ROY WILLIAM WARD

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SUMMARY

A senior software architect and engineer with a strong focus on building high performance solutions. Has knowledge of algorithms, mathematical training, and a deep understanding of computer architectures down to a very low level. Applies this to a wide variety of problems to design and implement efficient solutions that are highly optimized in speed and/or space. Has experience with concurrency/multithreading. Has experience designing and building back-end servers and stand-alone tools.

MAIN SKILLS

Optimization: optimizing for speed (typically 200%-2000% over existing solutions) and memory use, choosing appropriate algorithms and design patterns to fit business requirements, mathematical transformations, vectorizing, concurrency/multithreading, in memory and disk based efficient data structures, using processor specific features, just-in-time compilers, profiling, performance testing, tuning.

Application Experience: architecting and building back end solutions to ingest, store, process, and visualize big data (up to 800 billion records, processing 100-200 million records per second) including time series and geospatial data in near real-time applications, efficient stand-alone tools for data processing and computation, lossless data compression, distributed systems.

Application Areas: time-series and geospatial data storage and processing, data-specific compression, metadata, image processing, image rendering, encryption, artificial neural networks, computer language design, compiler design, others.

Languages: Modern C++, C, Java, SQL, Python, GLSL, Haskell, Verilog, several assemblers including x86-64 (with SSE, AVX, AVX512), PowerPC (with Altivec), PIC, and several others.

Protocols: XML, JSON, CORBA, custom binary protocols.

Platforms: Linux, Android, macOS.

Hardware: Xilinx FPGAs, Xilinx CPLDs, PIC Microcontrollers.

Tools and Libraries: PostgreSQL/libpq, POSIX, gdb, valgrind, Vulkan, Lucene, LaTeX, others.

Teamwork: working well in a team include leading, coordination, collaboration, mentoring, able to work with customers, able to communicate effectively both verbally and in writing.

EMPLOYMENT SUMMARY

2002-2024: Chief Software Architect and Applications Engineer for Moonshadow Mobile Inc.

1998-2000: Developer for Videoscript Inc. (Part time).

1997-2002: Research Assistant/Junior Research Fellow in the Department of Information Science at the University of Otago.

EDUCATION

B.Sc. (Hons) 1st Class in Mathematics from the University of Otago.

PROJECTS

https://www.orange-kiwi.com A blog on software optimization and related topics.

https://github.com/royward/pseudo-double A relatively fast C and C++ 64 bit floating point library written using only integer operations.

https://github.com/royward/random-variate-poisson A fast generator of random Poisson distribution variates.

1 Current Employment

Immediate supervisor: Eimar Boesjes, CEO

Moonshadow Mobile, Inc. is a company that specializes in ingesting, storing, managing, processing and visualizing large amounts of data, providing Software as a Service. It specializes in very fast responses to queries, allowing even relatively large datasets to have processing and visualizing done in a web browser. Types of data have included connected vehicle data, voter registration data, and census data.

Duties include:

- Architecting and building custom engines in C++ to handle highly efficient ingestion, storage, processing and visualization of large amounts of geographic data
- Working with customers to provide high performance custom solutions using these engines
- Optimization and performance tuning, both for speed and for size, including compression
- Writing JIT compilers and interpreters
- Building and maintaining a set of highly optimized libraries for common operations such as string handling, JSON parsing/writing, locking, threading, many more
- Writing tools for efficient compression of time series data
- Writing tools and interfaces to streamline the ETL pipeline
- Assisting other developers in the development of interfaces
- Mentoring other developers
- Writing patents in collaboration with a patent agent
- Supervising other developers and testers
- Managing the development team in the CEO's absence

Up till 2010, Moonshadow Mobile Inc. (called Buymusichere Inc. at the time) specialized in building and hosting highly customizable online stores with large product inventories, particulary with music, DVDs and books.

Duties included:

- Design, implementation and maintenance of an efficient custom server application written in Java, which managed much of interactions with the product database and much the core business logic, including pricing and availability, product searches, custum notes and reviews and access to credit card gateways
- Optimization and performance tuning of that server
- Design, implementation and maintenance of the product search system using Lucene
- Assisting other developers to build PHP applications that made calls to that server
- Design and implementation of the Sourcing Engine, which chooses which suppliers are selected to fulfil orders
- Linux system administration

2 Previous Employment

1998-2000: Part time Developer at Videoscript, Inc.

Videoscript was a scripting language for MacOS X that treated images and video as first class objects in the language, making a variety of image processing and image matching tasks very easy.

Co-developer: T. C. A. Molteno

Duties included:

- Language design and implementation
- Writing highly optimized routines for image processing and matching

1997-2002: Research Assistant/Junior Research Fellow in the Department of Information Science at the University of Otago, firstly with Connection based Information Systems, then with New Zealand Distributed Information Systems.

NZDIS was a research initiative to develop software and systems to facilitate connecting the many disparate and distributed databases across New Zealand.

