

# An Indexed Bibliography of Learning Classifier Systems

compiled by

**Jarmo T. Alander**

*Dedicated to Pier Luca Lanzi*

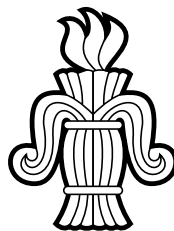
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DRAFT September 29, 1999

available via anonymous ftp: site [ftp.uwasa.fi](ftp://ftp.uwasa.fi) directory `cs/report94-1` file `gaLCSbib.ps.Z`

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## **Warning**

While this bibliography has been compiled with the utmost care, the editor takes no responsibility for any errors, missing information, the contents or quality of the references, nor for the usefulness and/or the consequences of their application. The fact that a reference is included in this publication does not imply a recommendation. The use of any of the methods in the references is entirely at the user's own responsibility. Especially the above warning applies to those references that are marked by trailing '†' (or '\*'), which are the ones that the editor has unfortunately not had the opportunity to read. An abstract was available of the references marked with '\*'.

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# Chapter 1

## Preface

“Living organism are consummate problem solvers.  
They exhibit a versatility that puts the best computer  
programs to shame.”

*John H. Holland* [1]

The material of this bibliography has been extracted from the genetic algorithm bibliography [2], which when this report was compiled (September 29, 1999) contained 11449 items and which has been collected from several sources of genetic algorithm literature including Usenet newsgroup `comp.ai.genetic` and the bibliographies [3, 4, 5, 6]. The following index periodicals have been used systematically

- A: *International Aerospace Abstracts*: Jan. 1995 – Sep. 1998
- ACM: *ACM Guide to Computing Literature*: 1979 – 1993/4
- BA: *Biological Abstracts*: July 1996 - Aug. 1998
- CA: *Computer Abstracts*: Jan. 1993 – Feb. 1995
- CCA: *Computer & Control Abstracts*: Jan. 1992 – Apr. 1998 (except May -95)
- ChA: *Chemical Abstracts*: Jan. 1997 - Dec. 1998
- CTI: *Current Technology Index* Jan./Feb. 1993 – Jan./Feb. 1994
- DAI: *Dissertation Abstracts International*: Vol. 53 No. 1 – Vol. 56 No. 10 (Apr. 1996)
- EEA: *Electrical & Electronics Abstracts*: Jan. 1991 – Apr. 1998
- EI A: *The Engineering Index Annual*: 1987 – 1992
- EI M: *The Engineering Index Monthly*: Jan. 1993 – Apr. 1998 (except May 1997)
- N: *Scientific and Technical Aerospace Reports*: Jan. 1993 - Dec. 1995 (except Oct. 1995)
- P: *Index to Scientific & Technical Proceedings*: Jan. 1986 – May 1998 (except Nov. 1994)
- PA: *Physics Abstracts*: Jan. 1997 – Sep. 1998

### 1.1 Your contributions erroneous or missing?

The bibliography database is updated on a regular basis and certainly contains many errors and inconsistencies. The editor would be glad to hear from any reader who notices any errors, missing information, articles etc. In the future a more complete version of this bibliography will be prepared for the learning classifier systems research community and others who are interested in this rapidly growing area of genetic algorithms.

When submitting updates to the database, paper copies of already published contributions are preferred. Paper copies (or ftp ones) are needed mainly for indexing. We are also doing reviews of different aspects and applications of GAs where we need as complete as possible collection of GA papers. Please, do not forget to include complete bibliographical information: copy also proceedings volume title pages, journal table of contents pages, etc. Observe that there exists several versions of each subbibliography, therefore **the reference numbers are not unique and should not be used alone in communication**, use the key appearing as the last item of the reference entry instead.

Complete bibliographical information is really helpful for those who want to find your contribution in their libraries. If your paper was worth writing and publishing it is certainly worth to be referenced right in a bibliographical database read daily by GA researchers, both newcomers and established ones.

For further instructions and information see `ftp.uwasa.fi/cs/GAbib/README`.

### 1.1.1 How to cite this report?

The complete BiBTeX record for this report is shown below:

```
@TECHREPORT{gaLCSbib,
  KEY = "LCS",
  ANNOTE = "*on,*FIN,bibliography /special",
  AUTHOR = "Jarmo T. Alander",
  TITLE = "Indexed Bibliography of Learning Classifier Systems",
  INSTITUTION = "University of Vaasa, Department of Information Technology and Production Economics",
  TYPE = "Report",
  NUMBER = "94-1-LCS",
  NOTE = "(\ftp{ftp.uwasa.fi}{cs/report94-1}{gaLCSbib.ps.Z})",
  YEAR = 1995
}
```

You can also use the BiBTeX file `GASUB.bib`, which is available in our ftp site `ftp.uwasa.fi` in directory `cs/report94-1` and contains records for all GA subbibliographies.

## 1.2 How to get this report via Internet?

Versions of this bibliography are available via anonymous ftp and www from the following sites:

<i>media</i>	<i>country</i>	<i>site</i>	<i>directory</i>	<i>file</i>
ftp	Finland	<code>ftp.uwasa.fi</code>	<code>/cs/report94-1</code>	<code>gaLCSbib.ps.Z</code>
www	Finland	<code>http://www.cs.hut.fi</code>	<code>~ja/gaLCSbib</code>	<code>gaLCSbib.html</code>

Observe that these versions may be somewhat different and perhaps reduced as compared to this volume that you are now reading. Due to technical problems in transforming L<sup>A</sup>T<sub>E</sub>X documents into html ones the www versions contain usually less information than the corresponding ftp ones. It is also possible that the www version is completely unreachable.

The directory also contains some other indexed GA bibliographies shown in table 1.1. In case you do not find a proper one please let us know: it may be easy to tailor a new one.

## 1.3 Acknowledgement

The editor wants to acknowledge all who have kindly supplied references, papers and other information on learning classifier systems literature. At least the following GA researchers have already kindly supplied their complete autobiographies and/or proofread references to their papers: Dan Adler, Patrick Argos, Jarmo T. Alander, James E. Baker, Wolfgang Banzhaf, Helio J. C. Barbosa, Hans-Georg Beyer, Christian Bierwirth, Joachim Born, Ralf Bruns, I. L. Bukatova, Thomas Bäck, David E. Clark, Carlos A. Coello Coello, Yuval Davidor, Dipankar Dasgupta, Marco Dorigo, J. Wayland Eheart, Bogdan Filipič, Terence C. Fogarty, David B. Fogel, Toshio Fukuda, Hugo de Garis, Robert C. Glen, David E. Goldberg, Martina Gorges-Schleuter, Hitoshi Hemmi, Vasant Honavar, Jeffrey Horn, Aristides T. Hatjimihail, Mark

<i>file</i>	<i>contents</i>
ga90bib.ps.Z	GA in 1990
ga91bib.ps.Z	GA in 1991
ga92bib.ps.Z	GA in 1992
ga93bib.ps.Z	GA in 1993
ga94bib.ps.Z	GA in 1994
ga95bib.ps.Z	GA in 1995
ga96bib.ps.Z	GA in 1996
ga97bib.ps.Z	GA in 1997
ga98bib.ps.Z	GA in 1998
gaAIbib.ps.Z	GA in artificial intelligence
gaALIFEBib.ps.Z	GA in artificial life
gaARTbib.ps.Z	GA in art and music
gaAUSbib.ps.Z	GA in Australia
gaBASICSbib.ps.Z	Basics of GA
gaBIObib.ps.Z	GA in biosciences including medicine
gaCADbib.ps.Z	GA in Computer Aided Design
gaCHEMPHYSbib.ps.Z	GA in chemistry and physics
gaCONTROLbib.ps.Z	GA in control
gaCSbib.ps.Z	GA in computer science (incl. databases and GP)
gaDBbib.ps.Z	GA in databases
gaECObib.ps.Z	GA in economics and finance
gaENGBib.ps.Z	GA in engineering
gaESbib.ps.Z	Evolution strategies
gaFAR-EASTbib.ps.Z	GA in the Far East (Japan etc)
gaFRAbib.ps.Z	GA in France
gaFTPBib.ps.Z	GA papers available via ftp
gaFUZZYbib.ps.Z	GA and fuzzy logic
gaGERbib.ps.Z	GA in Germany
gaGPbib.ps.Z	genetic programming
gaIMPLEbib.ps.Z	implementations of GA
gaISbib.ps.Z	immune systems
gaJOURNALbib.ps.Z	journal articles
gaLATINbib.ps.Z	GA in Latin America, Portugal & Spain
gaLOGISTICSbib.ps.Z	GA in logistics
gaMANUbib.ps.Z	GA in manufacturing
gaMEDITERbib.ps.Z	GA in the Mediterranean
gaNNbib.ps.Z	GA in neural networks
gaNORDICbib.ps.Z	GA in Nordic countries
gaOPTIMIBib.ps.Z	GA and optimization (only a few refs)
gaOPTICSbib.ps.Z	GA in optics and image processing
gaORBib.ps.Z	GA in operations research
gaPARAbib.ps.Z	Parallel and distributed GA
gaPOWERbib.ps.Z	GA in power engineering
gaPROTEINbib.ps.Z	GA in protein research
gaROBOTbib.ps.Z	GA in robotics
gaSAbib.ps.Z	GA and simulated annealing
gaSIGNAlbib.ps.Z	GA in signal and image processing
gaTHEORYbib.ps.Z	Theory and analysis of GA
gaTOP10bib.ps.Z	Authors having at least 10 GA papers
gaUKbib.ps.Z	GA in United Kingdom
gaVLSIbib.ps.Z	GA in VLSI design and testing

Table 1.1: Indexed GA subbibliographies in directory <ftp.uwasa.fi/cs/report94-1>.

