Prof. Dr.rer.nat.habil. Dr.rer.nat. Lothar M. Schmitt

Curriculum Vitae and References

Personal Information

Date of Birth:	April 20, 1955
Nationality:	German
Current Position:	Associate Professor (tenured, beamtet)
Address:	The University of Aizu, School of Computer Science and Engineering Aizu-Wakamatsu City, Fukushima Prefecture 965-8580, Japan
Phone:	[81] (242) 37-2577 (office), [81] (242) 32-9094 (answering machine)
Portable phone:	[81] 90 878 288 46
Fax:	[81] (242) 37-2745 (fax)
e-mail:	`L@LMSchmitt.de`

Academic Degrees

1979	**Dipl.-Math.**	(M.S.)	Universität des Saarlandes[1]
1985	**Dr.rer.nat.**	(Ph.D.)	Universität des Saarlandes[1]
1991	**Dr.rer.nat.habil.**	(Habilitation)	Universität Osnabrück[3]

Professional Training and Experience

1974–1979	**Student** (Mathematics and Physics) Universität des Saarlandes[1] Scholarship by the *Studienstiftung des deutschen Volkes*
1976–1979	**Teaching Assistant** Department of Mathematics, Universität des Saarlandes[1]
1979–1981	**Exchange Student** (Mathematics) Texas Christian University[2] Scholarship by the binational *Fulbright-Commission* Scholarship by *TCU Research Foundation*
1981–1986	**Wissenschaftlicher Mitarbeiter (BAT IIa)** Department of Mathematics, Universität des Saarlandes[1] "Wissenschaftlicher Mitarbeiter" is comparable to **Research Associate**.
1986–1993	**Hochschulassistent C1** Department of Mathematics/Computer-Science, Universität Osnabrück[3] "Hochschulassistent" is comparable to **Assistant Professor**. The law forbids continuation of employment after 6 years in that post and promotion.
1986–1987	**Instructor** (on leave from Osnabrück) Department of Mathematics, University of Kansas[4]
1987	**Researcher** (on leave from Osnabrück) Department of Mathematics, University of Kansas[4] Grant by the *National Science Foundation* of the USA
1993–present	**Associate Professor** School of Computer Science and Engineering, The University of Aizu[5]
2003	Holds papers ranked No. $6 + 17$ in regard to downloads from Elsevier publisher during 2003 among papers in *Theoretical Computer Science.*
since 2003	Listed in "*Who's who in the world.*"
2005	Co-organizer *Foundation of Genetic Algorithms Conference (FOGA).*

Administered Research Funding: Approximately USD 200,000 in start-up funding for the Computer Industry Laboratory (1993-1996). Approximately USD 110,000 regular prefectural research budget over 11 years (1993-2003) with yearly application procedure. Approximately USD 14,000 additional competitive prefectural research budget over 3 years (2001-2003) with yearly application procedure.

Referee for several scientific journals in mathematics and computer science.

Member: ACM, AMS, IEEE, ISGEC.

For additional details, consult the enclosures **Publications**, **Work Experience**, and **Abstracts** with listing of **Lecture Notes**.

References

Universität des Saarlandes, FB 9 Mathematik, Postfach 151150
66041 Saarbrücken, Germany **(1)**

Texas Christian University, Department of Mathematics
Fort Worth, Texas 76129, USA **(2)**

Universität Osnabrück, FB Mathematik/Informatik, AVZ, Albrechtstr. 28
49069 Osnabrück, Germany **(3)**

University of Kansas, Department of Mathematics
Lawrence, Kansas 66045, USA **(4)**

The University of Aizu, School of Computer Science and Engineering
Aizu-Wakamatsu City, Fukushima Prefecture 965-8580, Japan **(5)**

List of Publications

1 Reviewed Publications (49) Journals, Conferences and www-Databases

Includes 25 refereed journal articles totaling 445 pages.

a = anonymously refereed, e = editorially refereed, EA = extended abstract in conference proceedings, IBC = invited book chapter, J = journal publication, L = lecture note publication, P = publication in conference proceedings

1. **Characterization of matrix-ordered standard forms of W*-algebras** J_a
   Lothar M. Schmitt and Gerd Wittstock
   Mathematica Scandinavica **51** (1982), 241–260

2. **Kernel representation of completely positive Hilbert-Schmidt operators on standard forms** J_a
   Lothar M. Schmitt and Gerd Wittstock
   Archiv der Mathemetik (Basel) **38** (1982), 453–458

3. **Characterization of $L^2(\mathcal{M})$ for injective W*-algebras $\mathcal{M}$** J_a
   Mathematica Scandinavica **57** (1985), 267–280

4. **The Radon-Nikodym theorem for L^p-spaces of W*-algebras** J_a
   Publications of the Research Institute for Mathematical Sciences (RIMS), Kyoto University **22** (1986), 1025–1034

5. **Order derivations on L^p-spaces of W*-algebras** J_a
   Mathematische Zeitschrift **196** (1987), 117–124

6. **Semidiscrete Hilbert spaces** J_a
   Acta Mathematica Hungaria **53** (1989), 103–107

7. **A remark on Radon-Nikodym properties of ordered Hilbert spaces** J_a
   Proceedings of the American Mathematical Society **105** (1989), 938–940

8. **Direct integrals of matrix-ordered standard forms of W*-algebras** J_a
   Rocky Mountains Journal of Mathematics **20** (1990), 561–571

9. **Quotients of local Banach algebras are local Banach algebras** J_a
   Publications of the Research Institute for Mathematical Sciences (RIMS), Kyoto University **27** (1991), 837–843

10. **Die Programmiersprache Mathematica — Eine Einführung — Teil 1** J_e
    (In German: The programming language Mathematica — An introduction — Part 1)
    unix/mail **5**, Carl Hanser Verlag (1991), 320–327
    Republished in: Jahres-CD 1997, *Die Blauen Blätter* **4**, Carl Hanser Verlag (1997), ISSN 1432-1263

11. **Die Programmiersprache Mathematica — Eine Einführung — Teil 2** J_e
(In German: The programming language Mathematica — An introduction — Part 2)
unix/mail **6**, Carl Hanser Verlag (1991), 397–409
Republished in: Jahres-CD 1997, *Die Blauen Blätter* **4**, Carl Hanser Verlag (1997), ISSN 1432-1263

12. **Die Programmiersprache Mathematica — Eine Einführung — Teil 3** J_e
(In German: The programming language Mathematica — An introduction — Part 3)
unix/mail **1**, Carl Hanser Verlag (1992), 20–30
Republished in: Jahres-CD 1997, *Die Blauen Blätter* **4**, Carl Hanser Verlag (1997), ISSN 1432-1263

13. **An implementation of full standard Prolog** EA_a
LOTHAR M. SCHMITT AND SILKE SEEHUSEN
Proceedings of the Mathematica Conference Rotterdam 1992, Beurs-World Trade Center, Rotterdam, The Netherlands (September 2–4, 1992), 1 p.
Implementation by the authors primarily with Mathematica and some UNIX tools.

14. **K-theory for Banach algebras** L_e
Osnabrücker Schriften zur Mathematik, Reihe **V**, Heft **119**, Universität Osnabrück, Osnabrück, Germany (1992), 232 p.

15. **An equivariant version of the Hahn-Banach theorem** J_a
Houston Journal of Mathematics **18** (1992), 429–447

16. **q-canonical commutation relations and stability of the Cuntz algebra** J_a
PALLE E.T. JØRGENSEN, LOTHAR M. SCHMITT AND REINHARD F. WERNER
Pacific Journal of Mathematics **165** (1994), 131–151

17. **q-relations and stability of C*-isomorphism classes** P_a
PALLE E.T. JØRGENSEN, LOTHAR M. SCHMITT AND REINHARD F. WERNER
Proceedings of University of Iowa GPOTS 1992: "Algebraic Methods in Operator Theory", R. Curto and P.E.T. Jørgensen (eds.), Birkhäuser Verlag (1994), 261–271

18. **Positive representations of general commutation relations allowing Wick ordering** J_a
PALLE E.T. JØRGENSEN, LOTHAR M. SCHMITT AND REINHARD F. WERNER
Journal of Functional Analysis **134** (1995), 33–99
Contains larger Mathematica application developed by the authors for symbolic verification of proof.

19. **Multimedia, multilingual hyperdictionaries: A Japanese↔English example** EA_a
HARVEY ABRAMSON, SUBHASH BHALLA, KIEL T. CHRISTIANSON, JAMES M. GOODWIN, JANET R. GOODWIN, JOHN J. SARRAILLE AND LOTHAR M. SCHMITT
Joint International Conferences of "Association for Literary and Linguistic Computing" and "Association for Computers and the Humanities", Bergen, Norway (June 25-29, 1996), 3 p.
WWW: `http://www.hd.uib.no/allc-ach.abstract.html`

20. **The logic of Kanji lookup in a Japanese ↔ English hyperdictionary** EA_a
HARVEY ABRAMSON, SUBHASH BHALLA, KIEL T. CHRISTIANSON, JAMES M. GOODWIN, JANET R. GOODWIN, JOHN J. SARRAILLE AND LOTHAR M. SCHMITT
Joint International Conferences of "Association for Literary and Linguistic Computing" and "Association for Computers and the Humanities", Bergen, Norway (June 25-29, 1996), 3 p.
WWW: `http://www.hd.uib.no/allc-ach.abstract.html`

21. **Image transformation in integrated quantum well infrared photodetector-light emitting diode** J_a
MAXIM ERSHOV, H.C. LIU AND LOTHAR M. SCHMITT
Journal of Applied Physics **82** (1997), 1446–1449

22. **Recognition of Japanese kanji characters by non-Japanese learners through a support database system** P_a
SUBHASH BHALLA, HARVEY ABRAMSON, KIEL T. CHRISTIANSON, JAMES M. GOODWIN, JANET R. GOODWIN, JOHN J. SARRAILLE AND LOTHAR M. SCHMITT
Proceedings of the Second International Conference on Cognitive Technology CT97 — Humanizing the Information Age, The University of Aizu, Aizu-Wakamatsu City, Fukushima, Japan (August 25–28, 1997), J.P. Marsh, C.L. Nehaniv and B. Gorayska (eds.), IEEE Computer Society Press (1997), 190–199

23. **Information retrieval and database architecture for conventional Japanese character dictionaries** P_a
LOTHAR M. SCHMITT, JENS HERDER AND SUBHASH BHALLA
Proceedings of the Second International Conference on Cognitive Technology CT97 — Humanizing the Information Age, The University of Aizu, Aizu-Wakamatsu City, Fukushima, Japan (August 25–28, 1997), J.P. Marsh, C.L. Nehaniv and B. Gorayska (eds.), IEEE Computer Society Press (1997), 200–217
Implementation by the authors with UNIX tools and *exite* search engine.

24. **Linear analysis of genetic algorithms** J_a
LOTHAR M. SCHMITT, CHRYSTOPHER L. NEHANIV AND ROBERT H. FUJII
Theoretical Computer Science **200** (1998), 101–134

25. **Pedagogical aspects of a UNIX-based network management system for English instruction** J_a
LOTHAR M. SCHMITT AND KIEL T. CHRISTIANSON
Systems **26** (1998), 567–589
Implementation by the authors with UNIX tools.

26. **Combining the Bourne-shell, sed and awk in the UNIX environment for language analysis** L_e
LOTHAR M. SCHMITT AND KIEL T. CHRISTIANSON
ERIC: Educational Resources Information Center, Document Service, National Library of Education, USA, ED 424 729, FL 025 224 (1998), 72 p.
WWW: `http://www.accesseric.org:81/index.html`
WWW: `ftp://ftp.u-aizu.ac.jp/u-aizu/doc/Tech-Report/1997/97-2-007.ps.gz`
Implementation by the authors with UNIX tools.

27. **The linear geometry of genetic operators with applications to the analysis of genetic drift and genetic algorithms using tournament selection** P_a
LOTHAR M. SCHMITT AND CHRYSTOPHER L. NEHANIV
Proceedings of the International Workshop on Mathematics and Computational Biology: Computational Morphogenesis, Hierarchical Complexity, and Digital Evolution MCB '97, The University of Aizu, Aizu-Wakamatsu City, Fukushima, Japan (October 21–25, 1997), C.L. Nehaniv (ed.), Lectures on Mathematics in the Life Sciences Series Vol. **26**, American Mathematical Society (1999), 147–166

28. **Implementation of a UNIX-based network management system for English instruction** L_e
LOTHAR M. SCHMITT AND KIEL T. CHRISTIANSON
ERIC: Educational Resources Information Center, Document Service, National Library of Education, USA, ED 428 582, FL 025 781 (1999), 49 p.
WWW: `http://www.accesseric.org:81/index.html`
Implementation by the authors with UNIX tools.

29. **The effect of non-constant effective tunneling mass and asymmetry for resonant tunneling in double-barrier structures** J_a
Applied Physics A **68** (1999), 553–558
WWW: `ftp://ftp.u-aizu.ac.jp/u-aizu/doc/Tech-Report/1998/98-2-003.tar.gz`
Contains larger Mathematica application developed by the author for symbolic verification and numerical evaluation.

30. **Optimization of Mass Distribution in Articulated Figures for High Jump with a Genetic Algorithm** P_a
LOTHAR M. SCHMITT AND TOSHIO KONDOH
Proceedings of the IASTED International Conference "Applied Simulation and Modelling ASM 2000", Banff, Alberta, Canada (July 24–26, 2000), M.H. Hamza (ed.), IASTED-ACTA Press, Anaheim-Calgary-Zürich (2000), ISBN: 0–88986–294–X, ISSN: 1021–8181, 191–197
Contains computer algebra application, and numerical simulation in C developed by the authors.

31. **Convergent Genetic Algorithms and their Applications in Shape Modeling** EA_a
Proceedings of the Third International Conference on Human and Computer (HC-2000), The University of Aizu, Aizu-Wakamatsu City, Fukushima, Japan (September 6–9, 2000), S. Mori *et al.* (eds.), The University of Aizu, Japan (2000), 235

32. **Theory of Genetic Algorithms** J_a
Theoretical Computer Science **259** (2001), 1–61
Contains Mathematica application developed by the author for symbolic verification of a counter example.
Rank 6 among all papers in all volumes of *Theoretical Computer Science* in regard to downloads during calendar year 2003 from the Elsevier website.

33. **Reconstructing Occlusal Surfaces of Teeth Using a Genetic Algorithm with Simulated Annealing Type Selection** P_a
VLADIMIR V. SAVCHENKO AND LOTHAR M. SCHMITT

Proceedings "Solid Modeling 2001" — Sixth ACM Symposium on Solid Modeling and Applications, Sheraton Inn, Ann Arbor, Michigan, USA (June 4–8, 2001), D.C. Anderson and K. Lee (eds.), Sponsored by ACM SIGGRAPH, ACM Press (2001), ISBN 1–58113–366–9, 39–46.
Contains numerical simulation in C developed by the authors.

34. **Regular and irregular inflection in German: A perspective offered by an event-related functional magnetic resonance imaging study**
Alan Beretta, Carrie Campbell, Thomas H. Carr, Jie Huang, Lothar M. Schmitt, Kiel Christianson, and Yue Cao EA_a
Cognitive Neuroscience Society Annual Meeting, San Francisco, CA, USA (April 14-16, 2002)

35. **Comparing Cortical Activation of Regular and Irregular Inflection in German**
Jie Huang, Alan Beretta, Carrie Campbell, Thomas H. Carr, Kiel Christianson, Lothar M. Schmitt and Yue Cao EA_a
International Society for Magnetic Resonance in Medicine — Tenth Scientific Meeting and Exhibition, Honolulu, Hawaii, USA (May 18–24, 2002)

36. **Theory of Genetic Algorithms II — Models for genetic operators over the string-tensor representation of populations and convergence to global optima for arbitrary fitness function under scaling** J_a
Theoretical Computer Science **310** (2004), 181–231
Rank 17 among all papers in all volumes of *Theoretical Computer Science* in regard to downloads during calendar year 2003 from the Elsevier website (online since August 2003).

