CDMTCS: 2005 ANNUAL REPORT

The Centre for Discrete Mathematics and Theoretical Computer Science was founded in 1995 in order to a) support basic research on the interface between mathematics and computing, b) increase local knowledge in these areas, and c) broaden research skills in New Zealand. The Centre is supported nancially by the Departments of Computer Science and Mathematics and sponsored by Pukekohe Travel.

Director

Professor C.S. Calude

Management Committee

The activities of the Centre are overseen by a Management Committee consisting of

- Professor Douglas Bridges (External Researchers Representative, Canterbury University),

- Professor Cristian Calude (Director),

- Dr. Michael J. Dinneen (Deputy Director),

- A/Professor B. Barton (HOD Mathematics Department),

- Professor John Hosking (HOD, Computer Science).

Deputy Director

Dr. Michael J. Dinneen

Research Reports Coordinator

Dr. Michael J. Dinneen

Seminar Coordinator

Dr. André Nies

International Advisory Board

The Centre has a International Advisory Board consisting of the following members:

M.A. Arslanov (Kazan State University, Russia), R.C. Backhouse (Eindhoven University of Technology, Netherlands), J. Casti (Santa Fé Institute, New Mexico, US), G.J. Chaitin (IBM, New York, US), C.J. Colbourn (University of Vermont, US), E.W. Dijkstra (1995–2002), J.H. Dinitz (University of Vermont, US), J.A. Goguen (University of California at San Diego, US), E. Goles (CONICYT, Santiago, Chile), R.L. Graham (University of California at San Diego, US), J. Hartmanis (Cornell University, US), H. Jürgensen (University of Western Ontario, Canada and Potsdam University, Germany), C.C. Lindner (Auburn University, Alabama, US), R. Mathon (University of Toronto, Canada), B.D. Mackay (Australian National University, Australia), A. Nerode (Cornell University, US), I. Prigogine (1995–2003), G. Rozenberg (Leiden University, Netherlands), A. Salomaa (University of Turku, Finland), J. Seberry (University of Wollongong, Australia), D. van Dalen (University of Utrecht, Netherlands).

International Affiliations

- Logic Group at JAIST,

- Mindship International,

- Turku Centre for Computer Science (TUCS),

- Valparaiso Institute of Complex Systems.

Departments of Participating Members

Computer science, mathematics, philosophy.

Introduction

The aim of the Management Committee to build one of the world's best centres for research in Discrete Mathematics and Theoretical Computer Science is coming true. The Centre has become a major force in fostering research and development in those areas within the South Pacific Region and creating productive links between that region's researchers and their counterparts in the rest of the world.

Plans, Objectives, Areas

Although the Centre encourages and supports a wide range of research activity, its primary research foci are the following

- Artificial Intelligence

- Combinatorial Optimisation

- Computability and Complexity

- Constructive Algorithmics

- Unconventional Computation

The main objectives of the CDMTCS are:

- to stimulate and encourage the interest of undergraduate students in theoretical computer science and discrete mathematics (including ACM and regional programming contests),

- to foster research, development and cooperation in theoretical computer science and discrete mathematics (participating members, graduate students),

- to fund short and long term visitors, post-doctoral researchers, and doctoral students,

- to organize conferences, summer schools, workshops and seminars,

- to publish, in co-operation with Graz University of Technology and Turku University, the Journal of Universal Computer Science (Springer).

Participating Members

The Centre includes the following faculty members:

C. P. Bonnington (Mathematics, Auckland), D. S. Bridges (Mathematics, Canterbury), C. Calude (Computer Science, Auckland), M. D. E. Conder (Mathematics, Auckland), M. J. Dinneen (Computer Science, Auckland), R. W. Doran (Computer Science, Auckland), A. Drummond (Computer Science, Auckland), H. Guesgen (Computer Science, Auckland), P. R. Hafner (Mathematics, Auckland), F. Kroon (Philosophy, Auckland), B. Khoussainov (Computer Science, Auckland), R. Nicolescu (Computer Science, Tamaki), A. Nies (Computer Science, Auckland), E. O'Brien (Mathematics, Auckland), B. Pavlov (Mathematics, Auckland), J. Seligman (Philosophy, Auckland), U. Speidel (Computer Science, Tamaki), M. Titchener (Computer Science, Tamaki), C. Thomborson (Computer Science, Auckland), M.C. Wilson (Computer Science, Auckland).