J. Jakiela, Richard S. Judson, Bryant A. Julstrom, Charles L. Karr, Akihiko Konagaya, Aaron Konstam, John R. Koza, Kristinn Kristinsson, D. P. Kwok, Gregory Levitin, Carlos B. Lucasius, Michael de la Maza, John R. McDonnell, J. J. Merelo, Laurence D. Merkle, Zbigniew Michalewics, Melanie Mitchell, David J. Nettleton, Volker Nissen, Ari Nissinen, Tomasz Ostrowski, Kihong Park, Nicholas J. Radcliffe, Colin R. Reeves, Gordon Roberts, David Rogers, Ivan Santibáñez-Koref, Marc Schoenauer, Markus Schwehm, Hans-Paul Schwefel, Michael T. Semertzidis, Moshe Sipper, William M. Spears, Donald S. Szarkowicz, El-Ghazali Talbi, Masahiro Tanaka, Leigh Tesfatsion, Peter M. Todd, Marco Tomassini, Andrew L. Tuson, Jari Vaario, Gilles Venturini, Hans-Michael Voigt, Roger L. Wainwright, D. Eric Walters, James F. Whidborne, Steward W. Wilson, Xin Yao, and Xiaodong Yin.

The editor also wants to acknowledge Elizabeth Heap-Talvela for her kind proofreading of the manuscript of this bibliography.

# Chapter 2

## Introduction

The table 2.1 gives the queries that have been used to extract this bibliography. The query system as well as the indexing tools used to compile this report from the BiBTeX-database [7] have been implemented by the author mainly as sets of simple `awk` and `gawk` programs [8, 9].

<i>string</i>	<i>field</i>	<i>class</i>
<code>classifier system</code>	<code>ANNOTE</code>	Classifier systems
<code>bucket brigade</code>	<code>ANNOTE</code>	Classifier systems

Table 2.1: Queries used to extract this subbibliography from the source database.



# Chapter 3

## Statistical summaries

This chapter gives some general statistical summaries of learning classifier systems literature. More detailed indexes can be found in the next chapter.

References to each class (c.f table 2.1) are listed below:

- **Classifier systems** 172 references ([10]-[181])

Observe that each reference is included (by the computer) only to one of the above classes (see the queries for classification in table 2.1; query order gives priority for classes).

### 3.1 Publication type

This bibliography contains published contributions including reports and patents. All unpublished manuscripts have been omitted unless accepted for publication. In addition theses, PhD, MSc etc., are also included whether or not published somewhere.

Table 3.1 gives the distribution of publication type of the whole bibliography. Observe that the number of journal articles may also include articles published or to be published in unknown forums.

<i>type</i>	<i>number of items</i>
book	1
section of a book	2
part of a collection	5
journal article	35
proceedings article	110
report	11
PhD thesis	6
MSc thesis	1
<i>others</i>	1
<i>total</i>	172

Table 3.1: Distribution of publication type.

### 3.2 Annual distribution

Table 3.2 gives the number of learning classifier systems papers published annually. The annual distribution is also shown in fig. 3.1. The average annual growth of GA papers has been approximately 40 % during almost the last twenty years.

<i>year</i>	<i>items</i>	<i>year</i>	<i>items</i>
1981	1	1982	0
1983	0	1984	1
1985	4	1986	4
1987	7	1988	10
1989	17	1990	10
1991	20	1992	13
1993	14	1994	30
1995	17	1996	14
1997	7	1998	3
<i>total</i>			172

Table 3.2: Annual distribution of contributions.

### 3.3 Classification

Every bibliography item has been given at least one describing keyword or classification by the editor of this bibliography. Keywords occurring most are shown in table 3.3.

classifier systems	158
machine learning	16
others	317

Table 3.3: The most popular subjects.

### 3.4 Authors

Table 3.4 gives the most productive authors.

total number of authors	166
Goldberg, David E.	11
Fogarty, Terence C.	10
2 authors	9
2 authors	8
2 authors	7
2 authors	6
1 author	5
5 authors	4
16 authors	3
20 authors	2
113 authors	1

Table 3.4: The most productive learning classifier systems authors.

### 3.5 Geographical distribution

The following table gives the geographical distribution of authors, when the country of the author was known. Over 80% of the references of the source database are classified by country.

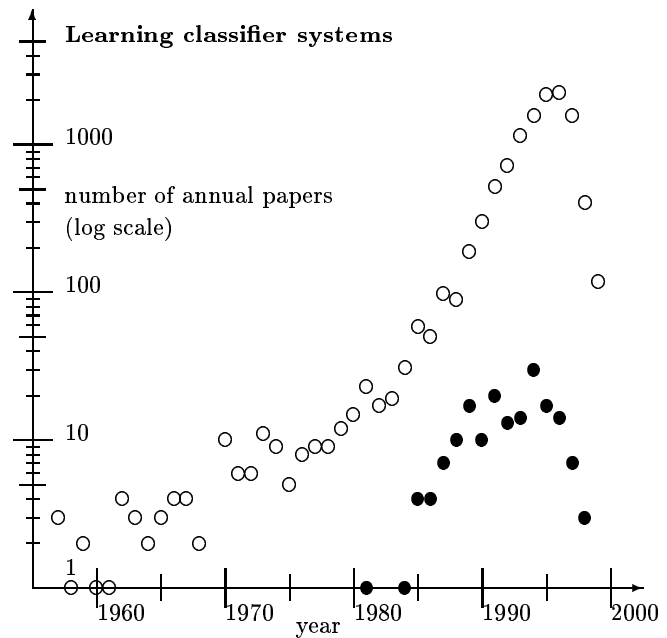


Figure 3.1: The number of papers applying **learning classifier systems** (•) ◦ = total GA papers. Observe that the last two years are most incomplete in the database.

<i>country</i>	<i>abs</i>	<i>%</i>
<i>Total</i>	172	100.00
United States	80	46.51
United Kingdom	22	12.79
Unknown country	21	12.21
Japan	13	7.56
France	8	4.65
Italy	6	3.49
Germany (incl. DDR)	4	2.33
Canada	3	1.74
Austria	2	1.16
Belgium	2	1.16
The Netherlands	2	1.16
Cyprus	1	0.58
Denmark	1	0.58
Greece	1	0.58
India	1	0.58
Poland	1	0.58
Romania	1	0.58
Spain	1	0.58

Table 3.5: The geographical distribution of the authors. Observe that joint papers may have authors from several countries. This decreases the unknown country count (= all - known countries).

### **3.6 Conclusions and future**

The editor believes that this bibliography contains references to most learning classifier systems contributions upto and including the year 1998 and the editor hopes that this bibliography could give some help to those who are working or planning to work in this rapidly growing area of genetic algorithms.



# Chapter 4

## Indexes

### 4.1 Books

The following list contains all items classified as books.

Parallelism and Programming in Classifier Systems, [115]

### 4.2 Journal articles

The following list contains the references to every journal article included in this bibliography. The list is arranged in alphabetical order by the name of the journal.

AI Communications, [33]  
AISB Quarterly, [45]  
Analytica Chimica Acta, [84]  
APL Quote Quad, [50, 70]  
Applied Artificial Intelligence, [126]  
Artificial Intelligence, [85, 92]  
Complex Systems, [163]  
Computers & Operations Research, [19]  
Design Theory and Methodology, [149]  
European Journal of Operational Research, [87]  
Evolutionary Computation, [34, 46]  
Expert Systems, [40]  
IEEE Transactions on Systems, Man, and Cybernetics, [30, 106]  
IEICE Transactions on Fundamentals of Electronics Communications and Computer Sciences, [175]  
Intelligent Systems Engineering, [137]  
International Journal of Intelligent Systems, [75, 143]  
Irish Journal of Psychology, [88]  
Jpn. J. Fuzzy Theory Syst. (USA), [49, 71]  
Machine Learning, [58, 91, 102, 111, 118, 157, 158, 161]

Mathematical and Computer Modelling, [171]

Nippon Kikai Gakkai Ronbunshu C Hen, [139]

Pattern Recognition, [17]

total 35 articles in 22 series

### 4.3 Theses

The following two lists contain theses, first PhD theses and then Master's etc. theses, arranged in alphabetical order by the name of the school.

#### 4.3.1 PhD theses

Katholieke Universiteit Nijmegen, [79]

Stanford University, [56]

University of Alabama, [151, 181]

University of Michigan, [117, 155]

total 6 thesis in 4 schools

#### 4.3.2 Master's theses

This list includes also "Diplomarbeit", "Tech. Lic. Theses", etc.

University of Tennessee, [140]

## 4.4 Report series

The following list contains references to all papers published as technical reports. The list is arranged in alphabetical order by the name of the institute.