37. **An ER-fMRI investigation of morphological inflection in German reveals that the brain makes a distinction between regular and irregular forms** J_a
Alan Beretta, Carrie Campbell, Thomas H. Carr, Jie Huang, Lothar M. Schmitt, Kiel Christianson and Yue Cao
Brain and Language **85** (2003), 67–92

38. **Asymptotic Convergence of Scaled Genetic Algorithms to Global Optima —A gentle introduction to the theory—** IBC_e
Invited book chapter. In: A. Menon (ed.). *Frontiers of Evolutionary Computation.* Other contributors: H. Mühlenbein, K. De Jong, P. Moscato/C. Cotta, L. Altenberg, G.A. Kochenberger/F. Glover/B. Alidaee/C. Rego, W. Macready C. Stephens/R. Poli J. Koza/M.J. Streeter/M.A. Keane V. Balaraman W. Banzhaf/J. Miller Genetic Algorithms And Evolutionary Computation Series, Vol. **11** (D.E. Goldberg, ed.). Boston, MA, USA: Kluwer Publishers (2004), pp. 157–192

39. **Coevolutionary Convergence to Global Optima** EA_a
Technical Report 2003-2-001, The University of Aizu, Japan (2003), 1–12.
Proceedings of the Genetic and Evolutionary Computation Conference GECCO 2003 (co-evolution track: poster), The Holiday Inn, Chicago, IL, USA (July 12–16, 2003), Erick Cantu-Paz *et al.* (eds.), Lecture Notes in Computer Science 2723, Springer Verlag, Berlin, Germany (2003), 373–375

40. **Tunnelling effects in concentric disk quantum dots: discrete — discrete and discrete — continuum limits** J_a

Lukáš Pichl, Lothar M. Schmitt, Victor Ryzhii, Mineo Kimura and Jiří Horáček

Proceedings of the 7th International Conference on Nonlinear Optics and Excitation Kinetics in Semiconductors (Poster II.19), Universität Karlsruhe, Karlsruhe, Germany (February 24–28, 2003).
Physica Status Solidi (C) **0** Nr. (5), 1540–1543
EarlyView service of Wiley InterScience (August 7, 2003)

41. **Optimization with Genetic Algorithms in Multi-Species Environments** P_a
Proceedings of the Fifth International Conference on Computation Intelligence and Multimedia Applications (ICCIMA 2003), Xidian University, Xi'an, China (September 27–30, 2003), Sponsored by IEEE, L. Jiao, H. Selvaraj, B. Verma and X. Yao (eds.), IEEE Computer Society (publisher), Los Alamitos, CA, USA, ISBN 0-7695-1957-1, 194-199

42. **Theory of Coevolutionary Genetic Algorithms** P_a
Proceedings of 'The 2003 International Symposium on Parallel and Distributed Processing and Applications' ISPA 2003, The University of Aizu, Aizu-Wakamatsu City, Fukushima, Japan (July 2–4, 2003). M. Guo, L.T. Yang (eds.). Sponsored by ACM and IPSJ. Lecture Notes in Computer Science 2745, Springer Verlag, Berlin, Germany (2003), pp. 285–293

43. **Portfolio optimization with hedging in strictly convergent coevolutionary markets** P_a
Lukáš Pichl, Lothar M. Schmitt, and Ayako Watanabe
Technical Report 2003-2-008, The University of Aizu, Japan (2003), 1–4.
Proceedings of the Third International Workshop on Computational Intelligence in Economics and Finance: CIEF 2003, Embassy Suites Hotel and Conference Center, Cary, NC, USA (September 26–30, 2003), Sponsored by AIM

44. **Modeling Genetic Algorithms from a Linear Operator Point of View — A Survey of Recent Advances and Future Perspectives** J_e
Proceedings of KOTAC International Conference 2003 'Operator Theory and Applications', Chungnam National University, Daejeon City, Korea (June 19–21, 2003), Sponsored by Daewoo Foundation.
Trends in Contemporary Mathematics **6** (2003), 113–123

45. **Classification with Scaled Genetic Algorithms in a Coevolutionary Setting** P_a
To appear: *Proceedings of the Genetic and Evolutionary Computation Conference GECCO 2004* (genetic algorithm track: full paper), Red Lion Hotel, Seattle, WA, USA (June 26–30, 2004), Riccardo Poli *et al.* (chairs). Lecture Notes in Computer Science, Springer Verlag, Berlin, Germany (2004), 12 p.

46. **Isomorphisms of K-groups for certain normed algebras and their closures** J_e
Proceedings of the 2004 KOTAC International Conference 'Operator Theory and Applications' , Seoul National University, Seoul, Korea (June 17–19, 2004), Sponsored by Korea Science and Engineering Foundation, Korea Research Foundation, BK21 Mathematical Sciences Division, Research Institute of Mathematics at Seoul National University.
To appear: *Trends in Contemporary Mathematics* (2004)

47. **De Jong's Challenge for Coevolutionary Genetic Algorithms** P_e
To appear: *Proceedings of the Dagstuhl Seminar 04081 'Theory of Evolutionary Algorithms'* (February 15–20, 2004), H.-G. Beyer, T. Jansen, C. Reeves, M.D. Vose (chairs):

preprint server of the Max-Planck Institute for Computer Science Conference Center Schloß Dagstuhl, Saarland, Germany (2004)

48. **Feasible Approaches to Convergence Results for Evolutionary Algorithms — Part I: Introductory overview and analysis of scaled genetic algorithms** P_a
LOTHAR M. SCHMITT, AND STEFAN DROSTE
Technical Report 2004-2-004, The University of Aizu, Japan (2004), 1–10.
Submitted: *Proceedings of the Workshop on Evolutionary Computation Theory, Genetic and Evolutionary Computation Conference GECCO 2004*, Red Lion Hotel, Seattle, WA, USA (June 26, 2004), Neal Richter *et al.* (organizers), 10 p.

49. **Feasible Approaches to Convergence Results for Evolutionary Algorithms — Part II: Runtime analysis of evolutionary algorithms and summary** P_a
STEFAN DROSTE AND LOTHAR M. SCHMITT
Technical Report 2004-2-005, The University of Aizu, Japan (2004), 1–10.
Submitted: *Proceedings of the Workshop on Evolutionary Computation Theory, Genetic and Evolutionary Computation Conference GECCO 2004*, Red Lion Hotel, Seattle, WA, USA (June 26, 2004), Neal Richter *et al.* (organizers), 10 p.

2 Theses by Lothar M. Schmitt (3)

1. **Charakterisierung von W*-Algebren durch autopolare, 2-geordnete, diagonal-homogene, 2-positive Kegelpaare.**
(In German: Characterization of W*-algebras by selfdual, 2-ordered, diagonal-homogeneous, 2-positive pairs of cones.)
Diplomarbeit (Thesis): Diplom Mathematiker (Master of Science).
Saarbrücken, Germany: Universität des Saarlandes, Fachbereich Mathematik (1979), 49 p.

2. **Zur Struktur der Seiten in L^p-Räumen von W*-Algebren**
(In German: On the structure of faces in L^p-spaces of W*-algebras)
Dissertation: Dr.rer.nat. (Ph.D.)
Saarbrücken, Germany: Universität des Saarlandes, Fachbereich Mathematik (1985), 106 p.

3. **Beiträge zur Theorie der Banachalgebren.**
—Schriftensammlung zur Habilitation—
(In German: *Contributions to the Theory of Banach Algebras.* —Collection of publications for Habilitation—)
Habilitation: Dr.rer.nat.habil.
Osnabrück, Germany: Universität Osnabrück, Fachbereich Mathematik/Informatik (1991), 103 p.

3 Lecture Notes (7)

During my career, I have been teaching a large variety of courses ranging from beginner's courses such as *Linear Algebra*, *Analysis*, *Computer Algebra*, and UNIX-*Tools* to advanced graduate and research courses such as *Functional Analysis*, several fields of *Advanced Operator Theory*, and

Theory of Probabilistic Algorithms. Some course material was published as lecture notes which is either listed below, or in some of the articles listed above. Lecture notes were distributed in class, or were made available for photocopy to participants of the courses. They can be obtained from the author (e-mail `lothar@u-aizu.ac.jp`).

1. **Lecture notes on Tomita-Takesaki theory.**
   Texas Christian University, Department of Mathematics, Fort Worth, TX, USA (1980), 316 p.

2. **K-theory for Banach algebras**
   Osnabrücker Schriften zur Mathematik, Reihe **V**, Heft **119**, Universität Osnabrück, Osnabrück, Germany (1992), 232 p.

3. **Lectures on Connes' theory of non-commutative differential geometry**
   Osnabrück, Germany: Universität Osnabrück, Fachbereich Mathematik/Informatik (1991), 128 p.

4. **Functional analysis**
   Osnabrück, Germany: Universität Osnabrück, Fachbereich Mathematik/Informatik (1991), 130 p.

5. **Mathematik für Naturwissenschaftler I**
   (In German: Mathematics for natural scientists I)
   Osnabrück, Germany: Universität Osnabrück, Fachbereich Mathematik/Informatik (1992), 200 p.

6. **Mathematik für Naturwissenschaftler II**
   (In German: Mathematics for natural scientists II)
   Osnabrück, Germany: Universität Osnabrück, Fachbereich Mathematik/Informatik (1992), 180 p.

7. **Lectures on Genetic Algorithms**
   Aizu-Wakamatsu, Japan: The University of Aizu (1998).

Work Experience

Research, Teaching and Administrative Duties

1974–1979	**Student** (Mathematics and Physics) Universität des Saarlandes[1] Scholarship by the *Studienstiftung des deutschen Volkes*
Research	Functional analysis: operator algebras.
1976–1979	**Teaching Assistant** Department of Mathematics, Universität des Saarlandes[1]
Teaching	Teaching exercise classes associated with mathematics courses: functional analysis, calculus, mathematics for chemists.
1979–1981	**Exchange Student** (Mathematics) Texas Christian University[2] Scholarship by the binational *Fulbright-Commission* Scholarship by *TCU Research Foundation*
Research	Functional analysis: operator algebras.
Teaching	Seminar and lectures in operator algebras.
1981–1986	**Wissenschaftlicher Mitarbeiter (BAT IIa)** Department of Mathematics, Universität des Saarlandes[1] "Wissenschaftlicher Mitarbeiter" is comparable to **Research Associate**.
Research	Functional analysis: operator algebras.
Teaching	Seminar lectures in functional analysis. Lectures in complex function theory. Guiding graduation research: functional analysis.
Administration	Designing and organizing a broad range of exercise classes associated with major courses with up to 500 students: functional analysis, complex function theory, analysis, calculus, mathematics for chemists. Administering the *Vordiplom* for the department of mathematics. The *Vordiplom* can be seen as the final exam for the unofficial German analogue of the B.S. degree.
1986–1993	**Hochschulassistent C1** Department of Mathematics/Computer-Science, Universität Osnabrück[3] "Hochschulassistent" is comparable to **Assistant Professor**. The law forbids continuation of employment after 6 years in that post and promotion.
Research	Functional analysis: operator algebras. Computer algebra: Prolog implementation.
Teaching	Courses: functional analysis, differential equations, calculus, mathematics for biologists, and mathematics for physicists. Research lectures in advanced topics of operator algebra theory. Guiding graduation research: functional analysis.

Administration	Designing and organizing a broad range of exercise classes associated with major courses with up to 1000 students: functional analysis, complex function theory, differential equations, analysis, calculus, mathematics for physicists, mathematics for economists. Appointment committees.
1986–1987	**Instructor** (on leave from Osnabrück) Department of Mathematics, University of Kansas[4]
Research	Functional analysis: operator algebras.
Teaching	Calculus
1987	**Researcher** (on leave from Osnabrück) Department of Mathematics, University of Kansas Grant by the *National Science Foundation* of the USA
Research	Functional analysis: operator algebras.
1993–present	**Associate Professor** School of Computer Science and Engineering, The University of Aizu[5]
2003	Holds papers ranked No. $6 + 17$ in regard to downloads from Elsevier publisher during 2003 among papers in *Theoretical Computer Science.*
since 2003	Listed in "*Who's who in the world.*"
2005	Co-organizer *Foundation of Genetic Algorithms Conference (FOGA).*
Research	Functional analysis: operator algebras. Theoretical computer science: genetic algorithms. UNIX: language analysis and teaching tools. Physics: mechanical robot models, and semiconductors.
Teaching	Mathematics: discrete mathematics, analysis, and topology. Computer algebra: Mathematica. UNIX tools: C, SED, AWK, LEX, YACC. Theoretical computer science: genetic algorithms. Physics: mechanics and Lagrange formalism. Supervising graduation research: (i) mathematical work (foundation of Lagrange formalism and Markov chains) (ii) simulating robot-type models of the human body using the Lagrange formalism and Mathematica/C as tools, (iii) application of UNIX in software-development of language analysis tools, and teaching tools, and (iv) neural networks applications.
Administration	Organizing the initial setup of the Computer Industry Laboratory as highest ranking member (1993–1995). Academic Affairs Commitee. Special Presidential Financial Affairs Commitee.

Abstracts

1 Reviewed Publications (49) Journals, Conferences and www-Databases

Includes 25 refereed journal articles totaling 445 pages.

a = anonymously refereed, e = editorially refereed, EA = extended abstract in conference proceedings, IBC = invited book chapter, J = journal publication, L = lecture note publication, P = publication in conference proceedings

Public Reviews are by the American Mathematical Society (`http://www.ams.org/mrlookup`).

1. **Characterization of matrix-ordered standard forms of W*-algebras** $J_a\circ$
   Lothar M. Schmitt and Gerd Wittstock
   Mathematica Scandinavica **51** (1982), 241–260

   Abstract: Let $\mathcal{M}$ be a von Neumann algebra operating in standard form on a Hilbert space $\mathcal{H}$, and let $\mathcal{H}^+$ be the corresponding selfdual cone (see, *e.g.*, U. Haagerup [*Math. Scand.* **37** (1997), 271–283]). The W*-algebras $M_n(\mathcal{M})$, $n \in \mathbf{N}$, of $n\times n$ matrices over $\mathcal{M}$ operate on $\mathcal{H}_n = M_n(\mathcal{H})$ in standard form in such a way that $\mathcal{H}$ is matrix-ordered by the corresponding selfdual cones $\mathcal{H}_n^+ \subset \mathcal{H}_n$. We call this situation a matrix-ordered standard form of $\mathcal{M}$.

   On the other hand, to any matrix-ordered Hilbert space with selfdual cones we associate a von Neumann algebra which respects the matrix order. We call it the *matrix multiplier algebra*. It is a non-commutative analogue of the ideal center of an ordered space. If a von Neumann algebra operates in standard form on a matrix-ordered Hilbert space $\mathcal{H}$ with selfdual cones $\mathcal{H}_n^+ \subset \mathcal{H}_n$, then it is the matrix multiplier algebra of this space.

   There is a one-to-one correspondence between the projections of the matrix multiplier algebra and the projectable faces of the cones. We obtain a characterization of matrix-ordered standard forms of von Neumann algebras in terms of the facial structure of the cones $\mathcal{H}_n^+$: The matrix multiplier algebra is in standard form, if and only if every completed face $F{=}F^{\perp\perp}$ of $\mathcal{H}_n^+$ is projectable (*i.e.*, $P_{\mathrm{span}(F)}\mathcal{H}_n^+ = F$) for every $n \in \mathbf{N}$.

   Public Review (American Mathematical Society): Following the set-up of M.D. Choi and E.G. Effros [*J. Funct. Anal.* **24** (1977), 156–209; MR 55 #3814] of matrix-ordered operator spaces, the authors study Hilbert spaces with self-dual cones. To such a matrix-ordered Hilbert space they associate a von Neumann algebra, called the matrix multiplier algebra, which respects the matrix order and is the non-commutative analogue of the ideal center of an ordered vector space. Conversely, if a von Neumann algebra M operates in standard form on a matrix-ordered Hilbert space K with self-dual cones K_n^+, $n \in N$, then M is the matrix multiplier algebra of K. They also characterize matrix multiplier algebras in standard form in terms of the facial structure of the cones K_n^+.

   Reviewed by E. Størmer

2. **Kernel representation of completely positive Hilbert-Schmidt operators on standard forms** $J_a\circ$

LOTHAR M. SCHMITT AND GERD WITTSTOCK

Archiv der Mathemetik (Basel) **38** (1982), 453–458

Abstract: Let $(\mathcal{M}, \mathcal{H}, \mathcal{H}_n^+)$ be matrix ordered standard form of a W*-algebra $\mathcal{M}$. If $(\mathcal{M}', \mathcal{H}, \mathcal{H}_n^{+\prime})$ is the matrix-ordered standard form of the commutant $\mathcal{M}'$ of $\mathcal{M}$, then $\mathcal{H}_n^{+\prime}$ is the transpose of $\mathcal{H}_n^+$.

