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Profile of a Scientist and Innovator

- Award-winning research in artificial intelligence and optimization.
- Research applications include customer prediction, flood risk, and economics.
- Academic research experience includes two postdoctoral research fellowships, one in Boston and one in Brisbane.
- R&D experience includes two technology-based start-up companies: drug design and financial risk optimization.
- On the Australian Academy of Science's list of Covid experts.
- Research publications on a wide range of topics in real-world problem-solving, including flood predictions, schedule optimization, portfolio risk minimization, and game theory.
- A superb communicator with state and national awards in public speaking.
- Most of my teaching experience is with students for whom English is a second language.
- An experienced political campaigner, and a major-party candidate in the 2020 state and 2022 Australian elections.
- Financial planner qualification PS146 from the Australian Stock Exchange is just one example of my continual learning of new skills and ideas, and an entrepreneurial outlook.

Selected Projects

- **Online Retailer Customer Churn** (2023): Predicting customer churn using only scarce data achieved 88% accuracy, better than any publicly-available data mining algorithm.
- **Protagonist Pty Ltd** (2003): At this biotech start-up, I initiated a schedule optimization program that reduced variable costs by 75% and wrote a paper about it.
- **Australian Research Council** (2001): Research on schedule optimization for open-cut mines raised NPV by 28%.
- **U.S. Defense Advanced Research Projects Agency (DARPA)** (1998): My research in Boston looked at supercomputer-based artificial intelligence for games and combat situations, by evolving neural networks.

Education

Bachelor of Science with Honours in Mathematics — *Australian National University 1989-1992*

- National Undergraduate Scholarship, 1 of 20 awarded annually.
- Subjects included applied and pure mathematics, theoretical physics and quantum mechanics, fluid dynamics, astrophysics, computer science, and philosophy.

Ph.D. in Computer Science — *University of New South Wales 1993-1996*

- Genetic algorithms for optimization and machine learning, especially with neural networks.
- My supervisor was Prof. Xin Yao, now at the Southern University of Science and Technology, Shenzhen, China.
- Automated machine learning of strategies for real-time control in situations with randomness, noise, and incomplete information, applied to behavioural economics and military simulation games.
- Awards at two international conferences for best student research paper.

Certificate IV in Business — *Ashby Allan Institute Jan-May 2004*

- Covers all aspects of starting and running a business, like a low-calorie MBA in entrepreneurship.
- This was a compromise between a full-blown MBA and getting real-world experience sooner.

PS146 Financial Planner in Listed Products — *Australian Stock Exchange Apr-May 2005*

- Listed financial products, including equities, instalments, listed managed investments, warrants, exchange-traded options, debentures, and other listed derivatives.

Graduate Certificate of Education — *James Cook University 2011-2017*

- This qualification is for academics working in higher education, to enhance educational practice.
- It reflects national and international trends in higher education.

Employment History

Associate Dean of Information Technology *James Cook University Brisbane, July 2018-present*

- Managing the IT degrees for the Brisbane campus of James Cook University, which has more IT students than the other three campuses put together.
- Launched the Master of Data Science (Professional) in 2023.
- Invited to Shanghai Business School for a sabbatical.
- Invited seminars include Shanghai Business School (2019).

Senior Lecturer *James Cook University Brisbane, May 2005-June 2018*

- Teaching in the Master of IT, MBA, MPA and B.Business.
- Subjects including computer security, data mining, statistics, discrete mathematics, programming, networking, data management, Linux, user interfaces, and optimization.
- Majority of my students are from non-English language backgrounds.
- As an Academic Discipline Leader, managed lecturers for subjects in mathematics, economics, and IT.
- Administration included evaluating credits, academic advising, and the re-accreditation of the Master of IT.
- Invited seminars include the Beijing Institute of Technology (2008), and the University of Science and Technology China (2008 and 2012).

Entrepreneur *Anadare Pty Ltd, June 2004 – April 2005*

- After a short course on business, I started a company to provide share portfolio optimization.
- For the number-crunching back end, I wrote innovative optimization software in C++ with inter-process message-passing for parallel hardware.
- The web site front end used PHP with an SQL database, with interactive graphics.