Aarhus University, [18]

Los Alamos National Laboratory, [112, 113, 116]

Politecnico di Milano, [105]

The Rowland Institute for Science, [159, 160]

University of Illinois at Urbana-Champaign, [39, 124]

University of Michigan, [130, 152]

total 11 reports in 6 institutes

## 4.5 Patents

The following list contains the names of the patents of learning classifier systems. The list is arranged in alphabetical order by the name of the patent.

Method of controlling a classifier system, [134]

## 4.6 Authors

The following list contains all learning classifier systems authors and references to their known contributions.

Andrey, Philippe,	[17]	Fellrath, Paul,	[40]	Kelemen, Arpad,	[53]
Arentoft, Peter Rolann,	[18]	Finnerty, S.,	[26]	Kiernan, L.,	[137]
Aurand, Jean-Philippe,	[22]	Fogarty, Terence C.,	[20, 36, 37, 45, 47, 63, 64, 65, 77, 109]	Kis, Zoltan,	[53]
Aytug, Haldun,	[19]	Forrest, Stephanie,	[110, 111, 112, 113, 114, 115, 116, 117]	Klebus, G. P.,	[57]
Barry, A. M.,	[88]	Frey, P. W.,	[118]	Koehler, Gary J.,	[19]
Belew, Richard K.,	[111]	Furuhashi, Takeshi,	[32, 49, 179]	Levenick, Jim,	[85]
Bersini, Hugues,	[38]	Furuhashi, T.,	[71]	Liepins, Gunar E.,	[141, 142, 143]
Bharadwaj, K. K.,	[75]	Gell-Mann, Murray,	[27, 68]	Lin, Jianhua,	[52]
Blekas, K.,	[87]	Geyer-Schulz, Andreas,	[50]	Maeda, H.,	[49, 71]
Bonelli, Pierre,	[89, 90]	Glesner, Manfred,	[51]	McAulay, Alastair D.,	[30, 144]
Booker, Lashon B.,	[91, 92, 93, 94, 95, 127]	Goldberg, David E.,	[39, 46, 69, 92, 121, 122, 123, 124, 125, 126, 127]	Meyer, Jean-Arcady,	[23]
Browne, W.,	[82]	Goodloe, M.,	[128]	Middleton, L. T.,	[145]
Bull, Lawrence,	[20, 36, 45, 47, 63, 64]	Graves, S. J.,	[128]	Miller, John H.,	[113, 114]
Bullock, J.,	[82]	Halgamuge, Saman K.,	[51]	Mitlöhner, Johann,	[70]
Burks, A. W.,	[134]	Hartmann, Uwe,	[28, 178]	Montanari, D.,	[97, 99, 100]
Buydens, Lutgarde M. C.,	[84]	Hedges, S.,	[29]	Moore, C.,	[82]
Carroll, C. C.,	[122]	Hewahi, N. M.,	[75]	Morikawa, Kojima,	[49, 179]
Carse, Brian,	[21, 37, 41, 44, 45, 63, 65, 77]	Hibbert, D. B.,	[84]	Mulholland, M.,	[84]
Chai, R.,	[172]	Hilliard, M. R.,	[141, 143]	Munro, A.,	[77]
Chalk, K.,	[78]	Holford, K.,	[82]	Murata, Tadahiko,	[59]
Cichosz, P.,	[57]	Holland, John H.,	[92, 130, 11, 131, 132, 133, 134, 135, 136]	Muro, Zen-ichirou,	[33]
Collard, Philippe,	[22, 48, 96]	Holyoak, Keith J.,	[132]	Muruzabal, Jorge,	[60]
Compiani, M.,	[97, 98, 99, 100]	Homaifar, Abdollah,	[122]	Nagasaka, Ichiro,	[80]
Cribbs III, H. Brown,	[66]	Horn, Jeffrey,	[39, 46, 69, 124, 125]	Nakaoka, K.,	[32, 49, 71]
Crowley, Philip H.,	[81]	Huang, Dijia,	[12]	Nakashima, Tomoharu,	[59]
Davis, Lawrence,	[101, 102]	Hunter, A.,	[29]	Neves, J.,	[54]
Deb, Kalyanmoy,	[39, 46, 124, 125]	Imecs, Maria,	[53]	Nikolopoulos, Chris,	[40, 42]
Donnart, Jean-Yves,	[23]	Ishibuchi, Hisao,	[59]	Nisbett, Richard E.,	[132]
Dorigo, Marco,	[38, 58, 10, 103, 104, 105, 106]	Jensen, Kaj Aage,	[18]	Odetayo, Michael O.,	[86]
Dumeur, Renaud,	[107]	Kakazu, Yukinori,	[139]	Oh, Jae Chan,	[30, 144]
Dwormann, Garrett,	[24]	Kampen, Antoine H. C. van,	[79, 84]	Ohuchi, Azuma,	[67]
Endoh, Satoshi,	[67]	Karr, Charles L.,	[138]	Ohwi, J.,	[55]
Escazut, Cathy,	[22, 48]	Kataoka, T.,	[31]	Oliver, Jim R.,	[146]
Fairley, Andrew,	[25, 35, 108]	Kawakami, Hiroshi,	[67]	Ono, Norihiko,	[31, 147, 148]
		Kawakami, Takashi,	[139]	Palmer, Mark R.,	[141]
				Panayides, N.,	[145]
				Parodi, Alexandre,	[89, 90]
				Patel, Mukesh J.,	[170]

Pattichis, C. S.,	[145]	Serra, R.,	[97, 98, 99, 100]	Twardowski, Kirk E.,	[176, 177]
Rahmani, Adel Torkaman,	[31, 147, 148]	Sheppard, Sheri D.,	[73, 72, 149]	Uchikawa, Yoshiki,	[32, 49, 179]
Ramadan, Z.,	[84]	Shu, Lingyan,	[168, 169, 172]	Uchikawa, Y.,	[71]
Rangarajan, G.,	[141]	Simonini, P.,	[98]	Ulyanov, S.V.,	[55]
Richards, Robert A.,	[56, 73, 72, 149]	Skolnick, Michael M.,	[173]	Valastro, G.,	[97]
Riolo, Rick L.,	[13, 14, 152, 153, 154, 155, 157]	Slate, D. J.,	[118]	Valenzuela-Rendón, Manuel,	[150, 180, 181]
Roberts, Gary,	[119]	Smith, George D.,	[78]	Venturini, Gilles,	[74]
Robertson, George G.,	[156, 157, 158]	Smith, Robert Elliot,	[123, 126, 150, 151]	Wang, Lori A.,	[140, 142]
Rusu, Calin,	[53]	Smith, Robert E.,	[66]	Warwick, Kevin,	[137]
Santos, M.,	[54]	Snowdon, Jane L.,	[19]	Weiß, Gerhard,	[43, 120]
Schaeffer, Jonathan,	[167, 168, 169]	Spiessens, Piet,	[174]	Westerdale, Thomas H.,	[15, 16]
Schizas, C. N.,	[145]	Spohn, Bryan G.,	[81]	Westerdale, Thonmas H.,	[83]
Schneider, B. J.,	[138]	Stafylopatis, A.,	[87]	Whinston, Andrew B.,	[175]
Schnepf, Uwe,	[103, 106, 170]	Stanley, Donald A.,	[138]	Wilson, Stewart W.,	[34, 159, 160, 161, 162, 163, 164, 165, 166]
Schrodt, P. A.,	[171]	Tarroux, Philippe,	[17]	Yamafuji, K.,	[55]
Schuurmans, Dale,	[167, 172]	Taura, Toshiharu,	[80]	Yates, Derek F.,	[25, 35, 108]
Sekaran, M.,	[61]	Terano, Takao,	[33]	Young, D. K.,	[101]
Sen, Sandip,	[76]	Thagard, Paul R.,	[132]	Zhou, Hayong (Harry),	[129]
Sen, S.,	[26, 61]	Theodosius, A.,	[145]		
Seredynski, F.,	[57]	Tokinaga, Shozo,	[175]		
		Tufts, Patrick,	[62]		

total 172 articles by 166 different authors

## 4.7 Subject index

All subject keywords of the papers given by the editor of this bibliography are shown next.