Let $\mathcal{M}^{(1)}$ and $\mathcal{M}^{(2)}$ be in matrix ordered standard form. If one identifies $\mathcal{H}^{(1)}\otimes\mathcal{H}^{(2)}$ with the Hilbert-Schmidt operators $HS(\mathcal{H}^{(1)}, \mathcal{H}^{(2)})$, then $\mathcal{M}^{(1)}\otimes\mathcal{M}^{(2)}$, $HS(\mathcal{H}^{(1)}, \mathcal{H}^{(2)})$ and the selfdual cone of completely positive Hilbert-Schmidt operators with respect to the families $\mathcal{H}_n^{(1)+}$ and $\mathcal{H}_n^{(2)+\prime}$ is a standard form.

Public Review (American Mathematical Society): For L^2-spaces over measure spaces, a Hilbert-Schmidt operator T from $L^2(\mu_1)$ to $L^2(\mu_2)$ is represented by a kernel function $k \in L^2(\mu_1 \otimes \mu_2)$, and T maps positive functions of $L^2(\mu_1)$ into the positive functions of $L^2(\mu_2)$ if and only if k is positive a.e. This is generalized to the following situation.

Consider a von Neumann algebra M operating in a standard form on a Hilbert space H. Let M_n be the complex $n \times n$ matrices and let $M \otimes M_n$ operate on $H_n \equiv H \otimes M_n$ by matrix multiplication from the left. Let $H_n^+ \subset H_n$ be the associated natural positive cone. The Hilbert space H is then matrix-ordered by self-dual cones $H_n^+ \subset H \otimes M_n$. Using the commutant M' instead of M, we also have the positive cone $H_n^{+\prime}$ (for each $n \in N$) which is the transpose of H_n^+ and provides another matrix-order for H. (M, H, H_n^+) is called a matrix-ordered standard form.

The generalization is then that for any two matrix-ordered standard forms $(M^{(j)}, H^{(j)}, H_n^{(j)+})$ $(j = 1, 2)$, $(H^{(1)} \otimes H^{(2)})^+$ (relative to $M^{(1)} \otimes M^{(2)}$) corresponds to the set $CP(H^{(1)\prime}, H^{(2)})$ of all completely positive maps from $H^{(1)\prime}$ ($H^{(1)}$ with the matrix-order $H_n^{(1)+\prime}$) to $H^{(2)}$ (with the matrix-order $H_n^{(2)+}$), where $\xi \otimes \eta \in H^{(1)} \otimes H^{(2)}$ corresponds to an operator $[\xi \otimes \eta]$ defined by $[\xi \otimes \eta]\zeta = \langle \xi, J^{(1)}\zeta\rangle\eta$, and $J^{(1)}$ is the modular conjugation operator on $H^{(1)}$ given by the Tomita-Takesaki theory. If $M^{(1)}$ and $M^{(2)}$ are commutative the result reduces to the classical case.

The main theorem (Theorem 1) is stated in a more general context as the identification of $(H^{(1)} \otimes H^{(2)})_j^+$ with $CP(H^{(1)\prime}, H_j^{(2)})$ and $CP(H_j^{(1)\prime}, H^{(2)})$, where H_j is matrix-ordered by $(H_j)_n^+ = H_{jn}^+$.

Reviewed by H. Araki

3. **Characterization of $L^2(\mathcal{M})$ for injective W*-algebras $\mathcal{M}$** $J_a\circ$

Mathematica Scandinavica **57** (1985), 267–280

Abstract: We characterize matrix ordered standard forms $(\mathcal{M}, \mathcal{H}, \mathcal{H}_n^+, n\in\mathbf{N})$ of W*-algebras $\mathcal{M}$ by the following property: every matrix ordered subspace of $(\mathcal{H}, \mathcal{H}_n^+)$ generated by the face of a single element in $\mathcal{H}_1^+$ must be completely isomorphic to some W*-algebra.

We relate the completely positive extension property (injectivity) of matrix ordered spaces which are dual spaces to a matricial analogue of the Riesz interpolation property introduced by G. Wittstock [*J. Funct. Anal.* **40** (1981), 127–150].

As consequences we obtain: if $(\mathcal{H}, \mathcal{H}_n^+)$ is a Hilbert space which is matrix ordered by a family of selfdual cones $\mathcal{H}_n^+ \subset M_n(\mathcal{H})$, then $(\mathcal{H}, \mathcal{H}_n^+)$ is (finitely) injective or has the

matricial Riesz interpolation property, if and only if there exists an injective W*-algebra $\mathcal{M}$ such that $(\mathcal{M}, \mathcal{H}, \mathcal{H}_n^+)$ is a matrix ordered standard form.

Public Review (American Mathematical Society): The first section of this paper contains a characterization of matrix-ordered standard forms $(M, H, H_n^+\colon\ n \in \mathbf{N})$ of W^*-algebras by the property that every matrix-ordered subspace of $(H, H_n^+\colon\ n \in \mathbf{N})$ generated by the face of a single element in H_1^+ is completely order isomorphic to some W^*-algebra. The proof uses a previous characterization due to G. Wittstock and the author [same journal **51** (1982), no. 2, 241–260; MR 84i:46062]. Section 2 contains a detailed analysis of the completely positive extension property (injectivity) in the category of matrix-ordered spaces. For dual spaces this property is related to matricial analogues of the Riesz interpolation property and of the Hahn-Banach property. The main result, given in Section 3, is the characterization of matrix-ordered standard forms $(M, H, H_n^+\colon\ n \in \mathbf{N})$ of injective W^*-algebras by the property that the matrix-ordered Hilbert space $(H, H_n^+ \colon n \in \mathbf{N})$ is (finitely) injective or has the matricial Riesz interpolation property.

Reviewed by S. Stratila

4. **The Radon-Nikodym theorem for L^p-spaces of W*-algebras** $J_a\circ$
Publications of the Research Institute for Mathematical Sciences (RIMS), Kyoto University **22** (1986), 1025–1034

Abstract: We prove an analogue of Sakai's [*Bull. AMS* **71** (1965), 149–151] Radon-Nikodym theorem for L^p-spaces of W*-algebras (consult, *e.g.*, [Araki+Masuda, *Publ. RIMS Kyoto Univ.* **18** (1992), 339–411]). Following Takesaki [Lecture Notes in Mathematics **128**, Springer Verlag], we characterize the Radon-Nikodym derivatives by analytic extensions of modular automorphism groups. Finally, we relate the facial structure in L^p-spaces of W*-algebras to Connes' unitary Radon-Nikodym cocycles [*Ann. Ec. Norm. Sup.* **6** (1973), 133–252].

Public Review (American Mathematical Society): Using Haagerup's approach to L^p-spaces over a von Neumann algebra M, the author generalizes some theorems of Radon-Nikodym type which were known in the cases $L^1(M) \simeq M_*$ or $L^\infty(M) \simeq M$. For example, he finds that if $S, T \in L^p(M)_+$ and the functionals $\varphi, \omega \in M_*^+$ correspond to the operators $S^p, T^p \in L^1(M)$, then $T \leq S$ if and only if the Radon-Nikodym cocycle $[D\omega, D\varphi]_t$ admits an analytic extension to the strip $\{z \in \mathbf{C}\colon\ -1/2p \leq \operatorname{Im} z \leq 0\}$, $(1 \leq p \leq \infty)$.

Reviewed by D. Petz

5. **Order derivations on L^p-spaces of W*-algebras** $J_a\circ$
Mathematische Zeitschrift **196** (1987), 117–124

Abstract: Let $\mathcal{M}$ be a W*-algebra and $L^p(\mathcal{M})$, $1{\leq}p{\leq}\infty$, be the associated L^p-space ordered by the cone $L^p(\mathcal{M})^+$ (consult, *e.g.*, [Araki+Masuda, *Publ. RIMS Kyoto Univ.* **18** (1992), 339–411]). An order derivation on $L^p(\mathcal{M})$ is a bounded linear operator δ satisfying $\exp(t\delta)L^p(\mathcal{M})^+ = L^p(\mathcal{M})^+$ for every $t{\in}\mathbf{R}$.

We show that order derivations δ are of the form $\delta = \pi(x) + J\pi(x)J$ $(*)$, $x{\in}\mathcal{M}$, where π is the natural representation of $\mathcal{M}$ on $L^p(\mathcal{M})$ by left multiplication, and J is the natural involution on $L^p(\mathcal{M})$ induced by the cone $L^p(\mathcal{M})^+$. We also show that in equation $(*)$, the $x{\in}\mathcal{M}$ can be chosen in such a way that $||x||{\leq}9/2||\delta||$.

Furthermore, we show that for groups of positive linear operators on $L^p(\mathcal{M})$-spaces of factors allowing square roots, all operators are in fact completely positive.

Public Review (American Mathematical Society): Let M be a W^*-algebra. The author treats certain problems in the noncommutative L^p-space $L^p(M)$ associated with M in the sense of Haagerup for $1 \leq p \leq \infty$. Here $L^p(M)$ is a certain linear subspace of unbounded operators affiliated with the commutant of M, and comes equipped with a natural positive cone $L^p(M)_+$ and involution J $L^p(M) \to L^p(M)$; M is represented naturally on $L^p(M)$ by the algebra homomorphism which maps an element x of M to its left regular representation $\pi(x)$ on $L^p(M)$. The author considers the Lie algebra of order derivations of $L^p(M)$, which consists of those bounded linear operators δ on $L^p(M)$ such that $e^{t\delta}(L^p(M)_+) = L^p(M)_+$ for all real numbers t. If $x \in M$, the operator $\pi(x) + J\pi(x)J$ is such a derivation, and the main result of this paper asserts that all order derivations of $L^p(M)$ arise in this way. This generalizes a result of A. Connes, who proved this when $p = 2$.

Reviewed by Steve Wright

6. **Semidiscrete Hilbert spaces** $J_a\circ$
Acta Mathematica Hungaria **53** (1989), 103–107

Abstract: A W*-algebra $\mathcal{M}$ is semidiscrete, if the identity on $\mathcal{M}$ can be approximated in the point-$\sigma(\mathcal{M}, \mathcal{M}_*)$ topology by factorization through the spaces of quadratic matrices with completely positive, normal, unital maps. Let $(\mathcal{H}, \mathcal{H}_n^+)$ be a Hilbert space which is matrix ordered by a family of selfdual cones $\mathcal{H}_n^+ \subset M_n(\mathcal{H})$. $(\mathcal{H}, \mathcal{H}_n^+)$ is called semidiscrete, if the identity of $\mathcal{H}$ can be approximated in the strong operator topology by factorization through quadratic matrices with completely positive maps. Using techniques of Torpe [Odense University Preprint No. 4, 1981], we show that with the above notation the following statements are equivalent: (a) $(\mathcal{H}, \mathcal{H}_n^+)$ occurs in the matrix ordered standard form of a semidiscrete W*-algebra $\mathcal{M}$. (b) $(\mathcal{H}, \mathcal{H}_n^+)$ is semidiscrete.

If one of the two conditions is satisfied, then the approximation of the identity can be achieved by factorizations whose combined norm is less than one. Semidiscreteness of Hilbert spaces, as defined above, is also related to approximation properties involving compactness as in Schaefer's book [*Topological Vector Spaces*, Springer Verlag, Thm. 9.5].

Public Review (American Mathematical Society): The paper is devoted to a characterization of noncommutative L^2-spaces among general Hilbert spaces.

A complex Hilbert space H, matrix ordered by a family of self-dual cones $H_n^+ \subseteq H \otimes M_n$, is said to be semidiscrete if the identity of H can be approximated in the strong operator topology by factorization through M_n with completely positive, linear maps.

The main result is the following theorem. For a complex Hilbert space H which is matrix ordered by a family of self-dual cones $H_n^+ \subseteq H \otimes M_n$, the following statements are equivalent: (a) There exists a semidiscrete W^*-algebra M such that $(H, H_n^+,\ n \in \mathbf{N})$ is completely isomorphic to the space $(L^2(M),\ L^2(M)_n^+,\ n \in \mathbf{N})$; (b) H is semidiscrete.

Reviewed by Sh.A. Ayupov

7. **A remark on Radon-Nikodym properties of ordered Hilbert spaces** $J_a\circ$
Proceedings of the American Mathematical Society **105** (1989), 938–940

Abstract: Segal [*Amer. J. Math.* **73** (1951), 275–313] has shown that usual measure theory can be extended reasonably only to measure spaces whose corresponding L^1-spaces have the Radon-Nikodym property. In this note, we characterize L^2-spaces obtained via commutative or non-commutative integration, respectively, by suitable Radon-Nikodym principles.

The concept of "lattice" is difficult to generalize to the non-commutative situation. In this paper, an algebraic condition involving the ideal center, or the matrix multiplier algebra, respectively, is given which distinctively shows the parallelism in structure of commutative or non-commutative L^2-spaces.

Public Review (American Mathematical Society): The aim of the paper is to show that the commutative and noncommutative L^2-spaces are determined as ordered spaces by Radon-Nikodym principles. We say that the Hilbert space H with a self-dual cone H^+ has the Radon-Nikodym property if, for $\eta, \xi \in M^+$ satisfying $\eta \leq \xi$, we have $\eta = x\xi$, where $x \in M^+$ ($M = M_h \oplus iM_h$ and M_h is the ideal center of (H, H^+) in the sense of Wils). The main result is that the pair (H, H^+) has the Radon-Nikodym property if and only if (H, H^+) is unitarily equivalent to $(L^2(X, \mu), L^2(X, \mu)^+)$ for a measure space (X, μ) in the sense of Segal.

Reviewed by A. Bartoszewicz

8. **Direct integrals of matrix-ordered standard forms of W*-algebras** $J_a\circ$
Rocky Mountains Journal of Mathematics **20** (1990), 561–571

Abstract: Bös [*Invent. Math.* **37** (1976), 241–251] proved that standard forms of W*-algebras behave naturally with respect to direct integrals. We give a new approach to disintegration of standard forms of W*-algebras which uses the characterization of matrix-ordered Hilbert spaces in standard forms obtained by Wittstock and the author [*Math. Scand.* **51** (1982), 241–260]. This is satisfactory from a categorial point of view, since it avoids the rather technical direct integral of orientations.

Public Review (American Mathematical Society): Standard forms of W^*-algebras [see, *e.g.*, U. Haagerup, *Math. Scand.* **37** (1975), no. 2, 271–283; MR 53 #11387] behave naturally with respect to direct integrals (in the cases when the algebra itself has a direct integral decomposition, *e.g.*, it is σ-finite). This has been shown by W. Bös [*Invent. Math.* **37** (1976), no. 3, 241–251; MR 55 #1086]. The author obtains Bös' main results by showing that matrix-ordered standard forms of W^*-algebras also disintegrate naturally. These forms were introduced and studied in a paper by the author and G. Wittstock [*Math. Scand.* **51** (1982), no. 2, 241–260; MR 84i:46062].

{For the entire collection see MR 91e:47001}.

Reviewed by Victor Kaftal

9. **Quotients of local Banach algebras are local Banach algebras** $J_a\circ$
Publications of the Research Institute for Mathematical Sciences (RIMS), Kyoto University **27** (1991), 837–843

Abstract: We show that quotients of local Banach algebras, *i.e.*, normed algebras closed under functional calculus, are local Banach algebras. This solves a problem posed by Blackadar in his book [*K-Theory for Operator Algebras*, Springer Verlag (1986)]. Furthermore, our techniques allow to prove additional density theorems for the K-theory of

normed algebras stable under inverses and logarithms, *i.e.*, the K-theory of the algebra and its norm-closure coincide.