External Researchers

The *External Researchers* had a great contribution to the Centre's activities by refereeing papers, assisting with conference and workshop organisation, and by other means. The current External Researchers are

I. Antoniou (Solvay Institute, Belgium), E. Calude (Massey University at Albany, New Zealand), R. Downey (Victoria University of Wellington, New Zealand), B. Everitt (University of Aberdeen, Scotland), R. Goldblatt (Victoria University of Wellington, New Zealand), P. Hertling (FernUniversität Hagen, Germany), D. Holton (University of Otago, New Zealand), K.-W. Lih (Institute of Mathematics, Academia Sinica, Taiwan), C. Little (Massey University, New Zealand), M. Lipponen (Turku University, Finland), J. McKay (Concordia University, Canada), Gh. Păun (Institute of Mathematics, Romanian Academy, Romania), C.E. Praeger (University of Western Australia), L. Staiger (Martin-Luther-Universität Halle-Wittenberg, Germany), K. Svozil (Technische Universität, Vienna), D. Ştefănescu (Bucharest University, Romania), S. Yu (University of Western Ontario, Canada), I. Tomescu (Bucharest University, Ontario).

Graduate Students

The following graduate students are working in close connection with the research program of the Centre:

1. Joshua Arulanandham, Natural Algorithms [PhD] (completed)

2. Gary Cleveland, Hierarchical Planning and Re-Planning [PhD]

3. Hannes Diener, Constructive theory of differential manifolds [PhD]

4. Cynthia Fok, Games Played on Finite Graphs [ME]

5. Matthew Goode, Computational Aspects of Phylogenetics [PhD]

6. Raimund Eimann, Entropy-based Detection of DDoS Attacks [PhD]

7. Robert Kieran, Optical switch [MSc]

8. Nicholas J. Hay. Optimal Agents [MSc]

9. Byung-Doo Lee, A Heuristic Life-and-Death Problem Solver for the Game of Go [PhD]

10. Yang Jia, Fast String Parsing and its Application in Information and Similarity Measurement [PhD] (completed)

11. Santiago Franco, Decision-theoretic Planning: Structural Analysis with Stressed Sensitivity Analysis [PhD]

12. Daniel Bertinshaw, Weighted Update Games [MSc]

13. Jamie Sneddon, Minors and Embeddings of Digraphs [PhD]

14. Anna Torstensson, Maximal Symmetry Groups of Hyperbolic 3-manifolds [PhD]

15. Qian Chen, Network Monitoring from a User's Perspective [MSc]

16. Jiafeng Qin, A Security Survey of PHP Scripts [MSc]

17. Ali al-Jumaily, A Lightweight Messaging Protocol for Mobile Communication [MSc]

18. Aisha Fenton, Restricted Broadcast Graphs [MSc]

19. Lea Chii Deng, Bioinformatics SARS [MSc]

20. Rongwei Lai, Network Design [MSc]

21. Terrence Wilson Johnson, Small World Graphs [MSc]

22. Bo Li, Geographic Reasoning Based on the Fuzzy Region Connection Calculus [MSc]

23. Tavish Fraser, Communicating Using Topological Maps [MSc]

24. Xiaodong Shi, Artificial Intelligence in Real-Time Computer Games [MSc]

25. Xuesong He, Artificial Intelligence [MSc]

26. David Uthus, Artificial Intelligence [MSc]

27. M.A. Stay. Truth and Light: Physical Algorithmic Randomness [MSc]

28. Xiaodong Yang, Dynamic-Heuristic Route Finding [MSc]

Visitors

The Centre hosted the following visitors:

- Prof. D. Bridges, Canterbury University, Christchurch
- Prof. R. Downey, Victoria University, Wellington
- Dr. T. Forster, Cambridge University, UK
- Dr. J. Gibbons, Oxford University, UK
- Prof. E. Goles, Director CONICYT, Santiago, Chile
- Prof. P. Gacs, Boston University, USA
- Prof. S. Gyori, Budapest Technical University, Hungary
- Prof. H. Ishihara, JAIST, Japan
- Dr. V. Keränen, Rovaniemi Polytechnic, Finland
- Dr. T. Peters, University of Applied Sciences, Hamburg, Germany
- Prof. L. Staiger, Martin-Luther-Universität Halle-Wittenberg, Germany
- Dr. J. Reimann, Mathematisches Institut, Heidelberg University, Germany

- Dr. L. Vâţă, Canterbury University, Christchurch

- Prof. P. Vitanyi, University of Amsterdam, Holland

- Prof. M. Watkins Syracuse University, USA

- Dr. R. Weber, Dartmouth College, USA

Dr Thomas Forster co-taught a course on the *Foundations and Philosophy of Set Theory* and presented a series of lectures on *BQO Theory*.

Major Developments

The major activities of the Centre in 2005 have been the organisation of the 4th *International Conference Unconventional Computation*, `https://www.cs.auckland.ac.nz/uc05/` and the 2005 *Information Theory Workshop* (ITW2005), `https://www.cs.auckland.ac.nz/itw2005/`.

The proceedings of UC'05 have appeared as

> C. S. Calude, M. J. Dinneen, M. J. Pérez Jiméne, G. Păun, G. Rozenberg (eds.). *Proc. 4th International Conference Unconventional Computation*, Lecture Notes Comput. Sci. 3699, Springer, Heidelberg, 2005, 266 pp.

Starting with 2005, International Conference Unconventional Computation has become an annual event, organised by the following Steering Committee (see `https://www.cs.auckland.ac.nz/uc`): C. Calude, co-chair, Auckland, L.K. Grover, Murray Hill, NJ, USA, J. van Leeuwen, Utrecht, Holland, S. Lloyd, Cambridge, MA, USA, Gh. Păun, Seville, Spain, T. Toffoli, Boston, MA, USA, C. Torras, Barcelona, Spain G. Rozenberg, Leiden, co-chair, Holland, A. Salomaa, Turku, Finland.

The proceedings of ITW2005 have appeared as

> Michael J. Dinneen (editor), Ulrich M. Spiedel and Desmond Taylor (co-chairs). *Proc. of the IEEE ITSOC Information Theory Workshop 2005 on Coding and Complexity, ITW'05*, IEEE Information Theory Society. IEEE Catalog Number: 05EX1207C, p1-291, 2005. ISBN 0-7803-9481-X.

Publications and Technical Reports

The CDMTCS co-operates with Graz University of Technology and Turku University in editing Springer *Journal of Universal Computer Science*. Members of the CDMTCS are members of the editorial boards of the following journals: *N.Z. Journal of Mathematics, International Journal of Applied Intelligence, Math. Logic Quarterly, Pattern Analysis and Applications Journal, Australasian Journal of Combinatorics, Philosophia Mathematica, Analele Universităţii Bucureşti, Matematică-Informatică, Journal of Computing and Information, Fundamenta Informaticae, Romanian Journal of Information Science and Technology, Natural Computing Journal, Contributions to Discrete Mathematics.*

Special Issues of the *Fundamenta Informaticae, International Journal of Foundations of Computer Science, International Journal on Applied Intelligence, Journal of Universal Computer Science* have been edited.

Research Papers

More than 190 research papers have been published by faculty members and graduate students.