agents,	[64, 78]	convergence,	[29]	credit,	[10]
ALECSYS,	[105, 58]	cooperating,	[36]	investment advising,	[40]
analysing GA,	[79]	credit allocation,	[162, 164]	portfolio management,	[175]
Animat problem,	[160, 161]	distributed,	[148, 58]	electrical power systems,	[128]
animats,	[23]	emergency,	[88]	engineering,	[128]
artificial life,	[23]	emergent behaviour,	[111, 114]	communal,	[121]
autonomous agents,	[61, 63]	evolutionary stability,	[35]	mechanical,	[72]
AutonoMouse,	[105, 58]	fuzzy,	[179, 21, 32, 49, 53, 55, 60, 65, 71, 77]	power,	[137]
book review		games,	[24]	structural,	[149]
Holland 1992,	[85]	niching,	[39, 46]	evolution,	[27, 68]
Boolean functions,	[159]	parallel,	[20]	expert systems,	[128, 40]
Boolean multiplexer problem,	[140]	real vectors,	[165]	fault diagnosis,	[137]
bucket brigade,	[11, 15, 13, 14, 12, 16, 99, 10, 108]	review,	[45]	forest fires	
CAD		rules,	[121]	simulated,	[18]
optimization,	[149]	classifiers,	[12, 16, 10, 62, 79]	fuzzy reasoning,	[60]
shape design,	[149, 56, 73]	fuzzy,	[49]	fuzzy sets,	[51]
CFS-C,	[152]	comparison,	[19]	fuzzy systems,	[180, 90, 179, 21]
chemistry		GA better than neural approach,	[87]	classifier,	[32]
analytical,	[84]	neural networks,	[87]	genetic programming,	[62]
structural,	[79]	simulated annealing,	[26, 79]	Hamming weights,	[102]
chromatography,	[84]	comparisons		hierarchies,	[169]
classification,	[26, 59, 76]	classifier,	[38]	human learning modeling,	[154]
classifier system,	[67, 86]	complex systems,	[27, 68]	image processing,	[173]
bucket brigade,	[75]	complexity		quantization,	[52]
classifier systems,	[130, 117, 129, 110, 131, 159, 160, 132, 133, 161, 91, 101, 122, 128, 152, 155, 156, 157, 163, 92, 97, 98, 112, 113, 134, 135, 138, 141, 150, 167, 168, 171, 181, 93, 99, 102, 136, 140, 153, 158, 174, 176, 89, 94, 95, 103, 104, 107, 115, 116, 118, 123, 142, 143, 144, 145, 151, 154, 169, 170, 180, 100, 96, 105, 120, 124, 125, 126, 147, 149, 166, 173, 175, 90, 106, 108, 109, 119, 127, 137, 139, 146, 177, 178, 17, 18, 19, 22, 23, 25, 26, 27, 30, 31, 33, 34, 37, 40, 41, 42, 43, 44, 47, 48, 51, 52, 54, 56, 57, 59, 61, 62, 63, 64, 66, 68, 69, 70, 72, 73, 74, 76, 78, 79, 80, 81, 84, 87]	classifier systems,	[28]	implementation,	[152]
classifier systems		control,	[109]	APL,	[50, 70]
APL,	[50]	classifier systems,	[58]	iterated prisoner's dilemma,	[78]
applications,	[82]	mobile robots,	[18]	knowledge-based systems,	[33]
comparison to Q-learning,	[38]	PID,	[53]	learning,	[178]
		rule based,	[87]	machine learning,	[103, 145, 105, 175, 106, 19, 25, 28, 30, 38, 44, 53, 72, 76, 87]
		controllers		machine learning	
		fuzzy,	[65]	medicine,	[89]
		critics		manufacturing	
		classifier systems,	[83]	simulation,	[19]
		economic modeling,	[70]	steel mill,	[82]
		economics		medicine	

electromyography,	[145]	robotics		dynamic,	[19]
mining		control,	[53, 58]	sequence of classifiers,	[13]
phosphate,	[138]	mobile,	[103, 106, 18,	shape design,	[73]
mobile robots,	[47]	55]		3D,	[72]
neural networks,	[97, 137, 42]	navigation,	[139]	shape generation,	[80]
NEWBOOLE,	[76]	wall-climbing,	[64]	telecommunications	
parallel GA,	[147, 17, 54]	robots		routing,	[77]
patent,	[134]	mobile,	[47]	TIERRA,	[27, 68]
pattern recognition,	[118]	routing		VCS,	[168]
politics,	[171]	distributed,	[77]	vehicles	
popular,	[27, 68]	rule based systems,	[155, 146, 63,	autonomous,	[87]
classifier systems,	[85]	75]		navigation,	[87]
population size,	[156, 158]	fuzzy,	[59, 63]	ZCS,	[34]
review		rule generation,	[86]		
classifier systems,	[172]	rules,	[150]		
		scheduling			

## 4.8 Annual index

The following table gives references to the contributions by the year of publishing.

1981,	[130]	1992,	[96, 105, 120, 124, 125, 126, 147, 149, 165, 166, 173, 175]
1984,	[121]	1993,	[88, 90, 106, 108, 109, 119, 127, 137, 139, 146, 148, 177, 178, 179]
1985,	[117, 129, 11, 15]	1994,	[17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46]
1986,	[110, 131, 159, 160]	1995,	[47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63]
1987,	[132, 133, 13, 14, 161, 162, 172]	1996,	[64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77]
1988,	[91, 101, 111, 122, 128, 152, 155, 156, 157, 163]	1997,	[78, 79, 80, 81, 82, 83, 84]
1989,	[92, 97, 98, 112, 113, 134, 135, 12, 138, 141, 150, 164, 167, 168, 171, 181, 16]	1998,	[85, 86, 87]
1990,	[93, 99, 102, 114, 136, 140, 153, 158, 174, 176]		
1991,	[89, 94, 95, 10, 103, 104, 107, 115, 116, 118, 123, 142, 143, 144, 145, 151, 154, 169, 170, 180]		

## 4.9 Geographical index

The following table gives references to the contributions by country.

- Austria: [50, 70]
- Belgium: [174, 38]
- Canada: [167, 168, 169]
- Cyprus: [145]
- Denmark: [18]
- France: [89, 107, 90, 17, 22, 23, 48, 74]
- Germany (incl. DDR): [170, 120, 178, 51]
- Greece: [87]
- India: [75]
- Italy: [10, 103, 104, 105, 106, 58]
- Japan: [147, 175, 139, 148, 179, 31, 33, 49, 55, 59, 67, 71, 80]
- Poland: [57]
- Romania: [53]
- Spain: [60]
- The Netherlands: [79, 84]
- United Kingdom: [88, 108, 109, 119, 137, 20, 25, 29, 35, 37, 41, 44, 45, 47, 63, 64, 65, 77, 78, 82, 86]
- United States: [130, 121, 117, 129, 11, 110, 131, 159, 160, 132, 133, 13, 14, 161, 162, 91, 101, 111, 122, 128, 152, 155, 163, 92, 112, 113, 134, 135, 138, 141, 150, 164, 181, 93, 102, 114, 136, 140, 153, 176, 94, 95, 115, 116, 123, 142, 143, 151, 154, 180, 124, 125, 126, 165, 166, 173, 127, 146, 177, 19, 24, 27, 30, 32, 36, 39, 40, 42, 46, 52, 56, 61, 62, 66, 68, 69, 72, 76, 85]
- Unknown country: [81, 83]

# Chapter 5

## Permuted title index

The words of the titles of the articles are shown in the next table arranged in alphabetical order. The most common words have been excluded. The key word is shown by a disk (●) in the title field with the exception that it is omitted when appearing as the first word of the title after shown keyword. The other abbreviation used to compress titles are shown in appendix A.