Public Review (American Mathematical Society): It is a fortunate circumstance that the basic results of analytic K-theory are valid for a somewhat larger class of algebras than Banach algebras. Completeness is not needed in full strength, but rather such properties (for unital algebras) as openness of the group of invertibles, the ability to exponentiate, and so forth. B.E. Blackadar's treatise [*K-theory for operator algebras*, Springer, New York, 1986; MR 88g:46082] develops the essentials of the theory for local Banach algebras, that is, those normed algebras which (together with all the matrix algebras over them) are closed under holomorphic functional calculus in their norm completions. In the paper under review, the author shows that if a normed algebra is closed under summation of power series with radius of convergence greater than the norm of the argument, then it is closed under holomorphic functional calculus. He deduces from this that the quotient of a local Banach algebra by a closed ideal is again a local Banach algebra, thereby resolving affirmatively a question whose answer Blackadar conjectured to be negative. There are several other K-theoretic results for not-quite Banach algebras, for instance: K_0 of a normed algebra closed (together with all the matrix algebras over it) under inverses and logarithms is naturally isomorphic to K_0 of its completion.

Reviewed by William Paschke

10. **Die Programmiersprache Mathematica — Eine Einführung — Teil 1** J_e
(In German: The programming language Mathematica — An introduction — Part 1)
unix/mail **5**, Carl Hanser Verlag (1991), 320–327
Republished in: Jahres-CD 1997, *Die Blauen Blätter* **4**, Carl Hanser Verlag (1997), ISSN 1432-1263

    Abstract: The programming language Mathematica is discussed with respect to basic functions: (1) calculator type computation, numerical formats and algebraic expressions; (2) function definitions and built-in functions; (3) manipulations on algebraic expressions such as factorization; (4) linear algebra and solution of systems of linear equations; (5) analysis including Taylor series computations; (6) function plots.

11. **Die Programmiersprache Mathematica — Eine Einführung — Teil 2** J_e
(In German: The programming language Mathematica — An introduction — Part 2)
unix/mail **6**, Carl Hanser Verlag (1991), 397–409
Republished in: Jahres-CD 1997, *Die Blauen Blätter* **4**, Carl Hanser Verlag (1997), ISSN 1432-1263

    Abstract: The programming language Mathematica is discussed with respect to list manipulations and programming: (1) lists, nested lists, and indexing; (2) generating multi-layer lists, list operations such as selection of sublists and sorting; (3) programming constructs such as `If`, `For`, and `Module`; (4) input/output management.

12. **Die Programmiersprache Mathematica — Eine Einführung — Teil 3** J_e
(In German: The programming language Mathematica — An introduction — Part 3)
unix/mail **1**, Carl Hanser Verlag (1992), 20–30
Republished in: Jahres-CD 1997, *Die Blauen Blätter* **4**, Carl Hanser Verlag (1997), ISSN 1432-1263

Abstract: The programming language Mathematica is discussed with respect to special aspects such as composition of functions, patterns and rule-based programming, list-programming, automated proofs, and graphics applications.

13. **An implementation of full standard Prolog** EA_a
LOTHAR M. SCHMITT AND SILKE SEEHUSEN
Proceedings of the Mathematica Conference Rotterdam 1992, Beurs-World Trade Center, Rotterdam, The Netherlands (September 2–4, 1992), 1 p.
Implementation by the authors primarily with Mathematica and some UNIX tools.

Abstract: A formal definition of full Prolog is given by Börger in [Logical operational semantics of full Prolog, Parts I–III, IBM Heidelberg (1990)]. We mainly use the part of Mathematica that allows functional programming and lists as underlying main data structures in order to implement this complete draft standard for Prolog.

We have implemented the full syntax of Prolog. We redesigned the selection core proposed by Börger [*loc.cit.*]. It now allows input and output operations as well as inclusion of all built-in predicates. The parser is implemented with LEX and YACC and transforms Prolog into Mathematica notation. Everything else is implemented in Mathematica. The main data structure of the operational semantics of Prolog is mapped to a global stack-like data structure in Mathematica.

In order to make Mathematica, in particular graphics operations, accessible by Prolog programs, we added a new construct `math` to the standard. If one wants to keep only the standard with no additions, then `math` can be removed by a single command line option.

14. **K-theory for Banach algebras** L_e
Research seminar lecture notes (in English). Fachbereich Mathematik/Informatik, Universität Osnabrück, Osnabrück, Germany (1988)
Osnabrücker Schriften zur Mathematik, Reihe **V**, Heft **119**, Universität Osnabrück, Osnabrück, Germany (1992), 232 p.

Abstract: These lecture notes follow the presentation in Blackadar's book [*K-Theory for Operator Algebras*, Springer Verlag (1986)]. Subjects which are covered include the functors K_o and K_1, the cyclic six-term exact sequence and its applications including Connes' Thom isomorphism theorem. The lecture notes also contain supplements covering the following topics: analytic functional calculus as can be found in Rudin's book [*Functional Analysis*, McGraw-Hill Publishers (1973)], some detail on C*-algebras, and a detailed presentation of the theory of crossed products following Pedersen's book [*C*-Algebras and Their Automorphism Groups*, Academic Press (1979)].

15. **An equivariant version of the Hahn-Banach theorem** $J_a\circ$
Houston Journal of Mathematics **18** (1992), 429–447

Abstract: We prove an equivariant version of the Hahn-Banach theorem that allows simultaneous access to Day's [*Notes on ordered linear spaces*, University of Illinois (1950)] versions of the Hahn-Banach theorem, and the Krein-Rutman extension theorem [*Trans. AMS* **26** (1950)] as well as related theorems due to Wittstock [*J. Funct. Anal.* **40** (1981), 127–150], and Arveson [*Acta Math.* **123** (1969), 141–224], respectively. We discuss an order-theoretical characterization of injective, unital C*-algebras. It can be used to obtain simple proofs of stability properties of injective W*-algebras. The main application is the proof of a conjecture by Silverman [*Trans. AMS* **81** (1956), 411–424]:

Let (L, L^+) be an ordered vector space with the least upper bound property. Suppose that S is a right amenable, discrete semigroup acting identically on L. If V is a real vector space with a representation of S as linear operators on V, and $\tau : V \to L$ is a sublinear map satisfying $\tau \circ s \leq \tau$, for every $s \in S$, then there exists an S-equivariant, linear map $\phi : V \to L$ satisfying $\phi \leq \tau$.

In particular, a discrete semigroup S is right amenable, if and only if an S-equivariant Hahn-Banach principle for the real numbers is valid.

Public Review (American Mathematical Society): Let G be an abelian group ordered by a proper cone $G^+ \subseteq G$. Let S be a semigroup with identity acting on G as identity-preserving, positive homomorphisms, and let π_G denote this action. The author says that G is injective if it satisfies the following condition: If H is an ordered abelian group with an identity-preserving, positive S-action, if J is a cofinal, S-invariant subgroup of H, and if $\phi\colon J \to G$ is an S-equivariant, positive group homomorphism, then ϕ extends to an S-equivariant, positive group homomorphism of H into G. If E is an ordered abelian group with an S-action π_E as above, he calls a map θ of E into the power set of G subadditive if, for each $x, y \in E$ and $s \in S$, (i) $\theta(x) \neq \emptyset$, (ii) $0 \leq \theta(0)$, (iii) $x \geq 0$ implies $\theta(-x) \leq 0$, (iv) $\theta(x+y) \leq \theta(x) + \theta(y)$, and (v) $\theta(\pi_E(s)x) \leq \pi_G(s)\theta(x)$, where we write $A \leq B$ for subsets A, B of G if $a \leq b$ for each $a \in A$ and $b \in B$.

The principal result of the paper is a characterization of the injective groups G as precisely those ordered abelian groups with the following S-equivariant, "Hahn-Banach" extension property: For every ordered abelian group E with an S-action and for every subadditive map θ of E into the power set of G, there exists an S-equivariant, positive homomorphism $\phi\colon E \to G$ such that $\phi(x) \leq \theta(x)$, for all $x \in E$. The author deduces from this theorem generalizations of extension theorems of V. Ptak [*Studia Math.* **15** (1956), 365–366; MR 18, 320] and G. Wittstock [*J. Funct. Anal.* **40** (1981), no. 2, 127–150; MR 83d:46072], and shows how to use it to obtain comprehensive and uniform proofs of several known stability results for injective von Neumann algebras. He also solves an old problem of R.J. Silverman [*Trans. Amer. Math. Soc.* **81** (1956), 411–424; MR 18, 492] on the existence of S-equivariant linear maps on ordered vector spaces with certain minimality properties relative to S-equivariant sublinear maps.

Reviewed by Steve Wright

16. **q-canonical commutation relations and stability of the Cuntz algebra** J_a
PALLE E.T. JØRGENSEN, LOTHAR M. SCHMITT AND REINHARD F. WERNER
Pacific Journal of Mathematics **165** (1994), 131–151

Abstract: We consider the q-deformed canonical commutation relations

$$a_i a_j^* - q a_j^* a_i = \delta_{ij}\mathbf{1}, \quad i,j = 1...d, \ d \in \mathbf{N}, \quad -1 \leq q \leq 1.$$

We show the existence of a universal solution of these relations, realized in a C*-algebra $\mathcal{E}^q$ with the property that every other realization of the relations by bounded operators is a homomorphic image of the universal one. For q=0, $\mathcal{E}^o$ is the Cuntz-Toeplitz algebra which is isomorphic to the Cuntz algebra extended by an ideal isomorphic to the compact operators.

We show that for a general class of commutation relations of the form $a_i a_j^* = \Gamma_{ij}(a_1, ...a_d)$ with Γ an invertible matrix, the algebra of the universal solution exists and is isomorphic to the Cuntz-Toeplitz algebra. For the particular case of the q-canonical commutation

relations, this result applies for $|q| \leq \sqrt{2} - 1$. Hence, for these values E^q is isomorphic to E^o. The example $a_i a_j^* - q a_i^* a_j = \delta_{ij} \mathbf{1}$ is also treated in detail.

Public Review (American Mathematical Society): Let $E^q(d)$, for $-1 < q < 1$ and an integer d with $1 < d < \infty$, be the universal C^*-algebra generated by the q-deformed canonical commutation relations $a_i a_j^* - q a_j^* a_i = \delta_{ij} 1$ for $i, j = 1, \cdots, d$. For $q = 0$, $E^0(d)$ is known to be an extension of the Cuntz algebra O_d by the compact operators. In the paper under review it is shown that $E^q(d)$ is isomorphic to $E^0(d)$ for $|q| < \sqrt{2} - 1$. Namely, by polar decomposition arguments one can show that the a_i are of the form $a_i = v_i \rho$ with $\rho = (\sum_{i=1}^d a_i^* a_i)^{1/2}$ and with v_i satisfying the $q = 0$ relations $v_i v_j^* = \delta_{ij} 1 (i, j = 1, \cdots, d)$. On the other hand, by using the Banach fixed-point theorem one concludes that ρ lies in the C^*-algebra generated by the v_i. Thus the a_i and the v_i generate the same C^*-algebra. The restriction $|q| < \sqrt{2} - 1$ comes essentially from the bounds needed to guarantee the applicability of the fixed-point theorem.

If one does not consider the universal C^*-algebra $E^q(d)$ but the Fock representation $R^q(d)$, then $R^q(d) \equiv R^0(d)$ can be proved for a slightly larger interval in q [see K.J. Dykema and A. Nica, *J. Reine Angew. Math.* **440** (1993), 201–212; MR 94e:46117].

In the present paper not only the q-relations are considered but the above described methods and results are extended to more general relations of the form $a_i a_j^* = \Gamma_{ij}(a_1, \cdots, a_d)$, where Γ is an invertible matrix of functions in the functional calculus of d variables which satisfy a continuity and a growth condition. In particular, the relations $a_i a_j^* - q a_i^* a_j = \delta_{ij} 1$ (note the position of the i and j index in the second term) are also considered in detail.

Similar considerations concerning a general class of deformed commutation relations allowing Wick ordering can be found in a preprint of the authors ["Positive representation of general commutation relations allowing Wick ordering", Preprint, Osnabruck, 1993; per bibl.] and a paper by M. Bozejko and R. Speicher [*Math. Ann.* **300** (1994), no. 1, 97–120; MR 95g:46105].

Reviewed by Roland Speicher

17. **q-relations and stability of C*-isomorphism classes** P_a

PALLE E.T. JØRGENSEN, LOTHAR M. SCHMITT AND REINHARD F. WERNER

Proceedings of University of Iowa GPOTS 1992: "Algebraic Methods in Operator Theory", R. Curto and P.E.T. Jørgensen (eds.), Birkhäuser Verlag (1994), 261–271

Abstract: In this paper, we consider a class of algebraic relations which is shown to generate C*-algebras. Our emphasis is on the deformation class which interpolates between the Fermions and the Bosons, and we give conditions for stability of the C*-isomorphism class as the deformation parameter varies. The base point C*-algebra is the Cuntz-Toeplitz algebra which is (for finitely many generators) an extension of the Cuntz algebra $\mathcal{O}_n$ by the compacts. Several classes of examples including Woronowicz' $S_\nu U(2)$ are discussed.

Public Review (American Mathematical Society): This paper gives a survey (without proofs) of the results of the authors from their earlier articles [*Pacific J. Math.* **165** (1994), 131–151; see the following review; "Positive representations of general commutation relations allowing Wick ordering", Preprint, Osnabruck, 1993; per bibl.].

{For the entire collection see MR 95b:46001}.

Reviewed by Roland Speicher

18. **Positive representations of general commutation relations allowing Wick ordering** J_a

PALLE E.T. JØRGENSEN, LOTHAR M. SCHMITT AND REINHARD F. WERNER

Journal of Functional Analysis **134** (1995), 33–99

Contains larger Mathematica application developed by the authors for symbolic verification of proof.

Abstract: We consider the problem of representing in Hilbert space commutation relations of the form

$$a_i a_j^* = \delta_{ij}\mathbf{1} + \sum_{kl} T_{ij}^{kl} a_l^* a_k$$

where the T_{ij}^{kl} are essentially arbitrary scalar coefficients. Examples comprise the q-canonical commutation relation introduced by Greenberg, Bozejko, and Speicher, and the twisted canonical (anti-)commutation relations studied by Pusz and Woronowicz, as well as the quantum group $S_\nu U(2)$. Using these relations, any polynomial in the generators a_i and their adjoints can uniquely be written in "Wick ordered form" in which all starred generators are to the left of all unstarred ones. In this framework, we define the Fock representation as well as coherent representations. We develop criteria for the natural scalar product in the associate representations to be positive definite and for the relations to have representations by bounded operators in a Hilbert space. We characterize the relations between the generators a_i (not involving a_i^*) which are compatible with the basic relations. The relations may also be interpreted as defining a non-commutative differential calculus. For generic coefficients T_{ij}^{kl}, however, all differential forms of degree 2 and higher vanish. We exhibit conditions for this not to be the case, and relate them to the ideal structure of the Wick algebra, and conditions of positivity. We show that the differential calculus is compatible with the involution, iff the coefficients T define a representation of the braid group. This condition is also shown to imply improved bounds for the positivity of the Fock representation. Finally, we study the KMS-states of the group of gauge transformations defined by $a_j \mapsto \exp(it)\, a_j$.

Public Review (American Mathematical Society): Let I be a set, and let $T_{ij}^{kl} \in \mathbf{C}$ for $i, j, k, l \in I$ such that for each pair i, j only finitely many $T_{ij}^{kl} \neq 0$. The algebra of polynomials in the symbols $i, i^\dagger$ for $i \in I$, divided by the relation

$$i^\dagger j = \delta_{ij} 1 + \sum_{k,l \in I} T_{ij}^{kl} l k^\dagger, \quad (*)$$

will be denoted by $W(T)$ and called the Wick algebra. The map $i \mapsto i^\dagger$ can be extended to the involution † in $W(T)$ provided that $T_{ji}^{lk} = \overline{T_{ij}^{kl}}$. The paper under review is basically about representations of $W(T)$ algebras. In particular, the authors are interested in representations π of $W(T)$ such that $W(T) \ni i \mapsto \pi(i) \in B(H)$ and $\pi(i^\dagger)$ is a restriction of $\pi(i)^*$, where * stands for the Hermitian conjugation in the set of all linear operators on a Hilbert space H, while $B(H)$ denotes the set of all linear bounded operators on H. The paper contains criteria for existence of such representations. Also, a characterization of relations between generators $i \in W(T)$ (not involving $i^\dagger$) which are compatible with the basic relations $(*)$ are given. Some natural links between noncommutative differential calculus and the structure of Wick algebras are studied. It is worth pointing out that the paper contains many very interesting and illustrative examples.