Computer Scientist *Protagonist Pty Ltd, January 2002 – September 2003*

- This was a biotechnology spin-off from the University of Queensland's Institute for Molecular Biology.
- Starting in an empty office, I selected and deployed the computer and network infrastructure.
- Negotiated, bought, and installed a cluster, and wrote genetic algorithm-based software to search for molecular shapes that minimize potential energy, in C++ and Fortran.
- On my own initiative, wrote a schedule optimizer for the chemical synthesis process that reduced preparation costs by 75%, gave it a web site front end for easy use, and wrote a paper about it.
- Wrote a graphical interface in Tk/Tcl to let biochemists interact with drug designs.

Adjunct Senior Lecturer *Mining Geology Research Centre, September 2001 – September 2002*

- The W.H. Bryan Mining Geology Research Centre is in the University of Queensland.
- This honorary position was part of a successful Australian Research Council (ARC) Discovery Project research grant application to study schedule optimization for open-cut mines.

ARC Postdoctoral Research Fellow *University of Queensland, October 1998 – October 2001*

- I won this competitive ARC grant while at the Volen National Center for Complex Systems in Boston (see below).
- I chose to take it up at the University of Queensland's School of IT and Electrical Engineering.
- Leadership experience included managing research assistants, supervising research students, being Course Coordinator for an honours-level subject, and managing casual lecturers.
- As editor and conference organizer, diplomatically encouraged fellow scientists to meet deadlines.

Postdoctoral Research Fellow *Brandeis University, September 1996 – August 1998*

- Volen National Center for Complex Systems, Brandeis University, Boston, USA.
- My research was sponsored by the U.S. Defense Advanced Research Projects Agency (DARPA) and the U.S. Naval Research Laboratory (NRL).
- Included machine learning on military-oriented games with uncertainty and random noise, and developing a machine learning add-on to ModSAF, a large-scale combat simulator.
- Liaised with local manufacturers looking at rapid schedule re-optimization.

Research Fellow *CSIRO Centre for Environmental Mechanics, November 1991 – February 1992*

- Supercomputer modelling of fluid flow in river estuary sediment.
- Applications include pollution control and irrigation management.

Research Scholar *Mount Stromlo Observatory, November 1990 – February 1991*

- Statistical analysis and astrophysical modelling to measure distances to nearby galaxies.
- Used this as another way to estimate the Hubble constant of universal expansion.

Grant Successes

- Co-authored an $800,000 AusIndustry R&D Start grant at Protagonist Pty Ltd, 2003.
- $50,000 ARC Discovery Project / Early Career DP0210427, "Genetic Algorithms for Open-Cut Mine Scheduling", 2001.
- $10,000 University of Queensland New Staff Research Start-Up grant, 2000.
- $150,000 3-year Australian Research Council (ARC) Postdoctoral Research Fellowship, 1998-2001.

Selected Professional Activities

- Associate Editor of the IEEE Transactions on Evolutionary Computation, 1999 – 2016.
- Guest Editor of a special issue of the International Journal of Computational Intelligence and Applications, 2002.
- Congress on Evolutionary Computation: Special Sessions chair in 2002, Tutorials chair in 2001, and I organized a special session in 2000.
- Program Committee member for many conferences including:
  - The International Conference on Computational Intelligence in Economics and Finance (CIEF)
  - Genetic and Evolutionary Computation Conference (GECCO)
  - Parallel Problem Solving from Nature (PPSN)
  - International Conference on Simulated Evolution and Learning (SEAL)
  - IEEE Symposium on Computational Intelligence and Games (IEEE CIG)

Political Campaigning and Policy Development

- Campaign committee vice-chair for the state seat of Yeerongpilly in the 2012 election, which resulted in a win.
- Candidate for the Queensland state seat of Miller in the 2020 election, against then-transport minister Mark Bailey.
- Candidate for the Federal seat of Rankin in the 2022 election, against now-Treasure Jim Chalmers.
- Candidate for the Queensland state seat of Woodridge in the 2024 election, against then-Treasure Cameron Dick.
- Chair of the LNP policy committee for science and innovation, 2022-present.

Publications

Refereed Journal Articles

1. "Bayesian Model Averaging for River Flow Prediction" by Paul Darwen, *Applied Intelligence* 49(1):103-111, 2019.

2. "Two Levels of Bayesian Model Averaging for Optimal Control of Stochastic Systems" by Paul Darwen, *International Journal of Systems Science* 44(2):201-213, 2013.

3. "Conformational Searching using a Population Based Incremental Learning Algorithm" by Stephen M. Long, Tran T. Tran, Peter Adams, Paul Darwen and Mark L. Smythe, *Journal of Computational Chemistry* 32(8):1541-1549, 2011.