- [165] **abstract** CS mapping of real vectors [extended ●  
[166] – Toward a GA solution of the discovery problem [ex-  
tended ●  
[32] **acquisition** A study on apportionment of credits of  
fuzzy classifier syst. for knowledge ● of large scale syst.  
[176] **ACS** Impl. of GA based associative classifier syst. ●  
[85] **Adaptation** Showing the way: a review of the second  
edition of Holland's ● *in Nat. and Artificial Syst.*  
[23] **adaptive** A hierarchical classifier syst. implementing a  
motivationally autonomous ● animat  
[175] – Applying ● credit assignment alg. for the learning clas-  
sifier syst. based upon the GA  
[77] – Distr. ● routing cntr. in communication networks using  
a temporal fuzzy classifier syst.  
[107] – Extended classifiers for simulation of ● behavior  
[118] – Letter recognition using Holland-style ● classifiers  
[137] ● alarm processor for fault diagnosis on power transmis-  
sion networks  
[52] ● image quantization based on learning classifier syst.  
[126] – Reinforcement learning with classifier syst. : ● default  
hierarchy formation  
[135] – Using classifier syst. to study ● nonlinear networks  
[40] **advising** Hybrid expert syst. for investment ●  
[24] **agents** Games computers play: simulating characteristic  
function game playing ● with classifier syst.  
[137] **alarm** Adaptive ● processor for fault diagnosis on power  
transmission networks  
[105] ALECSYS and the AUTONOUSE: Learning to Cntr. a  
Real Robot by Distr. CSs  
[58] ● and the AUTONOUSE: learning to cntr. a real robot  
by distr. classifier syst.  
[84] **algorithm-based** Learning classification rules from an  
ion chromatography database using a gen. ● classifier syst.  
[162, 164] **allocation** Hierarchical credit ● in a CS  
[66] **analogies** Classifier syst. renaissance: New ● new di-  
rections  
[181] **analysis** Two ● tools to describe the operation of clas-  
sifier syst.  
[23] **animat** A hierarchical classifier syst. implementing a  
motivationally autonomous adaptive ●  
[160, 161] **Animat** Classifier syst. and the ● problem  
[41, 44] **anticipatory** Learning ● behaviour using a delayed  
action classifier syst.  
[79] **Applicability** The ● of GAs to Complex Opt. Prob-  
lems in Chemistry  
[82] **application** A practical ● of a learning CS in a steel hot  
strip mill  
[117] – A study of par. and prog. in classifier syst. and its ●  
to classification in KL-ONE semantic networks  
[146] – Discovering individual decision rules: an ● of GAs  
[175] **Applying** adaptive credit assignment alg. for the learn-  
ing classifier syst. based upon the GA  
[71] **apportionment** A proposal on payoffs and ● of credits  
of fuzzy classifier syst. - Finding of knowledge for large scale  
syst.  
[32] – A study on ● of credits of fuzzy classifier syst. for  
knowledge acquisition of large scale syst.  
[10] – Message-based bucket brigade: An alg. for the ● of  
credit problem  
[98] **artificial intelligence** Dynamical syst. in ● The case  
of classifier syst. s  
[85] **Artificial** Showing the way: a review of the second edi-  
tion of Holland's *Adaptation in Nat. and ● Syst.*  
[141] **assignment** Alternatives for classifier syst. credit ●  
[175] – Applying adaptive credit ● alg. for the learning classi-  
fier syst. based upon the GA  
[143] – Credit ● and discovery in classifier syst.  
[177] – Credit ● for pole balancing with learning CSs  
[176] **associative** Impl. of GA based ● classifier syst. (ACS)  
[94] **attribute-based** Representing ● concepts in a CS  
[138] **Automation** and opt. of froth flotation  
[23] **autonomous** A hierarchical classifier syst. implement-  
ing a motivationally ● adaptive animat  
[87] ● vehicle navigation using evol. reinforcement learning  
[139] – Study on an ● robot navigation problem using a CS  
[105] AUTONOUSE ALECSYS and the ● Learning to Cntr. a  
Real Robot by Distr. CSs  
[58] – ALECSYS and the ● learning to cntr. a real robot by  
distr. classifier syst.  
[53] **autotuning** Run-time ● of a robot cntr. using a gen.  
based ML cntr. scheme  
[96] **Back** specialization with the bucket brigade alg.  
[177] **balancing** Credit assignment for pole ● with learning  
CSs  
[18] **baseret** Simuleret skovbrandsbekæmpelse – et eksempel  
på genetisk ● maskinindlæring [Simulated forest fire fights –  
an example of gen. based machine learning]  
[107] **behavior** Extended classifiers for simulation of adaptive  
●  
[171] – Short-term prediction of Int. ● using a Holland classi-  
fier  
[95] **behavioral** Instinct as an inductive bias for learning ●  
sequences  
[114] **behaviour** Emergent ● in classifier syst.  
[106] – Gen. -based machine learning and ● based robotics: A  
new synthesis  
[41, 44] – Learning anticipatory ● using a delayed action classi-  
fier syst.  
[103] – Organisation of robot ● through gen. learning process

- [55] **benchmark** GA in continuous space and fuzzy classifier syst. for opening of door with manipulator of mobile robot: new • of evol. intelligent computing
- [95] **bias** Instinct as an inductive • for learning behavioral sequences
- [163] **Bid** competition and specificity reconsidered
- [140] **Boolean** Classifier syst. learning of the • multiplexer function
- [142] – Classifier syst. learning of • concepts
- [159] – Classifier syst. learning of a • function
- [122] • function learning with a classifier syst.
- [16] **bucket brigade** A defence of the •
- [108] – An investigation into possible causes of, and solutions to, rule strength distortion in the •
- [96] – Back specialization with the • alg.
- [99] – Learning and • dynamics in classifier syst.
- [10] – Message-based • An alg. for the apportionment of credit problem
- [75] • alg. for hierarchical censored production rule-based syst.
- [13] • perf. : I. Long sequence of classifiers
- [14] • perf. : II. Default hierarchies
- [11] – Properties of the •
- [15] – The • is not gen.
- [12] **bucket-brigade** The context-array • alg. : An enhanced appr. to credit-apportionment in classifier syst.
- [174] **builds** PCS: A classifier syst. that • a predictive internal world model
- [76] **category** Modeling human • by a simple classifier syst.
- [154] **Category** Modeling Simple Human • Learning with a CS
- [108] **causes** An investigation into possible • of, and solutions to, rule strength distortion in the bucket brigade
- [75] **censored** Bucket brigade alg. for hierarchical • production rule-based syst.
- [152] **CFS-C** A package of domain-independent subroutines for implementing classifier syst. in arbitrary, user-defined environments
- [74] **changing** A classifier syst. appr. to cntr. in • environments
- [24] **characteristic** Games computers play: simulating • function game playing agents with classifier syst.
- [79] **Chemistry** The Applicability of GAs to Complex Opt. Problems in •
- [84] **chromatography** Learning classification rules from an ion • database using a GA-based classifier syst.
- [43] **chunking** Hierarchical • in classifier syst.
- [59] **classification** A fuzzy classifier syst. that generates fuzzy if-then rules for pattern • problems
- [117] – A study of par. and prog. in classifier syst. and its appl. to • in KL-ONE semantic networks
- [84] – Learning • rules from an ion chromatography database using a GA-based classifier syst.
- [26] – Simulated annealing based •
- [62] – Dynamic • gen. prog. and classifier syst.
- [107] – Extended • for simulation of adaptive behavior
- [118] – Letter recognition using Holland-style adaptive •
- [145] **clinical** Gen. -based-machine-learning in • electromyography
- [47] **communicating** Evol. in multi-agent syst. : Evolving • classifier syst. s for gait in a quadrapedal robot
- [36] – Evolving cooperative • classifier syst.
- [20] – Par. evol. of • classifier syst.
- [77] **communication** Distr. adaptive routing cntr. in • networks using a temporal fuzzy classifier syst.
- [147] – Gen. evol. of • in distr. classifier syst.
- [148] – Self-organization of • in distr. learning classifier syst.
- [38] **comparison** A • of Q-learning and classifier syst.
- [89] – An efficient classifier syst. and its experimental • with two representative learning methods on three medical domains
- [163] **competition** Bid • and specificity reconsidered
- [79] **Complex** The Applicability of GAs to • Opt. Problems in Chemistry
- [81] **Complexity** of strategies and the evol. of cooperation
- [28] – On the • of learning in classifier syst.
- [54] **computational** A distr. • environment for gen. -based CSs
- [110] – The classifier syst. : A • model that supports machine intelligence
- [121] **Computer-aided** pipeline operation using GAs and rule learning
- [64] **computing** Evol. • in multi-agent environments: speculation and symbiogenesis
- [55] – GA in continuous space and fuzzy classifier syst. for opening of door with manipulator of mobile robot: new benchmark of evol. intelligent •
- [170] **Concept** formation as emergent phenomena
- [142] **concepts** Classifier syst. learning of Boolean •
- [94] – Representing attribute-based • in a CS
- [12] **context-array** The • bucket-brigade alg. : An enhanced appr. to credit-apportionment in classifier syst.
- [55] **continuous** GA in • space and fuzzy classifier syst. for opening of door with manipulator of mobile robot: new benchmark of evol. intelligent computing
- [74] **control** A classifier syst. appr. to • in changing environments
- [109] – Classifier syst. for •
- [77] – Distr. adaptive routing • in communication networks using a temporal fuzzy classifier syst.
- [53] – Run-time autotuning of a robot cntr. using a gen. based ML • scheme
- [105] – ALECSYS and the AUTONOUSE: Learning to • a Real Robot by Distr. CSs
- [58] – ALECSYS and the AUTONOUSE: learning to • a real robot by distr. classifier syst.
- [53] **controller** Run-time autotuning of a robot • using a gen. based ML cntr. scheme
- [65] **controllers** Evol. learning of • using temporal fuzzy classifier syst.
- [134] **controlling** Method of • a classifier syst.
- [179] • excessive fuzziness in a fuzzy CS
- [29] **Convergence** and the classifier syst.
- [81] **cooperation** Complexity of strategies and the evol. of •
- [31] **cooperative** Evol. organization of • strategies in learning classifier syst. organisms
- [36] – Evolving • communicating classifier syst.
- [69] – Nat. niching for • learning in classifier syst.
- [61] **coordination** Multiagent • with learning classifier syst.
- [141] **credit** Alternatives for classifier syst. • assignment
- [175] – Applying adaptive • assignment alg. for the learning classifier syst. based upon the GA
- [162, 164] – Hierarchical • allocation in a CS
- [10] – Message-based bucket brigade: An alg. for the apportionment of • problem
- [143] • assignment and discovery in classifier syst.
- [177] • assignment for pole balancing with learning CSs
- [12] **credit-apportionment** The context-array bucket-brigade alg. : An enhanced appr. to • in classifier syst.
- [71] **credits** A proposal on payoffs and apportionment of • of fuzzy classifier syst. - Finding of knowledge for large scale syst.
- [32] – A study on apportionment of • of fuzzy classifier syst. for knowledge acquisition of large scale syst.
- [84] **database** Learning classification rules from an ion chromatography • using a GA-based classifier syst.
- [48] **DCS** A promising CS
- [146] **decision** Discovering individual • rules: an appl. of GAs
- [14] **Default** Bucket brigade perf. : II. • hierarchies
- [155] – Empirical studies of • hierarchies and sequences of rules in learning classifier syst.
- [104] – New perspectives about • hierarchies formation in learning classifier syst.
- [151] • hierarchy formation and memory exploitation in learning classifier syst.
- [126] – Reinforcement learning with classifier syst. : Adaptive • hierarchy formation
- [123] – Variable • hierarchy separation in a classifier syst.
- [16] **defence** A • of the bucket brigade
- [41, 44] **delayed** Learning anticipatory behaviour using a • action classifier syst.
- [37] **delayed-action** A • classifier syst. for learning in temporal environments
- [149] **design** Learning classifier syst. in • opt.
- [42] – Using classifier syst. to • neural nets
- [130] **detailed** A more • discussion of classifier syst.
- [150] **Development** A Study of Rule Set • in a CS
- [137] **diagnosis** Adaptive alarm processor for fault • on power transmission networks

