Chris Matthews

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Synopsis   I'm a computing generalist. My previous work and research centered on software tools that support compilers and operating systems. Currently, I'm focusing on compiler-testing tools and performance tools; specifically, using data analytics and cloud technologies.

Education

University of Victoria	1999–2013

- Ph.D, C.Sc 2013
- M.Sc. C.Sc., 2006
- B.Sc. C.Sc. with Distinction, 2004

Work Status Canadian Citizen, United States Permanent Resident

Recent Experience

2013 - Current	Apple Inc.	Cupertino, CA

Developer Tools: Sr. Software Engineer, Technical Lead

- Technical Lead of the Developer Tools Quality Engineering and Tools team; a six-person team responsible for qualification of clang, LLDB, ld64, and building and operating internal-testing infrastructure.

- Developed extensive compiler-performance tracking—the foundation for the compiler team's performance evaluation strategy. This spanned measurement and test suites, stabilization of devices, web services for data retention and analysis, dashboards, automatic regression detection and analysis, root cause analysis, issue tracking, and notifications. Built in Python, running in Jenkins using Jupiter notebooks and Tableau.

- Contributor and code owner of the open source LLVM-LNT project. LNT is a web based performance tracking and analysis system used to track the performance of software (and compilers) over software releases. Apple and several other companies use it for tracking compiler performance and more.

- Wrote and deployed many internal web services to Heroku- and Kubernetes-based clouds. Services primarily written in Flask, sqlalchemy with PostgreSQL. One service was a build-failure analysis service, that found common issues in the nearly 5k daily builds that our internal Jenkins ran, tracked these issues, and provided concise failure causes to speed up the triage of build issues. A second service was a secure artifact-storage system to hold build artifacts. The system had to meet the highest security requirements as it stored 120TB of extremely confidential data.

- Developed a large-scale testing system to test tool changes over large portions of Apple's App Store. The system could test against 100k apps per day, and was used to vet high risk compiler and linker changes. The system used Jenkins to shard work out to 30+ nodes, and LLVM's LIT tester to validate each app against new tools.

- Responsible for the compiler team's migration from physical hardware to internal cloud, then to Kubernetes. Also responsible for switching from ad hoc scripts to Ansible based deployments of all nodes.

- Setup Jenkins based testing for clang. Built a Jenkins server that ran 120+ cloud nodes, and 40 physical nodes. Wrote several hundred different testing projects, producing 5k builds a day.

- Managed releases of the apple-clang compiler for two years. This included qualifying compilers against Apple's major platforms, working with teams across the company to fix blocking issues caused by new compilers, working with compiler engineers and managers to make sure changes landed as needed.

2007	Google Inc.	Mountain View, CA

Platforms Group: Software Engineering Intern
- Worked on the GCC (GNU Compiler Collection) Tuples project with several compiler engineers. **Reducing the amount of memory that GCC consumed was the goal of this project.** To this end, we changed the data representation (AST) in the GCC middle-end. This project facilitated a GCC project that increased the memory consumption of the middle-end considerably. My work was self-directed, primarily. The code I wrote for this project is in the GCC public repositories—where it remains in use today.

- Initiated a side project to expand Google's benchmarking system. This project was mainly self-directed. **The goal of my side project was making it easier for developers to see the performance impact of small changes in the compiler toolchain.** I ran SPEC2000 benchmarks on a cluster of different toolchain builds then fed these results into a Google monitoring dashboard.

2006	University of British Columbia	Vancouver, BC

Software Practices Lab: Researcher
- **Built a prototype AspectC language and compiler**. AspectC is a research compiler for introducing advanced features of modern aspect-oriented languages like AspectJ into C. Gregor Kiczales—the creator of aspect-oriented programming—managed this project.

- Over a six-month period, this project produced a detailed programming-language design. The design collected detailed statistics about current uses of C and the CPP from hundreds of code bases; and, contained thought exercises on the tradeoffs of using different linguistic elements.

2005	IBM Research—T.J. Watson	Yorktown Heights, NY

Advanced Operating Systems Group: Intern
- **Built a Linux library that increased the scalability of data structures.** I achieved this using then-novel scalability techniques from the IBM-Research K42 operating system; I ported them to the user level. This Linux library proved increasing the scalability of user-level programs running on cache-coherent SMP hardware—significantly—is possible.