4. "A Gradient Descent Algorithm for Minimizing Amino Acid Coupling Reactions when Synthesizing Cyclic-Peptide Libraries" by Paul Darwen, Tran T. Tran, Gregory T. Bourne, Jonathon L. Nielson and Mark L. Smythe, *Combinatorial Chemistry and High Throughput Screening* 9(7):559-563, 2006.

5. "Co-Evolution in Iterated Prisoner's Dilemma with Intermediate Levels of Cooperation: Application to Missile Defense" by Paul Darwen and Xin Yao, *International Journal of Computational Intelligence and Applications* 2(1):87-107, 2002.

6. "Does extra genetic diversity maintain escalation in a co-evolutionary arms race" by Paul Darwen and Xin Yao, *International Journal of Knowledge-Based Intelligent Engineering Systems* 4(3):191-200, 2000.

7. "Speciation as automatic categorical modularization" by Paul Darwen and Xin Yao, *IEEE Transactions on Evolutionary Computation* 1(2):101-108, 1997.

8. "Viability of populations in a landscape" by Paul Darwen and David G. Green, *Ecological Modelling* 85:165-171, 1996.

9. "An experimental study of N-person iterated prisoner's dilemma games" by Xin Yao and Paul Darwen, *Informatica* 18(4):435-450, 1994.

Book Sections

10. "A Convenient Method for the Synthesis of Cyclic Peptide Libraries" by Gregory T. Bourne, Jonathon L. Nielson, Justin F. Coughlan, Paul J. Darwen, Marc R. Campitelli, Douglas A. Horton, Andreas Rhümann, Stephen G. Love, Tran T. Tran and Mark L. Smythe, in *Peptide Synthesis and Applications*, chapter 10, pages 151-165, Humana Press, 2005.

11. "Evolving a Schedule with Batching, Precedence Constraints, and Sequence-Dependent Setup Times: Crossover Needs Building Blocks" by Paul Darwen, in *Developments in Applied Artificial Intelligence*, pages 525-535. Volume 2358 of the *Lecture Notes in Artificial Intelligence* series. Springer, 2002.

12. "Genetic algorithms and evolutionary games" by Xin Yao and Paul Darwen, in *Commerce, Complexity and Evolution*, chapter 16, pages 325-347. Cambridge University Press, 2000.

13. "An Evolutionary Approach to the N-Player Iterated Prisoner's Dilemma Game" by Xin Yao and Paul Darwen, in *Evolutionary Computation: Theory and Applications*, chapter 10, pages 331-357, World Scientific Publishing, 1997.

14. "How to make best use of evolutionary learning" by Xin Yao, Yong Liu, and Paul Darwen, in *Complex Systems — From Local Interactions to Global Phenomena*, pages 229-242. IOS Press, 1996.

15. "On evolving robust strategies for iterated prisoner's dilemma" by Paul Darwen and Xin Yao, in *Progress in Evolutionary Computation*, pages 276-292. Volume 956 of the *Lecture Notes in Artificial Intelligence* series. Springer, 1995.

16. "An experimental study of N-person iterated prisoner's dilemma games" by Xin Yao and Paul Darwen, in *Progress in Evolutionary Computation*, pages 90-108. Volume 956 of the *Lecture Notes in Artificial Intelligence* series. Springer, 1995.

Invited Conference Papers and Workshop Presentations

17. "Exploiting Population Information in Evolutionary Learning" by Xin Yao, Yong Liu, and Paul Darwen. *Proceedings of the 1996 Japan-China Joint International Workshops on Information Systems*, pages 41-57. Invited paper. Mitsuo Gen and Weixuan Xu (editors), Ashikaga, Japan, 4-5 October 1996.

18. "Customer Churn Prediction by the Direction of the Difference between Bayesian Model Averaging and the Best-Fit Model" by Paul Darwen. Workshop on Autonomous Learning in Complex Decision Situations, in the *2023 International Joint Conference on Neural Networks* (IJCNN), Gold Coast, Australia, 18-24 June 2023.

Refereed Conference Papers

19. "Direction of the Difference between Bayesian Model Averaging and the Best-Fit Model on Scarce-Data Low-Correlation Churn Prediction" by Paul J. Darwen, *15th Asian Conference on Intelligent Information and Database Systems* (ACIIDS 2023), volume 1, pages 210–223, 24-26 July 2023.