- [66] **directions** Classifier syst. renaissance: New analogies, new •
- [133] – GAs and classifier syst. : foundations and future •
- [146] **Discovering** individual decision rules: an appl. of GAs
- [143] **discovery** Credit assignment and • in classifier syst.
- [166] – Toward a GA solution of the • problem [extended abstract]
- [130] **discussion** A more detailed • of classifier syst.
- [108] **distortion** An investigation into possible causes of, and solutions to, rule strength • in the bucket brigade
- [54] **distributed** A • computational environment for gen. -based CSs
- [147] – Gen. evol. of communication in • classifier syst.
- [77] • adaptive routing cntr. in communication networks using a temporal fuzzy classifier syst.
- [105] – ALECSYS and the AUTONOMOUSE: Learning to Cntr. a Real Robot by • CSs
- [58] – ALECSYS and the AUTONOMOUSE: learning to cntr. a real robot by • classifier syst.
- [148] – Self-organization of communication in • learning classifier syst.
- [17] – Unsupervised image segmentation using a • GA
- [93] – Using classifier syst. to implement • Rep.
- [152] **domain-independent** CFS-C: A package of • subroutines for implementing classifier syst. in arbitrary, user-defined environments
- [89] **domains** An efficient classifier syst. and its experimental comparison with two representative learning methods on three medical •
- [55] **door** GA in continuous space and fuzzy classifier syst. for opening of • with manipulator of mobile robot: new benchmark of evol. intelligent computing
- [19] **dynamic** Gen. learning of • sch. within a simulation environment
- [62] • classifiers: gen. prog. and classifier syst.
- [119] • planning for classifier syst.
- [112] **dynamical** Classifier syst. as • syst. s
- [98] • syst. in artificial intelligence: The case of classifier syst. s
- [99] **dynamics** Learning and bucket brigade • in classifier syst.
- [100] • of classifier syst.
- [113] – The • of classifier syst. : Empirical results
- [70] **economic modeling** Classifier syst. and •
- [85] **edition** Showing the way: a review of the second • of Holland's *Adaptation in Nat. and Artificial Syst.*
- [89] **efficient** An • classifier syst. and its experimental comparison with two representative learning methods on three medical domains
- [178] • Par. Learning in CSs
- [128] **electrical-power** Improving perf. of an • expert syst. with GAs
- [145] **electromyography** Gen. -based-machine-learning in clinical •
- [136] **emergence** Concerning the • of tag-mediated lookahead in classifier syst.
- [88] **emergency** The • of high level structure in classifier syst.
- [170] **emergent** Concept formation as • phenomena
- [114] • behaviour in classifier syst.
- [155] **Empirical** studies of default hierarchies and sequences of rules in learning classifier syst.
- [113] – The dynamics of classifier syst. : • results
- [12] **enhanced** The context-array bucket-brigade alg. : An • appr. to credit-apportionment in classifier syst.
- [54] **environment** A distr. computational • for gen. -based CSs
- [19] – Gen. learning of dynamic sch. within a simulation •
- [74] **environments** A classifier syst. appr. to cntr. in changing •
- [37] – A delayed-action classifier syst. for learning in temporal •
- [152] – CFS-C: A package of domain-independent subroutines for implementing classifier syst. in arbitrary, user-defined •
- [64] – Evol. computing in multi-agent • speciation and symbiogenesis
- [57] – Learning CSs in multi-agent •
- [81] **evolution** Complexity of strategies and the • of cooperation
- [147] – Gen. • of communication in distr. classifier syst.
- [47] • in multi-agent syst. : Evolving communicating classifier syst. s for gait in a quadrapedal robot
- [20] – Par. • of communicating classifier syst.
- [87] **evolutionary** Autonomous vehicle navigation using • reinforcement learning
- [55] – GA in continuous space and fuzzy classifier syst. for opening of door with manipulator of mobile robot: new benchmark of • intelligent computing
- [64] • computing in multi-agent environments: speciation and symbiogenesis
- [65] • learning of cntr. using temporal fuzzy classifier syst.
- [31] • organization of cooperative strategies in learning classifier syst. organisms
- [35] **Evolutionary stability** in simple classifier syst.
- [47] **Evolving** Evol. in multi-agent syst. : • communicating classifier syst. s for gait in a quadrapedal robot
- [36] • cooperative communicating classifier syst.
- [63] • multi-agent syst.
- [179] **excessive** cntr. • fuzzyness in a fuzzy CS
- [89] **experimental** An efficient classifier syst. and its • comparison with two representative learning methods on three medical domains
- [40] **expert system** Hybrid • for investment advising
- [128] – Improving perf. of an electrical-power • with GAs
- [151] **exploitation** Default hierarchy formation and memory • in learning classifier syst.
- [137] **fault** Adaptive alarm processor for • diagnosis on power transmission networks
- [18] **figts** Simuleret skovbrandsbekæmpelse – et eksempel på genetisk baseret maskinindlæring [Simulated forest fire • – an example of gen. based machine learning]
- [138] **flotation** Automation and opt. of froth •
- [18] **forest fire** Simuleret skovbrandsbekæmpelse – et eksempel på genetisk baseret maskinindlæring [Simulated • fights – an example of gen. based machine learning]
- [170] **formation** Concept • as emergent phenomena
- [151] – Default hierarchy • and memory exploitation in learning classifier syst.
- [104] – New perspectives about default hierarchies • in learning classifier syst.
- [126] – Reinforcement learning with classifier syst. : Adaptive default hierarchy •
- [133] **foundations** GAs and classifier syst. : • and future directions
- [131] **framework** A mathematical • for studying learning classifier syst.
- [138] **froth** Automation and opt. of • flotation
- [122] **function** Boolean • learning with a classifier syst.
- [140] – Classifier syst. learning of the Boolean multiplexer •
- [159] – Classifier syst. learning of a Boolean •
- [24] – Games computers play: simulating characteristic • game playing agents with classifier syst.
- [133] **future** GAs and classifier syst. : foundations and • directions
- [90] **fuzzy** A new appr. to • classifier syst.
- [71] – A proposal on payoffs and apportionment of credits of • classifier syst. - Finding of knowledge for large scale syst.
- [32] – A study on apportionment of credits of • classifier syst. for knowledge acquisition of large scale syst.
- [49] – A study on knowledge finding using • classifier syst.
- [21] – A • CS using the Pittsburgh appr.
- [59] – A • classifier syst. that generates • if-then rules for pattern classification problems
- [179] – cntr. excessive fuzzyness in a • CS
- [77] – Distr. adaptive routing cntr. in communication networks using a temporal • classifier syst.
- [65] – Evol. learning of cntr. using temporal • classifier syst.
- [55] – GA in continuous space and • classifier syst. for opening of door with manipulator of mobile robot: new benchmark of evol. intelligent computing
- [60] • and probabilistic reasoning in simple learning CSs
- [180] – The • CS: A Classifier Syst. for Continuously Varying Variables
- [179] **fuzzyness** cntr. excessive • in a fuzzy CS
- [47] **gait** Evol. in multi-agent syst. : Evolving communicating classifier syst. s for • in a quadrapedal robot
- [24] **game playing** Games computers play: simulating characteristic function • agents with classifier syst.
- [24] **Games** computers play: simulating characteristic function game playing agents with classifier syst.