Projects in PhD

(for earlier projects, please visit my website)
- **Lind** is a project I led for my PhD. My research team includes graduate and undergraduate students at UVic and New York University Polytechnic. **Lind is a runtime for retrofitting security and portability into legacy C applications: Lind uses the Google Native Client, and Seattle Project's Repy sandboxes for running legacy applications securely at native speeds.** Lind accepts applications written for POSIX-systems before running them on all platforms. Lind is useful for infrastructures for which isolated computation is necessary—infrastructures like SETI@home—and, for running extensions like Linux-kernel modules or browser plugins. While working on Lind, I built the following system-support tools: a build system; a

C-to-Python RPC library; a simple static verification system; a user-level file system; and, a portable file-system layer and network stack. GitHub

- **GreenCities** is a demo GIS cloud application. I led the UVic graduate and postdoctoral team that built this demo. **Calculating and representing big-data in interesting and impressive geovisualizations are the goals of GreenCities.** Using a 14 TB dataset of Landsat-satellite imagery, GreenCities computes the "greenest" cities on earth. The demo computes this data using the non-visible light spectra of major and minor urban municipalities to detect vegetation; this data then powers the geovisualization in a web frontend. This demo exemplifies how well the cloud is suited for creating and showcasing a visually-compelling big data problem—and its solution. I am now expanding the GreenCities demo to use more advanced GIS calculations based on live high-resolution data from the RapidEye satellite network. This project is eliciting interest from parties who want to commercialize and multi-purpose GreenCities.

- **GENICloud** is a research cloud I built with several researchers and students. **GENICloud is a IaaS cloud for standardizing cloud federation.** It runs in six self-managed intercontinental locations; each with 1 Gb or 10 Gb network links between sites. The cloud has 40 physical machines; it is also where we host projects such as GreenCities. GENICloud is run primarily on OpenStack, PlanetLab, and a host of other cloud technologies. We demo and present GENICloud internationally.

- I did a **Google Summer of Code** project in conjunction with the Eclipse Foundation. **Increasing the ease of deploying Eclipse OSGI applications into the cloud was the primary goal of this project.** I built a set of Eclipse plugins that analyzed the dependencies of the application using the P2 framework; and, then, generated a custom-minimal virtual machine that was uploadable to several cloud providers.

- **First Nations Stewardship Tools** is a web framework I helped build. **Facilitating easier and more responsive processing of First Nations' land-management claims was the goal of this project.** Currently, three First-Nation governments use this tool for managing forestry claims.

- **Advanced Scenario Generation** was a project I did with MDA in Vancouver. **Augmenting MDA's visual-combat simulator with a DSL, and a programmable-statistics library—in order to enhance the simulation-scenario complexity—were the goals of this project.**

Technical Skills

(a brief overview)

- Experience in measurement and performance analysis of systems. Analysis done using Python, Pandas, Jupiter, and Tableau.

- Advanced Python programmer.

- Web apps: Flask, Sqlalchemy, Celery, JavaScript and CSS. Databases including PostgreSQL and MySQL, sqlite, Redis. Operations with Graphite, Splunk.

- Advanced Jenkins. I have run several large scale Jenkins servers, and written hundreds of Jenkins jobs.

- Developed a medium-sized OS using Python, C, and shell-script. This project required modifying glibc and Google's Native Client extensively. I debugged problems this OS caused in several common code bases including coreutils; grep; wget; netcat; and, Tor. I developed and trouble-shot this project independently.

- Worked on large-project code, e.g. building Linux-loadable kernel models; extending and creating new GCC functionality; and, adding new functionality to the Xen Hypervisor. Modifying the clang and LLVM build system.

- Built private clouds using Eucalyptus and OpenStack; worked with Amazon's EC2 API; and, built virtual machines images from scratch. Intermediate Kubernetes and Helm.

- Extensive operating systems experience: e.g. administered most versions of MS Windows including server editions; and, Linux servers running several popular distributions including the Debian and Redhat versions. Large numbers of MacOS systems. Provisioning with Ansible and Fabric.