20. "Cost-Effective Prediction in Medicine and Marketing: Only the Difference Between Bayesian Model Averaging and the Single Best-Fit Model" by Paul J. Darwen, *2019 IEEE 31st International Conference on Tools with Artificial Intelligence* (ICTAI 2019), pages 1282-1287, Portland, Oregon, 3-6 November 2019.

21. "Cost-Effective Cancer Screening: Bayesian Model Averaging with Two Sources of Variation" by Paul J. Darwen, *International Conference on Intelligent Medicine and Health*, part of the *8th International Conference on Engineering Mathematics and Physics* (ICEMP 2019), pages 43-47, Ningbo, China, 1-3 July 2019. Published by ACM International Conference Proceedings Series.

22. "The Varying Success of Bayesian Model Averaging: An Empirical Study of Flood Prediction" by Paul J. Darwen, *2018 IEEE Symposium Series on Computational Intelligence* (SSCI), pages 1764-1771, Bengaluru, India, 18-21 November 2018.

23. "Questioning The Efficient Markets Hypothesis: Big Data Evidence of Non-Random Stock Prices" by Paul J. Darwen, *Proceedings of the 3rd IEEE International Conference on Big Data Analysis* (ICBDA 2018), pages 201-205, Shanghai, China, 9-12 March 2018.

24. "Bayesian Model Averaging for Streamflow Prediction of Intermittent Rivers" by Paul J. Darwen, *Proceedings of the 30th International Conference on Industrial, Engineering, and Other Applications of Applied Intelligent Systems* (IEA/AEI 2017), pages 227-236, Arras, France, 27-30 June 2017.

25. "Dam Management With Imperfect Models: Bayesian Model Averaging and Neural Network Control" by Paul J. Darwen, *Proceedings of the Eighth International Conference on Intelligent Computing* (ICIC 2012), pages 360-366, Huangshan, China, 25-29 July 2012.

26. "The Long Tail in Bayesian Optimal Control in Uncertain Environments" by Paul J. Darwen, *Proceedings of the World Congress on Nature and Biologically Inspired Computing* (NaBIC 2010), pages 579-586, Kokura, Japan, 15-17 December 2010.

27. "Leveraging the Flight to Quality: Maximizing Diversification of High-Risk High-Return Stocks Over Short Time Periods With Limited-Cardinality Portfolio" by Paul J. Darwen, *Seventh International Conference on Computational Intelligence in Economics and Finance* (CIEF 2008), Taoyuan, Taiwan, 5-7 December 2008.

28. "Evolving a Schedule with Batching, Precedence Constraints, and Sequence-Dependent Setup Times: Crossover Needs Building Blocks" by Paul J. Darwen. *Fifteenth International Conference on Industrial and Engineering Applications of Artificial Intelligence and Expert Systems*, pages 525-535. Cairns, Australia, 17-20 June 2002.

29. "Search Landscape of a Realistic Single-Machine Scheduling Task: Peaks with Big Differences" by Paul J. Darwen. *Congress on Evolutionary Computation* (CEC-2002), pages 1191-1196. Honolulu, Hawaii, 12-17 May 2002.

30. "Looking for the Big Valley in the Fitness Landscape of Single Machine Scheduling with Batching, Precedence Constraints, and Sequence-Dependent Setup Times" by Paul J. Darwen. *Fifth Japan-Australasia Joint Workshop on Intelligent and Evolutionary Systems*, pages 95-104. Dunedin, New Zealand, 19-21 November 2001.

31. "Why Co-Evolution beats Temporal Difference learning at Backgammon for a linear architecture, but not a non-linear architecture" by Paul J. Darwen. *Congress on Evolutionary Computation* (CEC 2001), pages 1003-1010. Seoul, Korea, 27-30 May 2001.

32. “Why More Choices Causes Less Cooperation in Iterated Prisoner’s Dilemma” by Paul J. Darwen and Xin Yao. *Congress on Evolutionary Computation* (CEC 2001), pages 987-994. Seoul, Korea, 27-30 May 2001.

33. “Genetic Algorithms and Risk Assessment to Maximize NPV With Robust Open-Pit Scheduling” by Paul J. Darwen. *Fourth Biennial Conference on Strategic Mine Planning*, pages 29-34. Perth, Western Australia, 26-28 March 2001.