- [59] **generates** A fuzzy classifier syst. that • fuzzy if-then rules for pattern classification problems
- [86] **Generating** rules using a Holland based classifier learning syst.
- [80] **generation** Geometric Rep. for shape • using classifier syst.
- [54] **genetic-based** A distr. computational environment for • CSs
- [53] **genetics** Run-time autotuning of a robot cntr. using a • based ML cntr. scheme
- [106] **Genetics-based** machine learning and behaviour based robotics: A new synthesis
- [145] **Genetics-based-machine-learning** in clinical electromyography
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- [80] **Geometric** Rep. for shape generation using classifier syst.
- [120] **goal** Learning the • relevance of actions in classifier syst.
- [102] **Hamming** Classifier syst. with • weights
- [101] – Classifier syst. with • weights
- [124, 125] **hard** What makes a problem • for a classifier syst. ?
- [169] **HCS** Adding Hierarchies to CSs
- [23] **hierarchical** A • classifier syst. implementing a motivationally autonomous adaptive animat
- [75] – Bucket brigade alg. for • censored production rule-based syst.
- [43] • chunking in classifier syst.
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- [67] **hierarchically** Extension of • CS using self GA invocation
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- [155] – Empirical studies of default • and sequences of rules in learning classifier syst.
- [169] – HCS: Adding • to CSs
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- [126] – Reinforcement learning with classifier syst. : Adaptive default • formation
- [123] – Variable default • separation in a classifier syst.
- [86] **Holland** Generating rules using a • based classifier learning syst.
- [50] **Holland** classifier syst.
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- [118] **Holland-style** Letter recognition using • adaptive classifiers
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- [154] **Human** Modeling Simple • Category Learning with a CS
- [76] – Modeling • categorization by a simple classifier syst.
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- [40] • expert syst. for investment advising
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- [52] **image** Adaptive • quantization based on learning classifier syst.
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- [176] **Implementation** of GA based associative classifier syst. (ACS)
- [23] **implementing** A hierarchical classifier syst. • a motivationally autonomous adaptive animat
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- [39, 46] **Implicit** niching in a learning classifier syst. : Nature's way
- [146] **individual** Discovering • decision rules: an appl. of GAs
- [132] **induction** CSs, Q-Morphisms, and •
- [95] **inductive** Instinct as an • bias for learning behavioral sequences
- [25] • operators and rule repair in a hybrid gen. learning syst. : some initial results
- [25] **initial** Inductive operators and rule repair in a hybrid gen. learning syst. : some • results
- [95] **Instinct** as an inductive bias for learning behavioral sequences
- [110] **intelligence** The classifier syst. : A computational model that supports machine •
- [55] **intelligent** GA in continuous space and fuzzy classifier syst. for opening of door with manipulator of mobile robot: new benchmark of evol. • computing
- [91] **internal** CSs that learn • world models
- [174] – PCS: A classifier syst. that builds a predictive • world model
- [108] **investigation** An • into possible causes of, and solutions to, rule strength distortion in the bucket brigade
- [40] **investment** Hybrid expert syst. for • advising
- [67] **invocation** Extension of hierarchically CS using self GA •
- [84] **ion** Learning classification rules from an • chromatography database using a GA-based classifier syst.
- [78] **iterated prisoners dilemma** Multi-agent classifier syst. and the •
- [68] **jaguaari** Kvarikki ja •
- [27] **Jaguar** The Quark and the •
- [117] **KL-ONE** A study of par. and prog. in classifier syst. and its appl. to classification in • semantic networks
- [71] **knowledge** A proposal on payoffs and apportionment of credits of fuzzy classifier syst. - Finding of • for large scale syst.
- [32] – A study on apportionment of credits of fuzzy classifier syst. for • acquisition of large scale syst.
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- [68] **Kvarikki** ja jaguaari
- [153] **latent** Lookahead planning and • learning in a CS
- [91] **learn** CSs that • internal world models
- [173] **learning** A classifier syst. for • spatial Rep. , based on a Pebble-Pond morphological wave propagation alg.
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- [82] – A practical appl. of a • CS in a steel hot strip mill
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- [89] – An efficient classifier syst. and its experimental comparison with two representative • methods on three medical domains
- [175] – Applying adaptive credit assignment alg. for the • classifier syst. based upon the GA
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- [140] – Classifier syst. • of the Boolean multiplexer function
- [159] – Classifier syst. • of a Boolean function
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- [178] – Efficient Par. • in CSs
- [155] – Empirical studies of default hierarchies and sequences of rules in • classifier syst.
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- [60] – Fuzzy and probabilistic reasoning in simple • CSs
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- [104] – New perspectives about default hierarchies formation in • classifier syst.
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- [88] **level** The emergency of high • structure in classifier syst.
- [34] – ZCS: A zeroth • classifier syst.
- [136] **lookahead** Concerning the emergence of tag-mediated • in classifier syst.
- [153] • planning and latent learning in a CS
- [53] **machine** Run-time autotuning of a robot cntr. using a gen. based • learning cntr. scheme
- [110] – The classifier syst. : A computational model that supports • intelligence
- [106] **machine learning** Gen. -based • and behaviour based robotics: A new synthesis
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- [165] **mapping** CS • of real vectors [extended abstract]
- [18] **maskinindlæring** Simuleret skovbrandsbekæmpelse – et eksempel på genetisk baseret • [Simulated forest fire fights – an example of gen. based machine learning]
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- [89] **medical** An efficient classifier syst. and its experimental comparison with two representative learning methods on three • domains
- [129] **memory** CSs with long term •
- [151] – Default hierarchy formation and • exploitation in learning classifier syst.
- [10] **Message-based** bucket brigade: An alg. for the apportionment of credit problem
- [82] **mill** A practical appl. of a learning CS in a steel hot strip •
- [55] **mobile robot** GA in continuous space and fuzzy classifier syst. for opening of door with manipulator of • new benchmark of evol. intelligent computing
- [174] **model** PCS: A classifier syst. that builds a predictive internal world •
- [110] – The classifier syst. : A computational • that supports machine intelligence
- [76] **Modeling** human categorization by a simple classifier syst.
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- [61] **Multiagent** coordination with learning classifier syst.
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- [139] – Study on an autonomous robot • problem using a CS
- [117] **networks** A study of par. and prog. in classifier syst. and its appl. to classification in KL-ONE semantic •
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- [42] **neural nets** Using classifier syst. to design •
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- [39, 46] **niching** Implicit • in a learning classifier syst. : Nature's way
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- [121] **operation** Computer-aided pipeline • using GAs and rule learning
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- [178] **Parallel** Efficient • Learning in CSs
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- [115] • and Prog. in Classifier Syst.
- [116] • in classifier syst.
- [59] **pattern** A fuzzy classifier syst. that generates fuzzy if-then rules for • classification problems
- [71] **payoffs** A proposal on • and apportionment of credits of fuzzy classifier syst. - Finding of knowledge for large scale syst.
- [174] **PCS** A classifier syst. that builds a predictive internal world model
- [173] **Pebble-Pond** A classifier syst. for learning spatial Rep. , based on a • morphological wave propagation alg.
- [13] **performance** Bucket brigade • I. Long sequence of classifiers
- [14] – Bucket brigade • II. Default hierarchies
- [128] – Improving • of an electrical-power expert syst. with GAs
- [104] **perspectives** New • about default hierarchies formation in learning classifier syst.
- [170] **phenomena** Concept formation as emergent •
- [121] **pipeline** Computer-aided • operation using GAs and rule learning
- [21] **Pittsburgh** A fuzzy CS using the • appr.
- [119] **planning** Dynamic • for classifier syst.
- [153] – Lookahead • and latent learning in a CS
- [24] **play** Games computers • simulating characteristic function game playing agents with classifier syst.
- [177] **pole** Credit assignment for • balancing with learning CSs