Reviewed by Wladyslaw Adam Majewski

19. **Multimedia, multilingual hyperdictionaries: A Japanese↔English example** EA_a

HARVEY ABRAMSON, SUBHASH BHALLA, KIEL T. CHRISTIANSON, JAMES M. GOODWIN, JANET R. GOODWIN, JOHN J. SARRAILLE AND LOTHAR M. SCHMITT
Joint International Conferences of "Association for Literary and Linguistic Computing" and "Association for Computers and the Humanities", Bergen, Norway (June 25-29, 1996), 3 p.
WWW: `http://www.hd.uib.no/allc-ach.abstract.html`

Abstract: While differences in vocabulary, culture, and grammar certainly contribute to the difficulties Westerners have to overcome in order to learn the Japanese language, probably the biggest obstacle is the complex writing system. In fact, the beginning learner is practically illiterate, and stays so for a long time. To master the Japanese writing system, the learner has to work with a variety of dictionaries such as bilingual dictionaries, and dictionaries with various methods of organization for native speakers explaining different meanings and pronunciations of kanji and compounds.

We discuss how a hyperdictionary (*i.e.*, a database with a suitable set of operations for various types of access and queries) combined with modern electronic input methods such as a writing pad can simplify these iterated searches through several layers of dictionaries mentioned above. In particular, identification of kanji by 214 radicals and stroke count can be replaced/supplemented with other methods of geometric characterization of kanji which are incorporated in the database. We present an example for a Prolog-based design of a database listing radicals, kanji, compounds, geometric/topological classification of kanji such as classical stroke count or, *e.g.*, "hole" count, English meaning, and pronunciation (sound). Such a database can be searched, *e.g.*, by approximate stroke count in the kanjis for a compound, which cannot be done with ease in a classical dictionary. This reduces the amount of work to understand and translate Japanese texts significantly, not only for the beginner but also for native speakers.

20. **The logic of Kanji lookup in a Japanese ↔ English hyperdictionary** EA_a

HARVEY ABRAMSON, SUBHASH BHALLA, KIEL T. CHRISTIANSON, JAMES M. GOODWIN, JANET R. GOODWIN, JOHN J. SARRAILLE AND LOTHAR M. SCHMITT
Joint International Conferences of "Association for Literary and Linguistic Computing" and "Association for Computers and the Humanities", Bergen, Norway (June 25-29, 1996), 3 p.
WWW: `http://www.hd.uib.no/allc-ach.abstract.html`

Abstract: We continue the discussion started in "*Multimedia, multilingual hyperdictionaries: A Japanese↔English example*" listed above about the design of a multi- dimensional database or hyperdictionary listing radicals, kanji, compounds, geometric and topological classification of kanji, English meaning, pronunciation (sound), and other information such as encodings in JIS or UNICODE using logic programming (Prolog). In particular, we discuss the organization of the database in regard to classification of kanji using geometric/topological features of various types. We illustrate how Prolog can then be used for a variety of advanced search methods, which are not easily available using a classical dictionary.

21. **Image transformation in integrated quantum well infrared photodetector-light emitting diode** J_a

Maxim Ershov, H.C. Liu and Lothar M. Schmitt
Journal of Applied Physics **82** (1997), 1446–1449

Abstract: We present an analysis of physical effects responsible for infrared image transformation in integrated quantum well infrared photodetector-light emitting diodes (QWIP-LED). For a large-area device, the spatial smearing of the transformed image is determined by the lateral photocurrent spreading in the QWIP and the lateral diffusion of carriers injected into the LED. For devices with low QWIP photocurrent gain, the spatial resolution is limited by the carrier diffusion lengths in the QWIP and in the LED active region, which is much shorter than radiation wavelength, and hence, the transformed image is practically undistorted.

22. **Recognition of Japanese kanji characters by non-Japanese learners through a support database system** P_a
Subhash Bhalla, Harvey Abramson, Kiel T. Christianson, James M. Goodwin, Janet R. Goodwin, John J. Sarraille and Lothar M. Schmitt
Proceedings of the Second International Conference on Cognitive Technology CT97 — Humanizing the Information Age, The University of Aizu, Aizu-Wakamatsu City, Fukushima, Japan (August 25–28, 1997), J.P. Marsh, C.L. Nehaniv and B. Gorayska (eds.), IEEE Computer Society Press (1997), 190–199

Abstract: This paper presents a qualitative analysis of differences in the way that kanji are perceived by different users of Japanese language. Most non-native of Japanese dictionaries find it difficult to use these dictionaries, because the data are organized in the conventional way, that is similar to dictionaries for native Japanese users.

These present complications are based on the assumption that each user has sufficient knowledge of the language. However, the non-native user, in particular at the beginner's level, have a number of difficulties concerning the Japanese characters (called *kanji*) and words (called *compounds*).

In practice, the experienced user with adequate background of the Japanese language also finds it difficult to use Japanese dictionaries. In some cases, these require up to 20 to 30 minutes to locate a reference which may involve the use of several dictionaries. A simple analysis demonstrates that learning tools currently in use are not favorable for non-Japanese learners, and that it is necessary to develop new tools. We describe, analyze, and give examples of some new tools that we are currently developing in connection with a multimedia Japanese $\leftrightarrow$ English dictionary, in particular a convenient user interface based on support data from multi-attribute databases.

23. **Information retrieval and database architecture for conventional Japanese character dictionaries** P_a
Lothar M. Schmitt, Jens Herder and Subhash Bhalla
Proceedings of the Second International Conference on Cognitive Technology CT97 — Humanizing the Information Age, The University of Aizu, Aizu-Wakamatsu City, Fukushima, Japan (August 25–28, 1997), J.P. Marsh, C.L. Nehaniv and B. Gorayska (eds.), IEEE Computer Society Press (1997), 200–217
Implementation by the authors with UNIX tools and *exite* search engine.

Abstract: The cycle of abstraction-reconstruction which occurs as a fundamental principle in the development of culture and in cognitive processes is described and analyzed.

This approach leads to recognition of boundary conditions for and directions of probable development of cognitive tools. It is shown how the transition from a conventional Japanese-English character dictionary to a multi-dimensional language database is an instance of such an abstraction-reconstruction cycle. The different phases of the design of a multi-dimensional language database based upon different computer software technologies are properly placed in this cycle. The methods used include the use of UNIX software tools, classical database methods as-well-as the use of search engines based upon full text search in this process. Several directions of application and extension for a multi-dimensional language database are discussed from the general point of view of an abstraction-reconstruction cycle.

24. **Linear analysis of genetic algorithms** J_a

LOTHAR M. SCHMITT, CHRYSTOPHER L. NEHANIV AND ROBERT H. FUJII
Theoretical Computer Science **200** (1998), 101–134

Abstract: We represent simple and fitness-scaled genetic algorithms by Markov chains on probability distributions over the set of all possible populations of a fixed finite size. Analysis of this formulation yields new insight into the geometric properties of the three phases mutation, crossover, and fitness selection of a genetic algorithm by representing them as stochastic matrices acting on the state space. This indicates new methods using mutation and crossover as the proposal scheme for simulated annealing. We show by explicit estimates that for small mutation rates a genetic algorithm asymptotically spends most of its time in uniform populations regardless of crossover rate. The simple genetic algorithm converges in the following sense: there exists a fully positive limit probability distribution over populations. This distribution is independent of the choice of initial population. We establish strong ergodicity of the underlying inhomogeneous Markov chain for genetic algorithms that use any of a large class of fitness scaling methods including linear fitness scaling, sigma-truncation, and power law scaling. Our analysis even allows for variation in mutation and crossover rates according to a pre-determined schedule, where the mutation rate stays bounded away from zero. We show that the limit probability distribution of such a process is fully positive at all populations of uniform fitness. Consequently, genetic algorithms that use the above fitness scalings do *not* converge to a population containing only optimal members. This answers a question of Rudolph [*IEEE Trans. on Neural Networks* **5** (1994), 96–101]. For a large set of fitness scaling methods, the limit distribution depends on the pre-order induced by the fitness function f, *i.e.*, $c \leq c' \iff f(c) \leq f(c')$ on possible creatures c and c', and not on the particular values assumed by the fitness function.

Public Review (American Mathematical Society): This interesting and important paper introduces a new approach to the exact analysis of genetic algorithms. It combines powerful methods from the theory of operators on linear spaces with a new view of populations, the objects manipulated by the algorithm. Here populations of size s are represented as s-tuples rather than the usual multi-sets—sets with multiplicity but no order on their elements. The finite-dimensional linear space on which their genetic operators act is the free vector space of these populations. Results about populations as multi-sets can be recovered through projection into the quotient space over the kernel of permutations on these populations. For example, it is shown that a simple genetic algorithm converges to a unique fully positive probability distribution over populations. This implies the same result for the multi-set model. The s-tuple representation allows for sim-

pler calculations and the use of additional analytical methods. Moreover, as the authors point out, position in the s-tuple may be used to mimic spacial effects and associated populations although this paper does not pursue this idea further.

The genetic algorithms treated are bit strings acted on by the three usual operators: mutation, crossover, and selection. One of the features of the paper is the wide variety of possibilities treated in a uniform manner. Thus mutations can be one-bit or multi-bit, crossover can be one-point or multi-point, and fitness can incorporate any scaling subject only to preservation of fitness rank.

The paper obtains many explicit results with bounds and rate constants included; some are similar to known results and some settle open questions. A few of the more important results are: (1) small mutation rates imply that the algorithm spends most of its time in the subspace of uniform populations regardless of crossover rate; (2) algorithms with mutation rate, crossover rate and fitness scaling allowed to vary with iteration n, and for which these parameters converge (with mutation rate converging to a positive limit), converge to a probability distribution which has positive probability on all uniform populations (not just maximally fit ones); (3) for a large class of fitness scalings (which preserve fitness rank), the limiting distribution depends only on the order induced by the raw fitness function and not on the particular values assigned.

{See also the following review [MR 2000f:90113].}

Reviewed by R. Shonkwiler

25. **Pedagogical aspects of a UNIX-based network management system for English instruction** J_a

LOTHAR M. SCHMITT AND KIEL T. CHRISTIANSON
Systems **26** (1998), 567–589
Implementation by the authors with UNIX tools.

Abstract: We have developed a UNIX-based management system (named UNEIM) which supports the instructor in teaching English as a second language using a network of workstations. The present implementation is aimed at teaching English composition to Japanese students at The University of Aizu. UNEIM has a convenient setup mechanism designed to assist, in particular, the computer novice. While running, UNEIM takes care of the following tasks using the `cron` mechanism of UNIX: assignments are sent out via e-mail on preset dates; if necessary, students are reminded of missing homework; homework sent back by students via e-mail is sorted in regard to course, section and assignment; submission deadlines and required length of the homework are enforced; homework is partially evaluated in regard to mechanical mistakes such as spelling or punctuation; results of the evaluations by the machine are sent back to the students automatically (to trigger resubmission); the writings of students are reformatted to make human correction easier; the use of global or specialized vocabulary can be measured for individual students as well as classes; authentic, interesting or critical examples of grammatical patterns can be identified and collected for presentation in class or research purposes; desired statistical evidence is generated; and graphical display of data is generated.

26. **Combining the Bourne-shell, sed and awk in the UNIX environment for language analysis** L_e

LOTHAR M. SCHMITT AND KIEL T. CHRISTIANSON
ERIC: Educational Resources Information Center, Document Service, National Library

of Education, USA, ED 424 729, FL 025 224 (1998), 72 p.
WWW: `http://www.accesseric.org:81/index.html`
WWW: `ftp://ftp.u-aizu.ac.jp/u-aizu/doc/Tech-Report/1997/97-2-007.ps.gz`
Implementation by the authors with UNIX tools.

Abstract: We show how to construct tools for language analysis in research and teaching using the Bourne-shell, SED and AWK under UNIX. Applications include the following: searches for words, phrases, grammatical patterns and phonemic patterns in text; statistical evaluation of texts in regard to such searches; transformation of phonetic, phonemic or typographic transcriptions; comparison of texts in various respects; lexical-etymological analysis; concordance; assistance in translating text; assistance in learning languages; assistance in teaching languages; and text processing and formatting. The latter includes the generation of on-line dictionaries for the internet from files that were generated with what-you-see-is-what-you-get editors representing only the linear structure of the dictionary (i.e., the book). All of the above can be achieved with particularly simple and short code. In that regard, we illustrate how SED and AWK can be combined in the pipe mechanism of UNIX to create very powerful processing devices. Our notes include a short introduction to programming the Bourne-shell and rather short, but complete descriptions of SED and AWK customized in regard to language analysis.

27. **The linear geometry of genetic operators with applications to the analysis of genetic drift and genetic algorithms using tournament selection** P_a
LOTHAR M. SCHMITT AND CHRYSTOPHER L. NEHANIV
Proceedings of the International Workshop on Mathematics and Computational Biology: Computational Morphogenesis, Hierarchical Complexity, and Digital Evolution MCB '97, The University of Aizu, Aizu-Wakamatsu City, Fukushima, Japan (October 21–25, 1997), C.L. Nehaniv (ed.), Lectures on Mathematics in the Life Sciences Series Vol. **26**, American Mathematical Society (1999), 147–166

Abstract: We extend the results of the authors and R. H. Fujii in [*Theoret. Comput. Sci.*, **200** (1998), 101–134] on the convergence of genetic algorithms with proportional fitness-scaled selection to genetic algorithms with various types of tournament fitness selection often used in practical applications. Our analysis allows for a general notion of fitness selection which includes types of fitness selection mechanisms where the fitness of the individual depends upon the population it lives in (such as frequency-dependent fitness selection). We also include a short analysis of the effect of genetic drift which has applications to the study of genetic algorithms with selection and crossover but without mutation. Genetic algorithms are represented by Markov chains on probability distributions over the set of all possible populations of a fixed finite size. Linear analysis of the stochastic matrices representing the three phases mutation, crossover, and fitness selection of a genetic algorithm — using, *e.g.*, computation of spectra and Hilbert space techniques — yields new insight into the geometric properties of these phases. We show by explicit estimates, that for small mutation rates a genetic algorithm asymptotically spends most of its time in uniform populations regardless of the crossover rate. We show ergodicity of genetic algorithms using scaled multiple-bit mutation, and a wide range of fitness selection mechanisms which includes scaled proportional fitness selection, tournament fitness selection, and fitness selection mechanisms where the fitness of the individual depends upon the population it lives in. Our analysis permits varying mutation and crossover rates according to a pre-determined schedule, where the mutation rate stays bounded

away from zero. If proportional fitness selection, tournament fitness selection or rank selection is used, then the limit probability distribution of such a process is fully positive at all populations of uniform fitness regardless of the fitness selection method and its possible scaling.

Public Review (American Mathematical Society): This paper extends the results of the authors and R.H. Fujii in [*Theoret. Comput. Sci.* **200** (1998), no. 1-2, 101–134; MR 2000f:90112; see the preceding review] on the convergence of genetic algorithms with proportional fitness-scaled selection to genetic algorithms with various types of tournament fitness selection. Genetic algorithms are represented by Markov chains on probability distributions over the set of all possible populations of a fixed finite size. The Hilbert space techniques of the stochastic matrices representing the three phases mutation, crossover and fitness selection of a genetic algorithm yield new insight into the geometric properties of these phases. Their analysis permits varying mutation and crossover rates according to a pre-determined schedule, where the mutation rate stays bounded away from zero.

{For the entire collection see MR 99k:92002.}

Reviewed by Hassan Emamirad

28. **Implementation of a UNIX-based network management system for English instruction** L_e

LOTHAR M. SCHMITT AND KIEL T. CHRISTIANSON

ERIC: Educational Resources Information Center, Document Service, National Library of Education, USA, ED 428 582, FL 025 781 (1999), 49 p.

WWW: `http://www.accesseric.org:81/index.html`

Implementation by the authors with UNIX tools.

Abstract: This containes a detailed description of implementation issues and organization of the UNIX-based management system (named UNEIM) which supports the instructor in teaching English as a second language using a network of workstations. See the abstract of "*Pedagogical aspects of a UNIX-based network management system for English instruction*" listed above for more detail.