33. “Genetic Algorithms and Risk Assessment to Maximize NPV With Robust Open-Pit Scheduling” by Paul J. Darwen. *Fourth Biennial Conference on Strategic Mine Planning*, pages 29-34. Perth, Western Australia, 26-28 March 2001.

34. “Black Magic: Interdependence Prevents Principled Parameter Setting, Self-Adapting Costs Too Much Computation” by Paul J. Darwen. *Complex Systems 2000*, pages 227-237. Dunedin, New Zealand, 19-22 November 2000.

35. “Computationally Intensive and Noisy Tasks: Co-Evolutionary Learning and Temporal Difference Learning on Backgammon” by Paul J. Darwen. *Congress on Evolutionary Computation* (CEC 2000), pages 872-879. San Diego, California, 16-19 July 2000.

36. “Unobtrusive Workstation Farming Without Inconveniencing Owners: Learning Backgammon with a Genetic Algorithm” by Paul J. Darwen. *IEEE International Workshop on Cluster Computing*, pages 303-311. Melbourne, Australia, 2 December 1999.

37. “Initial Population Diversity as a Wild Goose Chase: Phenotypic Effects Sometimes Dominate” by Paul J. Darwen and Xin Yao. *Australia-Japan Joint Workshop on Intelligent and Evolutionary Systems*, pages 70-77. Canberra, Australia, 23-25 November 1999.

38. “How Important Is Your Reputation in a Multi-Agent Environment” by Xin Yao and Paul J. Darwen. *IEEE Conference on Systems, Man, and Cybernetics*, pages II-575 – II-580. Tokyo, Japan, 12-15 October 1999.

39. “Co-Evolutionary Learning on Noisy Tasks” by Paul J. Darwen and Jordan Pollack. *Congress on Evolutionary Computation* (CEC 99), pages 1724-1731. Washington, D.C., 6-9 July 1999.

40. “Every Niching Method Has Its Niche: Fitness Sharing and Implicit Sharing Compared” by Paul Darwen and Xin Yao. *Fourth International Conference on Parallel Problem Solving from Nature* (PPSN 96), pages 398-407. Berlin, Germany, 22-26 September 1996.

41. “Automatic Modularization by Speciation” by Paul Darwen and Xin Yao. *Third IEEE International Conference on Evolutionary Computation* (ICEC 96), pages 88-93. Nagoya, Japan, 20-22 May 1996. This won the **Best Student Paper Award** for this conference.

42. “A Dilemma for Fitness Sharing with a Scaling Function” by Paul Darwen and Xin Yao. *Second IEEE International Conference on Evolutionary Computation* (ICEC 95), pages 166-171. Perth, Australia, 29 November - 1 December 1995. This won the **Best Student Paper Award** for this conference.

43. “An Experimental Study of N-person Iterated Prisoner’s Dilemma Games” by Xin Yao and Paul Darwen. Evolutionary Computation workshop, *1994 Australian Joint Conference on Artificial Intelligence* (AI 94). Armidale, Australia, 21-22 November 1994.

44. “On Evolving Robust Strategies for Iterated Prisoner’s Dilemma” by Paul Darwen and Xin Yao. Evolutionary Computation workshop, *1993 Australian Joint Conference on Artificial Intelligence* (AI 93). Melbourne, Australia, 16 November 1993.

Other Conference Presentations

45. “Genetic Algorithms and Evolutionary Games” by Xin Yao and Paul Darwen. *Seminar on Commerce, Complexity, and Evolution*, 12-13 February 1996 at the University of New South Wales, Kensington campus, Sydney, Australia.

46. “Population Models and Cellular Automata” by Paul Darwen. *Workshop on Complex Systems*, 29 April 1992, Australian National University, Canberra, Australia.

Dissertations

47. “Automatic Modularization in Evolutionary Learning” by Paul Darwen, for the degree of Doctor of Philosophy in Computer Science, University of New South Wales, 1996.

48. “Metapopulation Persistence in Cellular Automata Population Models” by Paul Darwen, in partial fulfillment of the degree of Bachelor of Science with Honours in Mathematics, Australian National University, 1992.

A Couple of Notable Mentions

49. My research on behavioral economics is cited as an example of out-of-the-box thinking in the book “Debunking Economics” by Prof. Steve Keen (chapter 2, page 53), 2002.

50. In 1993, I had a joke accepted in the moderated Usenet newsgroup `rec.humor.funny` and it’s now archived in the “Best of RHF”, i.e., the best two thousand jokes accepted by `rec.humor.funny` during 1987-1995.