- Experience coding in the following: numerous and different JVMs; the Linux kernel; and, in IBM Research's K42 kernel—with an emphasis on virtual memory and concurrency management. Developed compilers in Java with ANTLR, for C. Some JVM development including garbage collection, threading, and basic JIT and byte code interpretation.

Publications

- "Lind: Challenges turning virtual composition into reality"
  Workshop on Component Composition at SPLASH2011

- "NanoXen: Better Systems Through Rigorous Containment and Active Modeling"
  Workshop on Specification and Verification of Component Systems at FSE2010

- "Dynamic Resource Allocation in Computing Clouds using Distributed Multiple Criteria Decision Analysis" at IEEECLOUD 2010

- "Overcast: Eclipsing High Profile Open Source Cloud Initiatives"
  Workshop on Cloud Computing at OOPSLA 2009

- "Virtualized Recomposition: Cloudy or Clear?"
  Workshop on Software Engineering Challenges in Cloud Computing at ICSE 2009

- "Quantifying Artifacts of Virtualization: A Framework for Mirco-Benchmarks"
  The 2009 IEEE International Workshop on Quantitative Evaluation of large-scale Systems and Technologies at AINA 2009

- "Portability Events: A Programming Model for Scalable System Infrastructures"
  Workshop on Programming Languages and Operating Systems 2006 workshop at ASPLOS XII

- "HEY... You got your Paradigm in my Operating System!"
  Workshop on Programming Languages and Operating Systems 2005 at ECOOP 2005

Teaching Experience

- Sessional teacher for UVic's CS2 class

- Teacher Assistant for UVic's cloud-computing and distributed-systems class

- Teacher Assistant for UVic's operating-systems class eight times

- Mentored many undergraduate and graduate computer-science projects

- Guest lectured in several graduate-level classes

- Substituted for professors in operating-systems class 10+ times

- Comfortable speaking in front of 300+ people

- Teacher Assistant for classes at all levels of computer science

- Redesigned a UBC third-year software engineering course's curriculum

- Teacher Assistant for UBC's "Introduction to Software Engineering" course—this included implementing a new experimental curriculum

- Regular participant in departmental-research group on education

Awards

- Google Summer of Code 2009 (sponsored by the Eclipse Foundation)

- University of Victoria Fellowship 2004–2005

- Raytheon Canada Limited Scholarship

- UVic Computer Science Public Speaking Award

Volunteer Positions

- Willow Creek Village HOA: Board of Directors. I have sat on the board of directors for 4 years.
- Senior Dog Rescue: I foster senior and hospice dogs for a number of local dog rescues.
- I co-organized the ACP4IS workshop at AOSD08.
- I co-organized parts the SOSP09 student program; including their 90 student volunteers, and the travel-grant allocation.
- I volunteered as the webmaster for the Aspect Oriented Software Association. This involved web design for their AOSD.net website. This website is themed according to modern industrial and academic AOP, and the AOSD Conference.
- I volunteered as a web designer for the Victoria Pet Adoption Society. This site is their primary means of finding homes for animals.

Personal Skills

- I am an independent problem solver. During my PhD, I taught myself to write in and use many large code bases including glibc and Native Client—I solved every problem I encountered independently.
- Can-do/get-'er-done attitude: I have a "let's try and see what happens" approach to solving problems. Consequently, my research decisions are evidential rather than speculative.
- Comfortable public speaking and answering questions in a public setting—I taught in front of large audiences at UVic, and spoke at many conferences.
- I am personable and I work well with teams. I have worked successfully in a wide range of inter- and multi-disciplinary teams including lawyers; geographers; anthropologists; and, mathematics and business specialists. As well, I have worked with many specialized technical teams.
- I enjoy teaching and mentoring. At school I mentored more than 10 students in the last few years before my graduation—many of these students have continued on to successful undergraduate and graduate projects. At Apple, I mentored many junior employees.

Interests   I enjoy gardening, spending time with my family, and being outdoors.

References   To protect their privacy, references are available upon request.

Website   https://www.christophermatthews.ca.