29. **The effect of non-constant effective tunneling mass and asymmetry for resonant tunneling in double-barrier structures** J_a

Applied Physics A **68** (1999), 553–558

WWW: `ftp://ftp.u-aizu.ac.jp/u-aizu/doc/Tech-Report/1998/98-2-003.tar.gz`

Contains larger Mathematica application developed by the author for symbolic verification and numerical evaluation.

Abstract: We discuss the transmission coefficient τ_d in non-repetitive, one-dimensional, rectangular double-barrier structures without simplifications such as strongly attenuating barriers, strong localization, or overall constant effective tunneling mass of the electron. For resonance τ_d=1, we obtain two non-approximative conditions which require different resonance energies of the tunneling electron than previously reported in the literature. In fact, the resonance peaks are shifted to higher energy levels in the order of the width of the peaks due to the effect of non-constant tunneling mass. We investigate the dependence of the resonance condition and the shape of the resonance peaks in regard to pertubation of the electron energy, the gap width as well as the barrier width and height. Resonance is stable for variation of the barrier width but sensitive for variation of the barrier height and the gap width.

30. **Optimization of Mass Distribution in Articulated Figures for High Jump with a Genetic Algorithm** P_a

LOTHAR M. SCHMITT AND TOSHIO KONDOH

Proceedings of the IASTED International Conference "Applied Simulation and Modelling ASM 2000", Banff, Alberta, Canada (July 24–26, 2000), M.H. Hamza (ed.), IASTED-ACTA Press, Anaheim-Calgary-Zürich (2000), ISBN: 0–88986–294–X, ISSN: 1021–8181, 191–197

Contains computer algebra application, and numerical simulation in C developed by the authors.

Abstract: The movement of the human body is simulated with a virtual, mechanical, robot-type model (articulated figure) consisting of 14 solid subbodies. The shapes of these 14 subbodies are initially a ball, cylinders or rectangular boxes. The model is initially adapted, in particular the dimensions of the body, to fit measured data taken from a human athlete's high jump.

The initial model's subbodies are then allowed to vary in shape, but not in mass. For a particular shape of the articulated figure, the mechanical energy or work consumed during the high jump (following the measured trajectories of the human athlete) is computed applying the Euler-Lagrange formalism of classical mechanics. This energy value is set to the inverse fitness value of the corresponding shape in an otherwise custom designed genetic algorithm, where the shape of the articulated figure represents an individual or creature in the population.

Under a simple continuity assumption for the shape of the 14 solid subbodies of the articulated figure, we obtain an optimized figure which shows interesting features such as "cone-shaped muscle groups" or "hips." These features are stable under repeated application of the genetic algorithm procedure.

31. **Convergent Genetic Algorithms and their Applications in Shape Modeling** EA_a

Proceedings of the Third International Conference on Human and Computer (HC-2000), The University of Aizu, Aizu-Wakamatsu City, Fukushima, Japan (September 6–9, 2000), S. Mori *et al.* (eds.), The University of Aizu, Japan (2000), 235

Abstract: In [1: *Theoret. Comput. Sci.* **259** (2001)], the author has established for the first time that regular genetic algorithms (GA) with proper scaling of mutation rate and fitness function using proportional fitness selection actually converge asymptotically to a globally optimal solution. The main restriction in the result in [1] is the requirement that the globally optimal solution is unique in the search space. The result in [1] is similar in nature to results on asymptotic convergence of the simulated annealing algorithm (SAA) using proper cooling schedules, see, *e.g.*, [2: E.H.L. Aarts, P.J.M. van Laarhoven, *Statistica Neerlandica* **43** (1989), 31–52]. In this presentation, we first give an overview how the result mentioned above is achieved, and then discuss how to obtain a proof for convergence in the general case with an arbitrary set of optimal solutions in the search space. Mahfoud and Goldberg [3: R. Männer, B. Manderick (eds.), *Parallel Problem Solving from Nature 2*. Elsevier Publishers (1992), 301–310] have proposed a GA with SAA-type selection where in each round (or generation) the individual parents compete with their offspring. Even though it is clear that a SAA where the parent-generation as a whole competes with the offspring-generation must converge, a proof of convergence for the Mahfoud-Goldberg algorithm is not given in [3]. We discuss how to obtain such a

proof. We shortly discuss parallelization issues of the two algorithms considered. Finally, we indicate applications of the methods mentioned above to shape-modeling of anthropomorphic mannequin in joint work of the author with T. Kondoh, and shape-modeling of surfaces in joint work of the author with V. Savchenko

32. **Theory of Genetic Algorithms** J_a

Theoretical Computer Science **259** (2001), 1–61

Contains Mathematica application developed by the author for symbolic verification of a counter example.

Rank 6 among all papers in all volumes of *Theoretical Computer Science* in regard to downloads during calendar year 2003 from the Elsevier website.

Abstract: The results in [Schmitt *et al.*, *Theoret. Comput. Sci.*, **200** (1998), 101-134] are extended in several regards.

(i) We investigate spectral and geometric properties of the mutation-crossover operator in a genetic algorithm with general-size alphabet. By computing spectral estimates, we show how the crossover operator enhances the averaging procedure of the mutation operator in the random search phase of the genetic algorithm. By mapping our model to the multi-set model often investigated in the literature, we compute spectral estimates for mutation-crossover in the multi-set model.

(ii) Various types of unscaled or scaled fitness selection mechanisms are considered such as proportional fitness selection, rank selection, and tournament fitness selec tion. We allow fitness selection mechanisms where the fitness of an individual or creature depends upon the population it resides in. We investigate contracting properties of these fitness selection mechanisms and combine them with the crossover operator to obtain a model for genetic drift. This has applications to the study of genetic algorithms with zero or extremely low mutation rate.

(iii) We discuss a variety of convergent simulated-annealing-type algorithms with mutation-crossover as generator matrix.

(iv) The theory includes proof of strong ergodicity for various types of scaled genetic algorithms using common fitness selection methods. If the mutation rate converges to a positive value, and the other operators of the genetic algorithm converge, then the limit probability distribution over populations is fully positive at uniform populations whose members have not necessarily optimal fitness.

(v) In what follows, suppose the mutation rate converges to zero sufficiently slow to assure weak ergodicity of the inhomogeneous Markov chain describing the genetic algorithm, unbounded power-law scaling for the fitness selection is used, mutation and crossover commute, and the fitness function is injective which is a minor restriction in regard to function optimization.

($\mathbf{v}_a$) If a certain integrable convergence condition is satisfied such that the selection pressure increases fast, then there is essentialy no other restriction on the crossover operation, and the algorithm asymptotically behaves as the following take-the-best search algorithm: (1) mutate in every step with rate decreasing to zero, and (2) map any population to the uniform population with the best creature. The take-the-best search algorithm is investigated, and its convergence is shown. Depending upon population-size, the take-the-best search algorithm does or does not converge to the globally optimal solution.

(v_b) If population size is larger than length of genome, and a certain logarithmic convergence condition is satisfied such that the selection pressure increases slowly but sufficiently fast, then the algorithm asymptotically converges to the globally optimal solution.

(v_a) shows that a claimed proof of convergence for genetic algorithms by Suzuki in [*Foundations of Genetic Algorithms 4*, R.K. Belew and M.D. Vose (eds.), Morgan Kaufmann Publishers (1997), 53–72] is not correct.

Public Review (American Mathematical Society): This paper is an extension of [L.M. Schmitt, C.L. Nehaniv and R.H. Fujii, *Theoret. Comput. Sci.* **200** (1998), no. 1-2, 101–134; MR 2000f:90112]. It deals with general-size alphabets of strings of genetic algorithms with a wide variety of mutation, crossover and selection mechanisms, fitness scalings, and with inhomogeneity. It presents convergence statements about almost every known genetic algorithm, either on the basis of its extensive bibliography or by direct proofs.

As in the earlier paper [*op. cit.*], a genetic algorithm is a population of size s, treated as an s-tuple rather than the usual multi-set. The finite-dimensional linear space on which the genetic operators act is the free vector space of these populations. Results about populations as multi-sets can be recovered through projection into the quotient space over the kernel of permutations on the populations.

The final section of the paper is a summary of the convergence properties of the various genetic algorithms treated in the preceding sections. We repeat some of these conclusions here with the convention that convergence means convergence of the underlying Markov chain to a steady state distribution which is nonzero only over populations containing optimal individuals. (Non-convergence means the steady state distribution is positive over all populations.)

Case 1: The mutation rate converges to a strictly positive value. (a) Crossover and fitness selection operators converge. Non-convergence for general-size alphabets, generalized crossover and single or multiple spot mutation. (b) Unbounded power-law scaled fitness selection is used for an injective fitness function (different individuals have different fitnesses). The crossover operators need not converge to assure ergodicity. Non-convergence for general-size alphabets, generalized crossover and multiple spot mutation.

Case 2: The mutation and crossover rates vary in an interval. Simulated annealing type selection is used for a population dependent fitness. Convergence is shown for general-size alphabets, generalized crossover and single or multiple spot mutation.

Case 3: The mutation rate converges to zero. Multiple spot mutation and proportional fitness selection are used. (a) Crossover and fitness evaluation are constant. Non-convergence is shown for binary alphabet, regular crossover and multiple-bit mutation. Non-convergence is shown, in principle, for general-size alphabet and generalized crossover. (b) Unbounded power-law scaled fitness selection is used for an injective fitness function. Non-convergence is shown in general. Convergence is shown under certain conditions (the most interesting being that the population size s must exceed string length l).

Reviewed by R. Shonkwiler

33. **Reconstructing Occlusal Surfaces of Teeth Using a Genetic Algorithm with Simulated Annealing Type Selection** P_a

VLADIMIR V. SAVCHENKO AND LOTHAR M. SCHMITT

Proceedings "Solid Modeling 2001" — Sixth ACM Symposium on Solid Modeling and Applications, Sheraton Inn, Ann Arbor, Michigan, USA (June 4–8, 2001), D.C. Anderson and K. Lee (eds.), Sponsored by ACM SIGGRAPH, ACM Press (2001), ISBN 1–58113–366–9, 39–46.
Contains numerical simulation in C developed by the authors.

Abstract: We present an application of numerical optimization for surface reconstruction (more precisely: reconstruction of missing parts of a real geometric object represented by volume data) by employing a specially designed genetic algorithm to solve a problem concerning computer-aided design in dentistry. Using a space mapping technique introduced by Savchenko and Pasko [*The visual computer* **14** (1998), 257-270] the surface of a given model tooth is fitted by a shape transformation to extrapolate (or reconstruct) the remaining surface of a patient's tooth with occurring damage such as a "drill hole." Thereby, the genetic algorithm minimizes the error of the approximation by optimizing a set of control points that determine the coefficients for spline functions, which in turn define a space transformation. The fitness function to be minimized by the genetic algorithm is the error between the transformed occlusal surface of the model tooth and the remaining occlusal surface of the damaged (drilled) tooth. The algorithm, that is used, is based upon a proposal by Mahfoud and Goldberg [R. Männer, B. Manderick (eds.), *Parallel Problem Solving from Natur 2*, Elsevier Publishers (1992), 301–310]. It uses a simulated-annealing type selection scheme, which is applied sequentially (pair-wise, or one-by-one) to the members in the parent generation and their respective offspring generated by mutation-crossover. We outline a proof of convergence for this algorithm. The algorithm is parallel in regard to computing the fitness-values of creatures.

34. **Regular and irregular inflection in German: A perspective offered by an event-related functional magnetic resonance imaging study**
Alan Beretta, Carrie Campbell, Thomas H. Carr, Jie Huang, Lothar M. Schmitt, Kiel Christianson, and Yue Cao EA_a
Cognitive Neuroscience Society Annual Meeting, San Francisco, CA, USA (April 14-16, 2002)

Abstract: The symbol-manipulating approach to the cognitive processing of language predicts distinct neural activation patterns for the production of irregular and regular inflections, whereas the associative approach expects no distinct patterns of activation. An event-related fMRI study of German nominal and verbal inflections shows that the total extent of cortical activation was significantly greater for irregulars than regulars, an outcome consistent with the symbol-manipulating account.

35. **Comparing Cortical Activation of Regular and Irregular Inflection in German**
Jie Huang, Alan Beretta, Carrie Campbell, Thomas H. Carr, Kiel Christianson, Lothar M. Schmitt and Yue Cao EA_a
International Society for Magnetic Resonance in Medicine — Tenth Scientific Meeting and Exhibition, Honolulu, Hawaii, USA (May 18–24, 2002)

Abstract: The symbol-manipulating approach to the cognitive processing of language predicts distinct neural activation patterns for the production of irregular and regular inflections, whereas the associative approach expects no distinct patterns of activation. An event-related fMRI study of German nominal and verbal inflections shows that the total extent of cortical activation was significantly greater for irregulars than regulars, an outcome consistent with the symbol-manipulating account.

36. **Theory of Genetic Algorithms II — Models for genetic operators over the string-tensor representation of populations and convergence to global optima for arbitrary fitness function under scaling** J_a
Theoretical Computer Science **310** (2004), 181–231
Rank 17 among all papers in all volumes of *Theoretical Computer Science* in regard to downloads during calendar year 2003 from the Elsevier website (online since August 2003).

Abstract: We present a short setup for an asymptotically converging, scaled genetic algorithm which employs an arbitrary-size alphabet. The alphabet is primarily interpreted as a set of equidistant real numbers, and multiple-spot mutation performs a scalable compromise between pure random search and neighborhood-based change on the alphabet level. We discuss various versions of the crossover operator, in particular, uniform crossover and gene-lottery crossover which does not commute with mutation. The Vose-Liepins version of mutation-crossover is also integrated in our approach. In order to achieve convergence to global optima, the mutation rate and the crossover rate have to be annealed to zero in proper fashion, and unbounded, power-law scaled proportional fitness selection is used with logarithmic growth in the exponent. Our analysis shows that using certain specific types of crossover operation and large population size allows for particularly slow annealing schedules for the crossover rate. In our discussion, we focus on the following three major aspects based upon contraction properties of the mutation and fitness selection operators: **(i)** The drive towards uniform populations in a genetic algorithm using standard operations. **(ii)** Weak ergodicity of the inhomogeneous Markov chain describing the probabilistic model for the scaled algorithm. **(iii)** Convergence to globallly optimal solutions. In particular, we remove two restrictions imposed in Theorem 8.6 and Remark 8.7 of [*Theoret. Comput. Sci.* **259** (2001), 1–61] where a similar type of algorithm is considered as described here: mutation need not commute with crossover, and the fitness function need not have a single maximum.

37. **An ER-fMRI investigation of morphological inflection in German reveals that the brain makes a distinction between regular and irregular forms** J_a
Alan Beretta, Carrie Campbell, Thomas H. Carr, Jie Huang, Lothar M. Schmitt, Kiel Christianson and Yue Cao
Brain and Language **85** (2003), 67–92

Abstract: A bedrock assumption in linguistic theory is that the language faculty has two separate components, a mental dictionary of stored entries and a set of mental computations based on rules. We used event-related fMRI to test this distinction on German nominal and verbal inflections. In a two-component model, irregular inflections would involve retrieval from the mental dictionary while regular inflections would involve both retrieval of the base form from the mental dictionary and a computational operation combining the stem with an inflectional morpheme [Pinker, *Words and rules: the ingedients of language*, Basic Books, New York (1999)]. If this hypothesis reflects the actual organization of the language faculty, two distinct patterns of brain activation should be observed for production of irregular and regular noun and verb inflections. An alternative to the two-component, rules-and-memory model has been developed in artificial intelligence. Simulation modeling by Rumelhart and McClelland [On learning the past tenses of English verbs. In: J. McClelland, D. Rumelhart and the PDP research group (eds.), *Parallel distributed processing: Explorations in the microstructure of cognition. Vol. 2. Psychological and biological models.* (1986), 216–271] and many others since seeks to

explain the production of all inflected forms, irregular and regular, within a single mechanism, associative memory. This modeling dispenses with a rule-based computational system. Such a model makes a strong prediction: there should be no neural differentiation between German regular and irregular inflection, because a single system is involved in both. Our study examines both nominal and verbal German inflections in order to obtain results that have general implications for the language faculty. The results we report support the existence of different activitation for regulars versus irregulars, an outcome that is consistent with the two-component rules-and-memory account.