- [22] **polymorphic** A • GA for classifier syst.
- [156, 158] **Population** size in classifier syst.
- [137] **power** Adaptive alarm processor for fault diagnosis on • transmission networks
- [82] **practical** A • appl. of a learning CS in a steel hot strip mill
- [171] **prediction** Short-term • of Int. behavior using a Holland classifier
- [174] **predictive** PCS: A classifier syst. that builds a • internal world model
- [60] **probabilistic** Fuzzy and • reasoning in simple learning CSs
- [103] **process** Organisation of robot behaviour through gen. learning •
- [137] **processor** Adaptive alarm • for fault diagnosis on power transmission networks
- [75] **production** Bucket brigade alg. for hierarchical censored • rule-based syst.
- [117] **programming** A study of par. and • in classifier syst. and its appl. to classification in KL-ONE semantic networks
- [111] – Learning and • in classifier syst.
- [115] – Par. and • in Classifier Syst.
- [48] **promising** DCS: A • CS
- [173] **propagation** A classifier syst. for learning spatial Rep. , based on a Pebble-Pond morphological wave • alg.
- [11] **Properties** of the bucket brigade
- [71] **proposal** A • on payoffs and apportionment of credits of fuzzy classifier syst. - Finding of knowledge for large scale syst.
- [38] **Q-learning** A comparison of • and classifier syst.
- [132] **Q-Morphisms** CSs, • and induction
- [47] **quadrapedal** Evol. in multi-agent syst. : Evolving communicating classifier syst. s for gait in a • robot
- [52] **quantization** Adaptive image • based on learning classifier syst.
- [27] **Quark** The • and the Jaguar
- [165] **real** CS mapping of • vectors [extended abstract]
- [105] – ALECSYS and the AUTONOMOUSE: Learning to Cntr. a • Robot by Distr. CSs
- [58] – ALECSYS and the AUTONOMOUSE: learning to cntr. a • robot by distr. classifier syst.
- [60] **reasoning** Fuzzy and probabilistic • in simple learning CSs
- [45] **Recent** Classifier syst. – • research
- [118] **recognition** Letter • using Holland-style adaptive classifiers
- [163] **reconsidered** Bid competition and specificity •
- [33] **refinement** On-the-fly knowledge base • by a classifier syst.
- [87] **reinforcement** Autonomous vehicle navigation using evol. • learning
- [126] • learning with classifier syst. : Adaptive default hierarchy formation
- [120] **relevance** Learning the goal • of actions in classifier syst.
- [66] **renaissance** Classifier syst. • New analogies, new directions
- [25] **repair** Inductive operators and rule • in a hybrid gen. learning syst. : some initial results
- [80] **representation** Geometric • for shape generation using classifier syst.
- [167] **Representational** Difficulties with CSs
- [173] **representations** A classifier syst. for learning spatial • based on a Pebble-Pond morphological wave propagation alg.
- [93] – Using classifier syst. to implement distr. •
- [89] **representative** An efficient classifier syst. and its experimental comparison with two • learning methods on three medical domains
- [94] **Representing** attribute-based concepts in a CS
- [45] **research** Classifier syst. – Recent •
- [85] **review** Showing the way: a • of the second edition of Holland's *Adaptation in Nat. and Artificial Syst.*
- [47] **robot** Evol. in multi-agent syst. : Evolving communicating classifier syst. s for gait in a quadrapedal •
- [103] – Organisation of • behaviour through gen. learning process
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- [139] – Study on an autonomous • navigation problem using a CS
- [106] **robotics** Gen. -based machine learning and behaviour based • A new synthesis
- [77] **routing** Distr. adaptive • cntr. in communication networks using a temporal fuzzy classifier syst.
- [150] **Rule** A Study of • Set Development in a CS
- [108] – An investigation into possible causes of, and solutions to, • strength distortion in the bucket brigade
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- [144] **rule-based** Improved learning in gen. • classifier syst.
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- [75] **rule-based system** Bucket brigade alg. for hierarchical censored production •
- [146] **rules** Discovering individual decision • an appl. of GAs
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- [86] – Generating • using a Holland based classifier learning syst.
- [84] – Learning classification • from an ion chromatography database using a GA-based classifier syst.
- [53] **Run-time** autotuning of a robot cntr. using a gen. based ML cntr. scheme
- [32] **scale** A study on apportionment of credits of fuzzy classifier syst. for knowledge acquisition of large • syst.
- [19] **scheduling** Gen. learning of dynamic • within a simulation environment
- [53] **scheme** Run-time autotuning of a robot cntr. using a gen. based ML cntr. •
- [148] **Self-organization** of communication in distr. learning classifier syst.
- [117] **semantic** A study of par. and prog. in classifier syst. and its appl. to classification in KL-ONE • networks
- [123] **separation** Variable default hierarchy • in a classifier syst.
- [13] **sequence** Bucket brigade perf. : I. Long • of classifiers
- [155] **sequences** Empirical studies of default hierarchies and • of rules in learning classifier syst.
- [95] – Instinct as an inductive bias for learning behavioral •
- [150] **Set** A Study of Rule • Development in a CS
- [72] **shape** A learning classifier syst. for three-dimensional • opt.
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- [24] **simulating** Games computers play: • characteristic function game playing agents with classifier syst.
- [107] **simulation** Extended classifiers for • of adaptive behavior
- [19] – Gen. learning of dynamic sch. within a • environment
- [18] **Simuleret** skovbrandsbekæmpelse – et eksempel på genetisk baseret maskinindlæring [Simulated forest fire fights – an example of gen. based machine learning]
- [156, 158] **size** Pop. • in classifier syst.
- [18] **skovbrandsbekæmpelse** Simuleret • – et eksempel på genetisk baseret maskinindlæring [Simulated forest fire fights – an example of gen. based machine learning]
- [166] **solution** Toward a GA • of the discovery problem [extended abstract]
- [108] **solutions** An investigation into possible causes of, and • to, rule strength distortion in the bucket brigade
- [55] **space** GA in continuous • and fuzzy classifier syst. for opening of door with manipulator of mobile robot: new benchmark of evol. intelligent computing
- [173] **spatial** A classifier syst. for learning • Rep. , based on a Pebble-Pond morphological wave propagation alg.

- [96] **specialization** Back • with the bucket brigade alg.
- [64] **speciation** Evol. computing in multi-agent environments: • and symbiogenesis
- [163] **specificity** Bid competition and • reconsidered
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- [106] **synthesis** Gen. -based machine learning and behaviour based robotics: A new •
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- [129] **term** CSs with long • memory
- [72] **three-dimensional** A learning classifier syst. for • shape opt.
- [73] • shape opt. utilizing a learning classifier syst.
- [181] **tools** Two analysis • to describe the operation of classifier syst.
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- [17] **Unsupervised** image segmentation using a distr. GA
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- [165] **vectors** CS mapping of real • [extended abstract]
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- [173] **wave** A classifier syst. for learning spatial Rep. , based on a Pebble-Pond morphological • propagation alg.
- [102, 101] **weights** Classifier syst. with Hamming •
- [83] **wonder** Classifier syst. – No • they don't work
- [91] **world** CSs that learn internal • models
- [174] – PCS: A classifier syst. that builds a predictive internal • model
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## Notations

†(ref) = the bibliography item does not belong to my collection of genetic papers.

(ref) = citation source code. ACM = ACM Guide to Computing Literature, EEA = Electrical & Electronics Abstracts, BA = Biological Abstracts, CCA = Computers & Control Abstracts, CTI = Current Technology Index, EI = The Engineering Index (A = Annual, M = Monthly), DAI = Dissertation Abstracts International, P = Index to Scientific & Technical Proceedings, BackBib = Thomas Bäck's unpublished bibliography, Fogel/Bib = David Fogel's EA bibliography, etc

\* = only abstract seen.

? = data of this field is missing (BiBTeX-format).

The last field in each reference item in Teletype font is the BiBTeXkey of the corresponding reference.



# Appendix A

## Abbreviations

The following other abbreviations were used to compress the titles of articles in the permutation title index:

AI	= Artificial Intelligence	Int.	= International
Alg.	= Algorithm(s)	ImPr	= Image Processing
AL	= Artificial Life	JSS	= Job Shop Scheduling
ANN(s)	= Artificial Neural Net(work)(s)	ML	= Machine Learning
Appl.	= Application(s), Applied	Nat.	= Natural
Appr.	= Approach(es)	NN(s)	= Neural Net(work)(s)
Cntr.	= Control, Controlled, = Controlling, Controller(s)	Opt.	= Optimization, Optimal, = Optimizer(s), Optimierung
Coll.	= Colloquium	OR	= Operation(s) Research
Comb.	= Combinatorial	Par.	= Parallel, Parallelism
Conf.	= Conference	Perf.	= Performance
CS(s)	= Classifier System(s)	Pop.	= Population(s), Populational(ly)
Distr.	= Distributed	Proc.	= Proceedings
Eng.	= Engineering	Prog.	= Programming, Program(s), Programmed
EP	= Evolutionary Programming	Prob.	= Problem(s)
ES	= Evolutionsstrategie(n), = Evolution(ary) strategies	QAP	= Quadratic Assignment Problem
Evol.	= Evolution, Evolutionary	Rep.	= Representation(s), Representational(ly)
ExS(s)	= Expert System(s)	SA	= Simulated Annealing
FF(s)	= Fitness Function(s)	Sch.	= Scheduling, Schedule(s)
GA(s)	= Genetic Algorithm(s)	Sel.	= Selection, Selectionism
Gen.	= Genetic(s), Genetical(ly)	Symp.	= Symposium
GP	= Genetic Programming	Syst.	= System(s)
Ident.	= Identification	Tech.	= Technical, Technology
Impl.	= Implementation(s)	TSP	= Travel(l)ing Salesman Problem

# Appendix B

## Bibliography entry formats

This documentation was prepared with L<sup>A</sup>T<sub>E</sub>X and reproduced from camera-ready copy supplied by the editor. The ones who are familiar with B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> may have noticed that the references are printed using `abbrv` bibliography style and have no difficulties in interpreting the entries. For those not so familiar with B<sub>I</sub>B<sub>T</sub>E<sub>X</sub> are given the following formats of the most common entry types. The optional fields are enclosed by "[ ]" in the format description. Unknown fields are shown by "?". † after the entry means that neither the article nor the abstract of the article was available for reviewing and so the reference entry and/or its indexing may be more or less incomplete.

**Book:** Author(s), *Title*, Publisher, Publisher's address, year.

**Example**

John H. Holland. *Adaptation in Natural and Artificial Systems*. The University of Michigan Press, Ann Arbor, 1975.

**Journal article:** Author(s), Title, *Journal*, volume(number): first page – last page, [month,] year.

**Example**

David E. Goldberg. Computer-aided gas pipeline operation using genetic algorithms and rule learning. Part I: Genetic algorithms in pipeline optimization. *Engineering with Computers*, 3(?):35–45, 1987. †.

**Note:** the number of the journal unknown, the article has not been seen.

**Proceedings article:** Author(s), Title, editor(s) of the proceedings, *Title of Proceedings*, [volume,] pages, location of the conference, date of the conference, publisher of the proceedings, publisher's address.

**Example**

John R. Koza. Hierarchical genetic algorithms operating on populations of computer programs. In N. S. Sridharan, editor, *Eleventh International Joint Conference on Artificial Intelligence (IJCAI-89)*, pages 768–774, Detroit, MI, 20.-25. August 1989. Morgan Kaufmann, Palo Alto, CA. †.

**Technical report:** Author(s), Title, type and number, institute, year.

**Example**

Thomas Bäck, Frank Hoffmeister, and Hans-Paul Schwefel. Applications of evolutionary algorithms. Technical Report SYS-2/92, University of Dortmund, Department of Computer Science, 1992.