Immediate supervisor: Professor Martin Purvis, Professor and head of the NZDIS project

Duties included:

- Develop an Agent-based platform using CORBA on which to build a distributed information system
- My particular focus was the Query Planner, which would select the data sources used to answer a query and how they were to be combined
- Wrapping databases or other forms of data into datasources usable by the system
- Working on systems to programmatically deal with metadata
- Present the progress and results of research, in seminars, conferences and academic papers
- Working with a team on all of the above
- As part of CBIS, I designed and build a C++ library that allowed construction of artificial neural networks

Selected Publications, Patents and Presentations

[1] Roy W Ward. *Systems, Methods, and Data Structures for High-speed Searching or Filtering of Large Datasets*. Patents: US-10521411-B2 (2019-12-31), US-11573941-B2 (2023-02-07), US-11106646-B2 (2021-08-31), AU-2017310296 (2018-02-15), JP-7011848 (2022-01-27), JP-7257068 (2022-04-12). 2019–2023.
[2] Roy W Ward and David S Alavi. *Systems, Methods, and Data Structures for High-speed Searching or Filtering of Large Datasets*. Patents: US-10248621-B2 (2019-04-02), US-11100068-B2 (2021-08-24), AU-2017216997 (2017-08-17), CN-108885642 (2017-11-23), EU-2017216997 (2018-12-19), JP-6989137 (2022-01-05). 2017–2021.
[3] Roy W Ward. *Processing and Storage of Spatial Data*. Patents: US-8990204-B1 (2015-03-24), US-9411898-B1 (2016-08-09). 2015–2016.
[4] Roy W Ward. *Systems and Methods for High-speed Searching and Filtering of Large Datasets*. Patents: US-9002859-B1 (2015-04-07), US-9697250-B1 (2017-07-04). 2015–2017.
[5] Roy W Ward. *Systems and Methods for High-speed Searching and Filtering of Large Datasets*. Patents: US-9171054-B1 (2015-10-27), US-9626401-B1 (2017-04-18). 2015–2017.
[6] Roy W Ward and David S Alavi. *Inline Tree Data Structure for High-speed Searching and Filtering of Large Datasets*. Patents: US-8977656-B2 (2015-03-10), US-9652467-B2 (2017-05-16). 2015–2017.

[7]   Roy Ward. *Moonshadow Mobile: High Speed Visualization of Big Data.* Computer Science Colloquium Seminar at University of Oregon. Mar. 31, 2012.

[8]   P. A. Suggate, R. W. Ward, and T. C. A. Molteno. "Efficient Embedded FPGA Processor Cores". In: *Proceedings of the Fourteenth Electronics New Zealand Conference (ENZCon'07).* Victoria University, Wellington, New Zealand, 2007, pp. 13–18.

[9]   Roy Ward and Dr. T. C. A. Molteno. *Massively Parallel MIMD Processing in Hardware.* Computer and Information Science Seminar at Otago University. Aug. 3, 2007.

[10]   R. W. Ward and T. C. A. Molteno. "Counter Representation in Microprocessors". In: *Proceedings of the Thirteenth Electronics New Zealand Conference (ENZCon'06).* University of Canterbury, Christchurch, New Zealand, 2006, pp. 81–86.

[11]   M. Purvis, S. Cranefield, R. Ward, M. Nowostawski, D. Carter, and G. Bush. "A multi-agent system for the integration of distributed environmental information". In: *Environmental Modelling and Software* 18.6 (2003), pp. 565–572.

[12]   R. W. Ward and T. C. A. Molteno. "A CPLD Coprocessor for Embedded Cryptography". In: *Proceedings of the Tenth Electronics New Zealand Conference (ENZCon'03).* University of Waikato, Hamilton, New Zealand, 2003, pp. 173–178.

[13]   R. W. Ward and T. C. A. Molteno. "Efficient Hardware Calculation of Inverses in $GF(2^8)$". In: *Proceedings of the Tenth Electronics New Zealand Conference (ENZCon'03).* University of Waikato, Hamilton, New Zealand, 2003, pp. 179–174.

[14]   M. Purvis, S. Cranefield, M. Nowostawski, R. Ward, D. Carter, and MA Oliveira. "Agentcities interaction using the opal platform". In: *Work. on Challenges in Open Agent Systems, AAMAS* (2002).

[15]   M. K. Purvis, R. Cranefield S. Ward, M. Nowostawski, D. Carter, and G Bush. "A Multi-Agent System for the Integration of Distributed Environmental Information". In: *Environmental Software Systems – Proceedings of the 4th International Symposium on Environmental Software Systems (ISESS'01), Banff, Canada.* 2001, pp. 111–124.

[16]   MK Purvis, Q. Zhou, S.J.S. Cranefield, R. Ward, R. Raykov, and D. Jessberger. "Spatial information modelling and analysis in a distributed environment". In: *Environmental Modelling and Software* 16.5 (2001), pp. 439–445.

[17]   M. Purvis, S. Cranefield, G. Bush, D. Carter, B. McKinlay, M. Nowostawski, and R. Ward. "The NZDIS project: an agent-based distributed information systems architecture". In: *System Sciences, 2000. Proceedings of the 33rd Annual Hawaii International Conference on System Sciences* (2000), p. 10.

[18]   M. K. Purvis, S. Cranefield, M. Nowostawski, G. Bush, D. Carter, B. McKinlay, and R. Ward. *The NZDIS Project: an Agent-based Distributed Information Systems Architecture.* Tech. rep. 99/17. University of Otago, Dunedin, New Zealand, 1999.

[19]   M. Purvis, S. Cranefield, and R. Ward. "Distributed Software Systems: From Objects to Agents". In: *Proceedings of the 1998 International Conference on Software Engineering: Education & Practice* (1998).

[20]   R. Ward, M. Purvis, R. Raykov, F. Zhang, and M. Watts. "An Architecture for Distributed Connectionist Computation". In: *Progress in Connectionist-Based Information Systems: Proceedings of the ICONIP/ANZIIS/ANNES* 97 (1997), pp. 721–724.

[21]   (Software) ReWrite: as reviewed by Michael Swaine. "Programming Paradigms". In: *Dr. Dobbs Journal* 21.2 (1996), pp. 117–119.