38. **Asymptotic Convergence of Scaled Genetic Algorithms to Global Optima —A gentle introduction to the theory—** IBC_e
Invited book chapter. In: A. Menon (ed.). *Frontiers of Evolutionary Computation.* Other contributors: H. Mühlenbein, K. De Jong, P. Moscato/C. Cotta, L. Altenberg, G.A. Kochenberger/F. Glover/B. Alidaee/C. Rego, W. Macready C. Stephens/R. Poli J. Koza/M.J. Streeter/M.A. Keane V. Balaraman W. Banzhaf/J. Miller Genetic Algorithms And Evolutionary Computation Series, Vol. **11** (D.E. Goldberg, ed.). Boston, MA, USA: Kluwer Publishers (2004), pp. 157–192

Abstract: The invited book chapter discusses elements of journal articles listed above in a simplified setting with an additional mathematical framework. In addition, an outlook on possible future research activities is given. Altogether, the following is presented:

We present a self-contained theoretical framework for a scaled genetic algorithm over the alphabet $\{0, 1\}$ which converges asymptotically to global optima as anticipated by Davis and Principe in analogy to the simulated annealing algorithm. We employ the two most common and most simple mixing operators: multiple-bit mutation and single-cut-point crossover. In addition, power-law scaled proportional fitness selection is used based upon an arbitrary fitness function. In order to achieve asymptotic convergence to global optima, the mutation and crossover rates have to be annealed to zero in proper fashion, and power-law scaling is used with logarithmic growth in the exponent. Our analysis shows that a large population size allows for a particularly slow annealing schedule for crossover. For the foremost described setting, a detailed listing of theoretical aspects is presented including prerequisites on inhomogeneous Markov chains. In particular, we focus on: (i) The drive towards uniform populations in a genetic algorithm. (ii) Weak and strong ergodicity of the inhomogeneous Markov chain describing the probabilistic model for the scaled algorithm. (iii) Convergence to globally optimal solutions.

We discuss various generalizations and extensions of the core framework presented in this exposition such as larger alphabets or other versions of the mutation-crossover operator, in particular, the Vose-Liepins version of mutation-crossover. This refers to recent work by the author in [*Theoret. Comput. Sci.* **259** (2001), 1–61] and [*Theoret. Comput. Sci.* **310** (2004), 181–231] where similar types of algorithms are considered over an arbitrary-size alphabet and convergence for arbitrary fitness function to global optima under more general conditions is shown. Finally, we present an outlook on further developments of the theory.

39. **Coevolutionary Convergence to Global Optima** EA_a
Technical Report 2003-2-001, The University of Aizu, Japan (2003), 1–12.
Proceedings of the Genetic and Evolutionary Computation Conference GECCO 2003 (coevolution track: poster), The Holiday Inn, Chicago, IL, USA (July 12–16, 2003), Erick

Cantu-Paz *et al.* (eds.), Lecture Notes in Computer Science 2723, Springer Verlag, Berlin, Germany (2003), 373–375

Abstract: This research generalizes the approach for scaled genetic algorithms converging to global optima for arbitrary fitness function to a 2-species setting. Theory for such genetic algorithms was demanded by K. DeJong in a lecture on coevolution in:
H.-G. Beyer *et al.* (chairs). Seminar "*Theory of Evolutionary Computation 2002*", Max Planck Inst. for Comput. Sci. Conf. Cent., Schloß Dagstuhl, Saarland, Germany (2002).

We discuss a theory for a realistic, applicable scaled genetic algorithm (GA) which converges asymptoticly to global optima in a coevolutionary setting involving two species. It is shown for the first time that coevolutionary arms races yielding global optima can be implemented successfully in a procedure similar to simulated annealing.
KEYWORDS: coevolution; convergence of genetic algorithms; simulated annealing; genetic programming.

40. **Tunnelling effects in concentric disk quantum dots: discrete — discrete and discrete — continuum limits** J_a
LUKÁŠ PICHL, LOTHAR M. SCHMITT, VICTOR RYZHII, MINEO KIMURA AND JIŘÍ HORÁČEK
Proceedings of the 7th International Conference on Nonlinear Optics and Excitation Kinetics in Semiconductors (Poster II.19), Universität Karlsruhe, Karlsruhe, Germany (February 24–28, 2003).
Physica Status Solidi (C) **0** Nr. (5), 1540–1543
EarlyView service of Wiley InterScience (August 7, 2003)

Abstract: Double quantum dot and quantum dot - quantum wire systems are studied in a model with axial symmetry, within the effective mass approximation. Elaborating on exact hole and electron states, we apply the discrete and continuum limits to the outer ring and study exciton formation in this system. Possible applications range from terahertz radiation devices to storage quantum bits.

41. **Optimization with Genetic Algorithms in Multi-Species Environments** P_a
Proceedings of the Fifth International Conference on Computation Intelligence and Multimedia Applications (ICCIMA 2003), Xidian University, Xi'an, China (September 27–30, 2003), Sponsored by IEEE, L. Jiao, H. Selvaraj, B. Verma and X. Yao (eds.), IEEE Computer Society (publisher), Los Alamitos, CA, USA, ISBN 0-7695-1957-1, 194-199

Abstract: This generalizes The University of Aizu, Tech. Reps. 2003-2-001 and 2003-2-006 on coevolution to a setting with more than two species where not all species need to be globally optimized but is restricted to binary encoding and regular crossover as follows:

We discuss a converging scaled genetic algorithm (GA) in a setting where populations contain several types of interacting creatures. The interaction is used to define a population-dependent fitness function which, in particular, need not be injective. Encoding is discussed fo the binary case. The GA employs multiple-spot mutation, various crossover operators (but focusses on regular one/two/multiple-cutpoint crossover) and power-law scaled proportional fitness selection. To achieve convergence, the mutation and crossover rates have to be annealed to zero in proper fashion, and power-law scaling is used with logarithmic growth in the exponent. If creatures of specific types exist that have maximal fitness in every population they reside in, then the GA described here converges

asymptotically to a probability distribution over multi-uniform populations containing only such maximal creatures.

KEYWORDS: coevolution, asymptotic convergence of genetic algorithms; multiple-spot mutation; power-law scaled proportional fitness selection; simulated annealing.

42. **Theory of Coevolutionary Genetic Algorithms** P_a

Proceedings of 'The 2003 International Symposium on Parallel and Distributed Processing and Applications' ISPA 2003, The University of Aizu, Aizu-Wakamatsu City, Fukushima, Japan (July 2–4, 2003). M. Guo, L.T. Yang (eds.). Sponsored by ACM and IPSJ. Lecture Notes in Computer Science 2745, Springer Verlag, Berlin, Germany (2003), pp. 285–293

Abstract: We discuss recent advances in the stochastic modeling of coevolutionary genetic algorithms (GAs). The discussion includes theorems on asymptotic convergence of these GAs to global optima under the condition that (appropriately defined) globally maximal elements exist. Our presentation refers mainly to work by the author in recent publications on coevolutionary GAs (Tech. Reps. 2003-2-001/006/0011, The University of Aizu, Japan) but *extends some of these findings*, in particular, in regard to the use of (1) general-size alphabets, (2) a mutation operator that allows a scalable compromise between neighborhood-based search and uniform change on the alphabet level, (3) gene-lottery crossover and (4) more general cooling schedules.

Specifically, we discuss a theoretical framework for a scaled GA which converges asymptotically to global optima in a setting where populations contain several types of interacting creatures. The interaction is used to define a population-dependent fitness function which, in particular, need not be injective. The algorithm employs multiple-spot mutation, various crossover operators (with focus on and explicit treatment of gene-lottery crossover) and power-law scaled proportional fitness selection. The mutation operator uses a spot-mutation operator that represents a scalable compromise between neighborhood-based search in the spirit of the simulated annealing algorithm and pure random change on the alphabet level. The general-size alphabet is primarily interpreted as a set of equidistant real numbers. Proper scaling of mutation ensures ergodicity of the inhomogeneous Markov chain describing the probabilistic model for the algorithm. As for crossover, a detailed description and focus on algorithms using gene-lottery crossover is included. Our analysis shows that a large population size allows for a particularly slow annealing schedule for standard crossover operators. The algorithm uses power-law scaling for the fitness function with logarithmic growth in the exponent. If creatures of specific types exist that have maximal fitness in every population they reside in, then the GA described here converges asymptotically to a probability distribution over multi-uniform populations containing only such maximal creatures.

KEYWORDS: coevolution; convergence of genetic algorithms; gene-lottery crossover; unbounded power-law scaled proportional fitness selection; simulated annealing; parallel processing.

43. **Portfolio optimization with hedging in strictly convergent coevolutionary markets** P_a

LUKÁŠ PICHL, LOTHAR M. SCHMITT, AND AYAKO WATANABE

Technical Report 2003-2-008, The University of Aizu, Japan (2003), 1–4.

Proceedings of the Third International Workshop on Computational Intelligence in Economics and Finance: CIEF 2003, Embassy Suites Hotel and Conference Center, Cary, NC, USA (September 26–30, 2003), Sponsored by AIM

Abstract: The portfolio optimization problem with hedging adapted utility function is studied within a fully computerized multi-agent market system. We clarify the conditions under which static approaches such as constraint optimization with stochastic rates or stochastic programming apply in coevolutionary markets with strictly maximal market players under scaled genetic algorithms. Convergence to global optimum is discussed for (1) coevolution of buying and selling strategies and for (2) coevolution of portfolio strategies and asset distributions over market players. Since only a finite population size in our setting suffices for the asymptotic convergence, the design criteria for genetic algorithm given (explicit cooling scheme for mutation and crossover, exponentiation schedule for fitness-selection) are of practical importance. Finally, a JAVA model of stationary market was developed and made available for use and download.
KEYWORDS: coevolution, asymptotic convergence of genetic algorithms; multiple-spot mutation; power-law scaled proportional fitness selection; simulated annealing.

44. **Modeling Genetic Algorithms from a Linear Operator Point of View — A Survey of Recent Advances and Future Perspectives** J_e
Proceedings of KOTAC International Conference 2003 'Operator Theory and Applications', Chungnam National University, Daejeon City, Korea (June 19–21, 2003), Sponsored by Daewoo Foundation.
Trends in Contemporary Mathematics **6** (2003), 113–123

Abstract: We present an overview over recent advances in stochastic modeling of genetic algorithms. In addition, we discuss possible future research activities in this field.

45. **Classification with Scaled Genetic Algorithms in a Coevolutionary Setting** P_a
To appear: *Proceedings of the Genetic and Evolutionary Computation Conference GECCO 2004* (genetic algorithm track: full paper), Red Lion Hotel, Seattle, WA, USA (June 26–30, 2004), Riccardo Poli *et al.* (chairs). Lecture Notes in Computer Science, Springer Verlag, Berlin, Germany (2004), 12 p.

Abstract: This note discusses asymptotic convergence of scaled genetic algorithms in a coevolutionary setting where the underlying population contains fixed numbers of creatures of various types. These types of creatures can act on each other in cooperative or competitive manner. The genetic algorithm uses common mutation and crossover operators as well as proportional fitness selection. By a scaled genetic algorithm, we mean that the mutation and crossover rates have to be annealed to zero in proper fashion over the course of the algorithm, and power-law scaling is used for the fitness function with (unbounded) logarithmic growth in the exponent. In the case that a scaled genetic algorithm is used as function optimizer, it has been shown [Theoret. Comput. Sci. 310, p. 181] that such an algorithm is able to find global optima asymptoticly with probability one. However, in the case of a coevolutionary setting, global optima need not exist. Based upon a properly defined, population-dependent fitness function, the set of creatures of a specific type can be canonically grouped into equivalence classes such that all members of one equivalence class are either inferior or superior to all members of another class. We show that in the situation of a coevolutionary setting, a scaled genetic algorithm at least retains the property of converging to a probability distribution over such populations that contain only copies of one creature from the *top-class* for every or a selected group of types while on the other hand maintaining a noisy field of test-cases.

46. **Isomorphisms of K-groups for certain normed algebras and their closures** J_e

Proceedings of the 2004 KOTAC International Conference 'Operator Theory and Applications' , Seoul National University, Seoul, Korea (June 17–19, 2004), Sponsored by Korea Science and Engineering Foundation, Korea Research Foundation, BK21 Mathematical Sciences Division, Research Institute of Mathematics at Seoul National University.
To appear: *Trends in Contemporary Mathematics* (2004)

Abstract: We present an approach to K-theory for certain normed algebras that is particularly algebraic in nature and uses the norm and other topological properties with the most possible restraint. This yields simplified and strengthened statements plus proofs of certain theorems related to the cyclic 6-term exact sequence of K-theory for such normed algebras. In addition, isomorphisms of K-groups for certain normed algebras and their closures can be shown based upon the previously mentioned results related to the cyclic 6-term exact sequence of K-theory. This presentation is based upon Remark 3.5 in [Publ. RIMS, Kyoto, 27 (1991), p. 842].

47. **De Jong's Challenge for Coevolutionary Genetic Algorithms** P_e
To appear: *Proceedings of the Dagstuhl Seminar 04081 'Theory of Evolutionary Algorithms'* (February 15–20, 2004), H.-G. Beyer, T. Jansen, C. Reeves, M.D. Vose (chairs): preprint server of the Max-Planck Institute for Computer Science Conference Center Schloß Dagstuhl, Saarland, Germany (2004)

Abstract: Presentation given during the conference on the topic covered in the GECCO 2004 contribution 'A Note on Classification with Scaled Genetic Algorithms in a Coevolutionary Setting' of mine (see listing and abstract above). The written contribution to the Proceedings of the Dagstuhl Seminar 04081 is an extension of the GECCO 2004 contribution of mine. It contains additional examples for the setting under consideration, and a detailed collection of proofs which could not be added to the GECCO 2004 publication due to length-of-submission limitations.

48. **Feasible Approaches to Convergence Results for Evolutionary Algorithms — Part I: Introductory overview and analysis of scaled genetic algorithms** P_a
Lothar M. Schmitt, and Stefan Droste
Technical Report 2004-2-004, The University of Aizu, Japan (2004), 1–10.
Submitted: *Proceedings of the Workshop on Evolutionary Computation Theory, Genetic and Evolutionary Computation Conference GECCO 2004*, Red Lion Hotel, Seattle, WA, USA (June 26, 2004), Neal Richter *et al.* (organizers), 10 p.

Abstract: Despite many successes of evolutionary algorithms (EAs) in real-world applications, theoretical knowledge in regard to these algorithms is still in its infancy. In this work, we discuss a number of approaches to theory for EAs in regard to strengths and weaknesses of statements for convergence-speed obtained with these methods. This includes the general convergence-analysis of a broad class of EAs in an arbitrary-fitness-function black-box scenario similar to the setting for the simulated annealing algorithm, and the runtime-analysis of specific EAs on limited classes of fitness-functions within the framework of asymptotic runtime-analysis for randomized algorithms.

We propose that a suitable merger of ideas put forward through the latter two types of convergence-analysis may yield substantial progress towards understanding convergence behavior of EAs. In particular, this may yield a unified theoretical framework for EAs as well as probabilistic estimates for runtimes of EAs used in real-world applications.

49. **Feasible Approaches to Convergence Results for Evolutionary Algorithms — Part II: Runtime analysis of evolutionary algorithms and summary** P_a
STEFAN DROSTE AND LOTHAR M. SCHMITT
Technical Report 2004-2-005, The University of Aizu, Japan (2004), 1–10.
Submitted: *Proceedings of the Workshop on Evolutionary Computation Theory, Genetic and Evolutionary Computation Conference GECCO 2004*, Red Lion Hotel, Seattle, WA, USA (June 26, 2004), Neal Richter *et al.* (organizers), 10 p.

Abstract: See Abstract of part I.

2 Theses by Lothar M. Schmitt (3)

1. **Charakterisierung von W*-Algebren durch autopolare, 2-geordnete, diagonal-homogene, 2-positive Kegelpaare.**
(In German: Characterization of W*-algebras by selfdual, 2-ordered, diagonal-homogeneous, 2-positive pairs of cones.)
Diplomarbeit (Thesis): Diplom Mathematiker (Master of Science).
Saarbrücken, Germany: Universität des Saarlandes, Fachbereich Mathematik (1979), 49 p.