CDMTCS Research Reports

The following reports were published in 2005 (see (`http://www.cs.auckland.ac.nz/staff-cgi-bin/mjd/secondcgi.pl`):

259. J. Yang and U. Speidel. A T-decomposition Algorithm with $O(nlogn)$ Time and Space Complexity. 01/2005

260. H. Ishihara, R. Mines, P. Schuster, and L.S. Vîţă. Quasi-Apartness and Neighbourhood Spaces. 03/2005

261. C.S. Calude, E. Calude and M.J. Dinneen. What is the Value of Taxicab(6)? An Update. 04/2005

262. M.C. Wilson. Asymptotics for Generalized Riordan Arrays. 04/2005

263. R. Pemantle and M.C. Wilson. Twenty Combinatorial Examples of Asymptotics Derived From Multivariate Generating Functions. 04/2005

264. L. Staiger. Infinite Iterated Function Systems in Cantor Space and the Hausdorff Measure of omega-power Languages. 04/2005

265. M. Stay. Very Simple Chaitin Machines for Concrete AIT. 05/2005

266. R. Eimann, U. Speidel, N. Brownlee and J. Yang. Network Event Detection with T-Entropy. 05/2005

267. M.R. Titchener, U. Speidel and J. Yang. A Comparison of Practical Information Measures. 05/2005

268 D.M. Greenberger and K. Svozil. Quantum Theory Looks at Time Travel. 06/2005

269. K. Svozil. Characterization of Quantum Computable Decision Problems by State Discrimination. 06/2005

270. S. Comoroşan. Computing with Molecules: A New Type of Quantum Molecular Computation. 07/2005

271. M.A. Stay. Truth and Light: Physical Algorithmic Randomness. 08/2005

272. L. Staiger. Hausdorff Measure and Lukasiewicz Languages. 11/2005

273. C.S. Calude and M.A. Stay. Natural Halting Probabilities, Partial Randomness, and Zeta Functions. 11/2005

274. G. Pritchard and M.C. Wilson. Exact Results on Manipulability of Positional Voting Rules. 12/2005

275. Nicholas J. Hay. Optimal Agents. 12/2005

Educational Activities

The CDMTCS supports the following activities:

- The group of courses "Logic and computation" leading to BA, BSc, MA, MSc degrees organized in cooperation with the departments of computer science, mathematics, philosophy and linguistics. See `http://www.cs.auckland.ac.nz/~bmk/lc/`.

- The CDMTCS is the major contributor to the undergradute core courses CompSci 220 (Algorithms and Data Structures), CompSci 225 (Discrete Structures), CompSci 320 (Algorithmics), and CompSci 350 (Mathematical Foundations of Computer Science).

- Two theoretical graduate courses CompSci 720 (Advanced Design and Analysis of Algorithms), CompSci 750 (Computational Complexity) were taught by CDMTCS staff.

- CDMTCS members spend time organizing, judging NZ and ACM programming contests. This year Michael Dinneen coached the advancing NZ team (Jsun Pe, Robert Donald, Sam McCall) at the ACM World Finals in Shanghai China, April 3-7, 2005.

- Awards the "J.C. Butcher Award in Theoretical Computer Science"; Owen Auger is the fourth recipient of this award.

CDMTCS Seminars

1. Ludwig Staiger, The Kolmogorov complexity of infinite words

2. Jan Reimann, Measures and their random reals

3. Nick Hay, Optimal Agents

4. D. Bridges, Apartness on Lattices

5. Rebecca Weber, Kurtz 2-randomness

6. Peter Gacs, Uniform tests of algorithmic randomness over a general space

7. Paul Vitanyi, Automatic meaning discovery using Google

8. V. Keränen, Abelian Pattern-Free Words

9. Y. Liang, Antichains in the Turing degrees

10. M. Dinneen, A Simple Linear-Time Algorithm for Finding Path-Decompositions of Small Width

11. J. Gibbons, Enumerating the Rationals

12. M. Wilson, Analysis of Multivariate Generating Functions

13. R. Downey, Generalized Collatz Functions and Computability

14. G. Sandor, Tree Algorithm for Collision Resolution

C. Calude

Professor Cristian S. Calude

Centre for Discrete Mathematics and Theoretical Computer Science

Financial Statement for 2005

The Centre is supported financially by the Departments of Computer Science and Mathematics and sponsored by *Pukekohe Travel*.