier system, iLCS, and tests it on the Wisconsin Breast Cancer classification problem. Dixon et al. present an algorithm for reducing the solutions evolved by the classifier system XCS, so as to produce a small set of readily understandable rules. Enee and Barbaroux take a close look at Pittsburgh-style classifier systems, focusing on the multi-agent problem known as *El-farol*. Holmes and Bilker investigate the effect that various types of missing data have on the classification performance of learning classifier systems. The two papers by Kovacs deal with an important theoretical issue in learning classifier systems: the use of accuracy-based fitness as opposed to the more traditional strength-based fitness. In the first paper, Kovacs introduces a strength-based version of XCS, called SB-XCS. The original XCS and the new SB-XCS are compared in the second paper, where Kovacs discusses the different classes of solutions that XCS and SB-XCS tend to evolve. Landau et al. compare two approaches aimed at solving non-Markov problems, i.e., the new ATNoSFERES and the extension of XCS with internal memory, XCSM. Llorà et al. introduce a novel model of Pittsburgh-style classifier system in which multiobjective optimization is used to develop solutions that are both accurate and compact. Metivier and Lattaud apply an Anticipatory Classifier System (ACS) enriched with behavioral sequences to tackle non-Markov problems. Vargas et al. discuss the similarities and the differences of Artificial Immune Systems and Learning Classifier Systems, and they show how a mapping between these two approaches can be defined. The volume ends with a complete bibliography of papers related to learning classifier system research, based on Kovacs' on-line bibliography.

This book is the ideal continuation of the three volumes from the previous workshops, published by Springer-Verlag as LNAI 1813, LNAI 1996, and LNAI 2321. We hope it will be a useful support for researchers interested in learning classifier systems and will provide insights into the most relevant topics and the most interesting open issues.

June 2003

Pier Luca Lanzi
Wolfgang Stolzmann
Stewart W. Wilson

Organization

The 5th International Workshop on Learning Classifier Systems (IWLCS 2002) was held September 7–8, 2002 in Granada, Spain, during the 7th International Conference on Parallel Problem Solving from Nature (PPSN VII).

Organizing Committee

Pier Luca Lanzi	Politecnico di Milano, Italy
Wolfgang Stolzmann	DaimlerChrysler AG, Germany
Stewart W. Wilson	University of Illinois at Urbana-Champaign, USA Prediction Dynamics, USA

Program Committee

Alwyn Barry	University of Bath, UK
Erik Baum	NEC Research Institute, USA
Larry Bull	University of the West of England, UK
Lashon B. Booker	MITRE Corporation, USA
Martin V. Butz	University of Würzburg, Germany
Lawrence Davis	NuTech Solutions, USA
Terry Fogarty	Southbank University, UK
John H. Holmes	University of Pennsylvania, USA
Tim Kovacs	University of Birmingham, UK
Pier Luca Lanzi	Politecnico di Milano, Italy
Rick L. Riolo	University of Michigan, USA
Sonia Schulenburg	Napier University, UK
Olivier Sigaud	AnimatLab-LIP6, France
Robert E. Smith	University of The West of England, UK
Wolfgang Stolzmann	DaimlerChrysler AG, Germany
Keiki Takadama	ATR International, Japan
Stewart W. Wilson	University of Illinois at Urbana-Champaign, USA Prediction Dynamics, USA

Table of Contents

Balancing Specificity and Generality in a Panmictic-Based Rule-Discovery Learning Classifier System	1
<i>William N.L. Browne</i>	
A Ruleset Reduction Algorithm for the XCS Learning Classifier System	20
<i>Phillip William Dixon, Dawid Wolfe Corne, and Martin John Oates</i>	
Adapted Pittsburgh-Style Classifier-System: Case-Study	30
<i>Gilles Enée and Pierre Barbaroux</i>	
The Effect of Missing Data on Learning Classifier System Learning Rate and Classification Performance	46
<i>John H. Holmes and Warren B. Bilker</i>	
XCS's Strength-Based Twin: Part I	61
<i>Tim Kovacs</i>	
XCS's Strength-Based Twin: Part II	81
<i>Tim Kovacs</i>	
Further Comparison between ATNoSFERES and XCSM	99
<i>Samuel Landau, Sébastien Picault, Olivier Sigaud, and Pierre Gérard</i>	
Accuracy, Parsimony, and Generality in Evolutionary Learning Systems via Multiobjective Selection	118
<i>Xavier Llorà, David E. Goldberg, Ivan Traus, and Ester Bernadó</i>	
Anticipatory Classifier System Using Behavioral Sequences in Non-Markov Environments	143
<i>Marc Métivier and Claude Lattaud</i>	
Mapping Artificial Immune Systems into Learning Classifier Systems	163
<i>Patrícia A. Vargas, Leandro N. de Castro, and Fernando J. Von Zuben</i>	
The 2003 Learning Classifier Systems Bibliography	187
<i>Tim Kovacs</i>	
Author Index	231