Abstract: Let $\mathcal{M}$ be a W*-algebra with associated standard form $(\mathcal{M}, \mathcal{H}, \mathcal{H}_1^+)$ in the sense of Araki-Connes-Haagerup with selfdual cone $\mathcal{H}_1^+ \subset \mathcal{H}$. Let $\mathcal{M}_2 = M_2(\mathcal{M})$ be the W*-algebra of 2×2-matrices over $\mathcal{M}$. Let $(\mathcal{M}_2, M_2(\mathcal{H}), \mathcal{H}_2^+)$ be the standard form associated with $\mathcal{M}_2$. Then $(\mathcal{H}, \mathcal{H}_1^+, \mathcal{H}_2^+)$ enjoys the following *characterizing* properties:
(i) $(\mathcal{H}, \mathcal{H}_1^+, \mathcal{H}_2^+)$ is 2-ordered, *i.e.*, one has $\gamma \mathcal{H}_\kappa^+ \gamma^* \subset \mathcal{H}_\nu^+$ for scalar matrices γ, and $\kappa, \nu \in \{1, 2\}$.
(ii) $(\mathcal{H}, \mathcal{H}_1^+, \mathcal{H}_2^+)$ is diagonal-homogeneous, *i.e.*, if F_1 is a face in $\mathcal{H}_1$, $F_2 = F_1 \oplus 0$, then $\exp(t(P_{F_\nu} - P_{F_\nu^\perp}))$ are positive operators for all $t \in \mathbf{R}$.
(iii) $(\mathcal{H}, \mathcal{H}_1^+, \mathcal{H}_2^+)$ is 2-positive, *i.e.*, if $\exp(t\delta)$ are positive operators for all $t \in \mathbf{R}$, $\delta \in \mathcal{B}(\mathcal{H})$, then $exp(t\delta \otimes id) \in \mathcal{B}(\mathcal{H}_2)$ are positive operators for all $t \in \mathbf{R}$.

Background: U. Haagerup, Math. Scand., 37 (1997), 271–283. A. Connes, Ann. Inst. Fourier 24 (1974), 121–155.

2. **Zur Struktur der Seiten in L^p-Räumen von W*-Algebren**
(In German: On the structure of faces in L^p-spaces of W*-algebras)
Dissertation: Dr.rer.nat. (Ph.D.)
Saarbrücken, Germany: Universität des Saarlandes, Fachbereich Mathematik (1985), 106 p.

Abstract: L^p-spaces of W*-algebras are the non-commutative analogues of the classical L^p-spaces in commutative integration. Thus, they are examples of what could be called "non-commutative Banach lattices." For these spaces, an order theoretical principle was developed which has many interesting applications. It characterizes the facial subspaces generated by single positive elements as C*- resp. W*-algebras. In the case of Banach lattices, this corresponds to facial subspaces of type $\mathcal{C}(K)$, K compact, as consequence of the Krein-Kakutani Theorem.

Applications include the characterization of L^2-spaces of injective W*-algebras, the characterization of order derivations on L^p-spaces of W*-algebras, and the correspondence of

a Hahn-Banach principle in the sense of Arveson-Wittstock for W*-algebras and their L^p-spaces.

Background: H. Araki, T. Masuda, Publ. RIMS Kyoto, 18 (1982), 339–411. A. Connes, Ann. Inst. Fourier 24 (1974), 121–155. G. Wittstock, J. Funct. Analysis 40 (1981), 127–150.

3. **Beiträge zur Theorie der Banachalgebren.**
   —Schriftensammlung zur Habilitation—
   (In German: *Contributions to the Theory of Banach Algebras.* —Collection of publications for Habilitation—)
   Habilitation: Dr.rer.nat.habil.
   Osnabrück, Germany: Universität Osnabrück, Fachbereich Mathematik/Informatik (1991), 103 p.

   Abstract: The collection of publications for Habilitation contains my research papers written until 1991 which are marked with ∘ above. They represent research in functional analysis on the Hahn-Banach theorem, K-theory of Banach algebras, L^p-spaces of W*-algebras, and, in particular, characterization of non-commutative L^2-spaces. This work was evaluated by H. Behncke (Universität Osnabrück, Osnabrück, Germany), J. Cuntz (Westfälische Wilhelms-Universität, Münster, Germany), and G. Wittstock (Universität des Saarlandes, Saarbrücken, Germany).

   The German Habilitation is the equivalent of the French *Thèse d'état*, the Japanese *Marugo* evaluation for the Ph.D.-level, the Russian degree of *Dr.sci.*, and the evaluation procedure at US universities usually done for promotion from assistant to associate professor. It entitles to tenure in Germany.

3 Lecture Notes (7)

During my career, I have been teaching a large variety of courses ranging from beginner's courses such as *Linear Algebra*, *Analysis*, *Computer Algebra*, and UNIX-*Tools* to advanced graduate and research courses such as *Functional Analysis*, several fields of *Advanced Operator Theory*, and *Theory of Probabilistic Algorithms*. Some course material was published as lecture notes which is either listed below, or in some of the articles listed above. Lecture notes were distributed in class, or were made available for photocopy to participants of the courses. They can be obtained from the author (e-mail `lothar@u-aizu.ac.jp`).

1. **Lecture notes on Tomita-Takesaki theory.**
   Research seminar lecture. Notes in English (taken by R.S. Doran).
   Texas Christian University, Department of Mathematics, Fort Worth, TX, USA (1980), 316 p.

   Abstract: The lecture notes on Tomita-Takesaki theory follow the presentation by Takesaki in [Lectire Notes in Mathematics **128**, Springer Verlag] on the subject occasionally simplifying proofs. The presentation starts with an account of the theory of densely defined linear operators on Hilbert spaces as can be found in Rudin's book on Functional Analysis and the treatise by Dunford-Schwarz. Included are the spectral theorem, the polar decomposition, and representation of semigroups. Then, Tomita's theory of modular Hilbert algebras is developed as presented by Takesaki up to the central theorems that establish the standard form of W*-algebras.

2. **K-theory for Banach algebras**
Research seminar lecture notes (in English). Fachbereich Mathematik/Informatik, Universität Osnabrück, Osnabrück, Germany (1988)
Osnabrücker Schriften zur Mathematik, Reihe **V**, Heft **119**, Universität Osnabrück, Osnabrück, Germany (1992), 232 p.

Abstract: These lecture notes follow the presentation in Blackadar's book [*K-Theory for Operator Algebras*, Springer Verlag (1986)]. Subjects which are covered include the functors K_o and K_1, the cyclic six-term exact sequence and its applications including Connes' Thom isomorphism theorem. The lecture notes also contain supplements covering the following topics: analytic functional calculus as can be found in Rudin's book [*Functional Analysis*, McGraw-Hill Publishers (1973)], some detail on C*-algebras, and a detailed presentation of the theory of crossed products following Pedersen's book [*C*-Algebras and Their Automorphism Groups*, Academic Press (1979)].

3. **Lectures on Connes' theory of non-commutative differential geometry**
Research seminar lecture. Notes in English.
Osnabrück, Germany: Universität Osnabrück, Fachbereich Mathematik/Informatik (1991), 128 p.

Abstract: These lecture notes follow Connes' work [*Publ. Math. IHES* **62** (1986), 257-360]. Subjects which are covered include analytical functional calculus, K-theory, Schatten classes, Fredholm modules, characters for p-summable Fredholm modules, Eisenstein series, homological algebra, homology group pairing with K_o, the index map, operation S and relation between higher characters, homotopy invariance, KK-theory, main theorem: if $F(\mathcal{A})$ denotes homotopy classes of finitely summable Fredholm modules over a certain subalgebra $\mathcal{A}$ of a C*-algebra A, and $H^{ev}(\mathcal{A})$ denotes cyclic homology of $\mathcal{A}$, then there are canonical maps such that $F(\mathcal{A}) \to KK(A, \mathbf{C}) \to Hom(K_o(A), \mathbf{Z}) \subset Hom(K_o(A), \mathbf{C})$, and $F(\mathcal{A}) \to H^{ev}(\mathcal{A}) \to Hom(K_o(A), \mathbf{C})$ define a commutative diagram.

4. **Functional analysis**
Graduate course (one semester). Notes in English.
Osnabrück, Germany: Universität Osnabrück, Fachbereich Mathematik/Informatik (1991), 130 p.

Abstract: The course follows chapters 1–4 and 10–12 in Rudin's book [Functional Analysis, McGraw-Hill Publishers (1973)] with occasional additions such as the proof of the bipolar theorem, and some elementary theory of C*-algebras.

5. **Mathematik für Naturwissenschaftler I**
(In German: Mathematics for natural scientists I)
Graduate course (mainly for physicists, one semester). Notes in German.
Osnabrück, Germany: Universität Osnabrück, Fachbereich Mathematik/Informatik (1992), 200 p.

Abstract: Logic, sets and relations, the real and complex numbers (axiomatic approach), linear algebra for analysis (vector spaces and linear maps), metrics, norms and inner products, calculus in Banach spaces mainly following Lang's book [Analysis I, Addison-Wesley Publishers (1969)], series and complex exponential function, the Riemann integral.

6. **Mathematik für Naturwissenschaftler II**
(In German: Mathematics for natural scientists II)

Graduate course (mainly for physicists, one semester). Notes in German.
Osnabrück, Germany: Universität Osnabrück, Fachbereich Mathematik/Informatik (1992), 180 p.

Abstract: (1) Linear Algebra (including tensor products, and the spectral theorem for matrices); (2) Analytic function theory (up to residue calculus and evaluation of integrals); (3) Measure theory mainly following Rudin's book [Real and Complex Analysis, McGraw-Hill (1974)] (including Lebesque's dominated convergence theorem, and (without proof) the Riesz representation theorem); (4) Supplement: Proof of the Riesz representation theorem (not lectured).

7. **Lectures on Genetic Algorithms**
Graduate Course (one 9-week quarter). Notes in English.
Aizu-Wakamatsu, Japan: The University of Aizu (1998).

Abstract: The course gives a thorough treatment of mathematical foundations of probabilistic algorithms (genetic algorithms, and simulated annealing applications) based upon my current research. (See the abstracts above.)

1 Diplomas

The following document contains scans of diplomas. The original documents will be made available at the time of employment.

1.1 Abitur

The German *Abitur* is the certificate of completion for high school. Essentially, it entitles the bearer to study any subject[1] at any university in Germany. Thus, the Abitur serves the purpose of a university entrance examination.

1.2 Diplom Mathematiker

The German *Diplom* is the analogue to the *Master of Science* degree. There is no *Bachelor of Science* degree in the traditional German university system.

1.3 Doktor der Naturwissenschaften

Doctor of Natural Sciences in Mathematics. This corresponds to the American *Doctor of Philosophy* degree for Mathematics, or the Russian *Cand.sci.* degree.

1.4 Habilitierter Doktor der Naturwissenschaften

The German *Habilitation* is the equivalent of the French *Thèse d'état*, the Japanese *Marugo* evaluation for the Ph.D.-level, the Russian degree of *Dr.sci.*, and the evaluation procedure at US universities usually done for promotion from assistant to associate professor.

[1] Some fields of study are further regulated due to limitation of capacity. However, waiting yields a bonus in the system, and after waiting long enough, anyone can study any field in principle.


STAATLICHES KNABENGYMNASIUM
SAARBRÜCKEN
Neusprachliches und mathematisch-naturwissenschaftliches Gymnasium

ZEUGNIS

DER REIFE

Figure 1: Abitur. Page 1.

Lothar Schmitt

geboren am 30. April 1955 in Saarbrücken

wohnhaft in Dudweiler - Saar

hat sich der Reifeprüfung am Staatlichen Knabengymnasium Saarbrücken unterzogen.

I.

Die Leistungen in den einzelnen Fächern sind wie folgt beurteilt worden:

Religion ~~Philosophie~~ . sehr gut

Deutsch . . . . . befriedigend

Gemeinschaftskunde:

Geschichte und Sozialkunde befriedigend

Erdkunde . . . . . gut

Mathematik . . . . sehr gut

Physik . . . . . sehr gut

Französisch . . . . ausreichend

Biologie sehr gut

~~Bildnerisches Gestalten~~ - Musik sehr gut

Leibesübungen . . . befriedigend

Lothar Schmitt hat die Reifeprüfung bestanden.

Die Prüfungskommission hat ihm das

Zeugnis der Reife

zuerkannt und damit die Befähigung zum Studium an einer Hochschule in der Bundesrepublik Deutschland ausgesprochen.

Figure 2: Abitur. Page 2.

II.

a) Wahlfreier Unterricht der Klassen 12 und 13:

Informatik (Klasse 12)

/

b) Fächer, die vor Beginn der Klasse 12 abgeschlossen worden sind:

Englisch	befriedigend
Chemie	sehr gut
Bild. Kunst	sehr gut
/	/

III.

/

Durchschnittsnote 2,0

Saarbrücken, den 16. Mai 1974

Der Vorsitzende der Prüfungskommission:

Der Oberstudiendirektor:

Reihenfolge der Notenstufen: sehr gut, gut, befriedigend, ausreichend, mangelhaft, ungenügend

UNIVERSITÄT DES SAARLANDES

DIPLOM

HERR - FRAU Lothar Maria SCHMITT

GEBOREN AM 20.04.1955 IN Saarbrücken

HAT AM 28.08.1979 DIE DIPLOM-HAUPTPRÜFUNG FÜR MATHEMATIKER

AN DER UNIVERSITÄT DES SAARLANDES MIT DER GESAMTNOTE

sehr gut

BESTANDEN.

AUF GRUND DIESER PRÜFUNG WIRD IHM/IHR HIERMIT DER AKADEMISCHE GRAD

DIPLOM-MATHEMATIKER

VERLIEHEN.

SAARBRÜCKEN, DEN 28. August 1979

DER VORSITZENDE DES PRÜFUNGSAMTES
FÜR DIE DIPLOM-PRÜFUNG FÜR MATHEMATIKER AN DER
UNIVERSITÄT DES SAARLANDES

Professor Dr. E. Lamprecht

DER DEKAN DER MATHEMATISCH-NATURWISSENSCHAFTLICHEN FAKULTÄT
DER UNIVERSITÄT DES SAARLANDES

Professor Dr. L. Heck

Figure 4: Diplom Mathematiker

DIE
MATHEMATISCH-NATURWISSENSCHAFTLICHE FAKULTÄT
DER UNIVERSITÄT DES SAARLANDES

PROMOVIERT

HERRN DIPL.-MATH. LOTHAR MARIA S C H M I T T

GEBOREN AM 20.04.1955 IN SAARBRÜCKEN

ZUM

DOKTOR DER NATURWISSENSCHAFTEN
(DOCTOR RERUM NATURALIUM)

— NACHDEM ER IM ORDENTLICHEN
PROMOTIONSVERFAHREN DURCH DIE DISSERTATION

"ZUR STRUKTUR DER SEITEN IN L^p-RÄUMEN VON W*-ALGEBREN"

SOWIE DURCH DAS KOLLOQUIUM SEINE
WISSENSCHAFTLICHE QUALIFIKATION NACHGEWIESEN HAT —

MIT DER GESAMTNOTE

MAGNA CUM LAUDE

SAARBRÜCKEN, DEN 12. JULI 1985

DER DEKAN

PROFESSOR DR.-ING. H. JASCHEK

Figure 5: Promotion: Dr. rer. nat.

DIE UNIVERSITÄT OSNABRÜCK

verleiht durch diese mit dem Universitätssiegel versehene,
vom Präsidenten und vom Dekan unterzeichnete Urkunde

Herrn Dr. rer. nat.

Lothar M. Schmitt

geb. am 20. April 1955 in Saarbrücken

den akademischen Grad

Habilitierter Doktor der Naturwissenschaften
(Dr. rer. nat. habil.).

Er ist berechtigt, den Titel

Privatdozent

zu führen und ist befugt, an der Universität Osnabrück
im Fachgebiet

Mathematik
mit der Fachrichtung Reine Mathematik

selbständig zu lehren,
nachdem er sich

aufgrund eines ordnungsgemäßen Habilitationsverfahrens
im Fachbereich **Mathematik/Informatik**

habilitiert hat.

Osnabrück, den 08. April 1991

Der Präsident

Prof. Dr. R. Künzel

Der Dekan

Prof. Dr. E. Cohors-Fresenborg

Figure 6: Habilitation: Dr. rer. nat. habil.