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David Lion

Education

University of Toronto

- Ph.D. in Computer Engineering — *September 2016 - Present*
  Advisor: Prof. Ding Yuan
- M.A.Sc. in Computer Engineering — *September 2014 - June 2017*
  Advisor: Prof. Ding Yuan
- B.A.Sc. in Computer Engineering — *September 2009 - June 2014*

Research Interests

The design and implementation of software systems with an emphasis on the performance of managed language runtime environments.

Research Projects

Investigating Managed Language Runtime Performance *Published July 2022* [C2]
Open sourced: https://github.com/topics/langbench

- Created instrumented versions of the OpenJDK (Java), V8 (JavaScript), and CPython (Python) runtime implementations, using C++, C, and x86 assembly, to enable profiling of interpreted bytecode execution and dynamic type-checking overhead in V8.
- Created six applications, in C++, Go, Java, JavaScript, and Python, differing in compute intensity, memory usage, I/O intensity, and degree of concurrency, to evaluating managed language runtimes.
- Quantitatively analyse the advantages and disadvantages of the targeted managed language runtimes, using C++ as a baseline.

End-to-End Memory Management in Elastic System Software Stacks *Published April 2021* [C4]
Open sourced: https://github.com/topics/dsrg-m3

- Designed a system that bridges memory abstractions between all layers in a system software stack, allowing applications to continuously adapt to current system memory availability.
- The system improves performance and maximizes memory utilization by removing static memory settings that are fundamentally incapable of reacting to workload or memory usage changes.
- The system uses a global monitor written in C++ and was implemented and evaluated on Spark, the JVM, a Go caching application, and the Go runtime using Java, C++, and Go.

Eliminate JVM Warm-up Overhead in Data-Parallel Systems *Published November 2016* [C7]
Open sourced: https://github.com/dsrg-uoft/hottub

- Studied the effects of JVM Warm-up overhead on popular data-parallel distributed systems, such as HDFS, Hive on Tez, and Spark through comprehensive instrumentation written in Java and C++.
- Found that warm-up overhead is frequently the bottleneck even in I/O intensive work, that it reveals a contradiction between the principle of parallelization and the JVM, and that multi-layer systems aggravate these problems.
- Designed and implemented, HotTub, a new JVM that amortizes warm-up overhead by reusing a pool of already warm JVMs. Written using C++, C, Java, and x86 assembly.

Professional Experiences

YScope Inc., Toronto *September 2021 - Present*
Founding Engineer

Advanced Micro Devices (AMD), Markham *May 2012 - September 2013*
Software Engineer, Apple Platform

Gamebot, Mississauga *Summer 2011*
Web Developer

Publications

Refereed Conference Papers

[C1] Xiang (Jenny) Ren, Sitao Wang, Zhuqi Jin, **David Lion**, Adrian Chiu, Tianyin Xu, and Ding Yuan. "Relational Debugging — Pinpointing Root Causes of Performance Problems". In: *17th USENIX Symposium on Operating Systems Design and Implementation (OSDI 23)*. USENIX Association, July 2023. Acceptance rate: 19.6% = 50/255.

[C2] **David Lion**, Adrian Chiu, Michael Stumm, and Ding Yuan. "Investigating Managed Language Runtime Performance: Why JavaScript and Python are 8x and 29x slower than C++, yet Java and Go can be Faster?" In: *2022 USENIX Annual Technical Conference (USENIX ATC 22)*. USENIX Association, July 2022. Acceptance rate: 16.2% = 64/393. **Invited to appear in USENIX ;login:**

[C3] Yu Luo, Kirk Rodrigues, Cuiqin Li, Feng Zhang, Lijin Jiang, Bing Xia, **David Lion**, and Ding Yuan. "Hubble: Performance Debugging with In-Production, Just-In-Time Method Tracing on Android". In: *16th USENIX Symposium on Operating Systems Design and Implementation (OSDI 22)*. USENIX Association, July 2022. Acceptance rate: 19.5% = 49/251.

[C4] **David Lion**, Adrian Chiu, and Ding Yuan. "M3: End-to-End Memory Management in Elastic System Software Stacks". In: *Proceedings of the Sixteenth European Conference on Computer Systems*. ACM, Apr. 2021. Acceptance rate: 14.1% = 27/191.

[C5] Yongle Zhang, Serguei Makarov, Xiang (Jenny) Ren, **David Lion**, and Ding Yuan. "Pensieve: Non-Intrusive Failure Reproduction for Distributed Systems Using the Event Chaining Approach". In: *Proceedings of the 26th Symposium on Operating Systems Principles*. ACM, Oct. 2017. Acceptance rate: 16.8% = 39/232.

[C6] Naif Tarafdar, Thomas Lin, Nariman Eskandari, **David Lion**, Alberto Leon-Garcia, and Paul Chow. "Heterogeneous Virtualized Network Function Framework for the Data Center". In: *27th International Conference on Field Programmable Logic and Applications*. IEEE. Sept. 2017.

[C7] **David Lion**, Adrian Chiu, Hailong Sun, Xin Zhuang, Nikola Grcevski, and Ding Yuan. "Don't Get Caught in the Cold, Warm-up Your JVM: Understand and Eliminate JVM Warm-up Overhead in Data-Parallel Systems". In: *12th USENIX Symposium on Operating Systems Design and Implementation*. USENIX Association, Nov. 2016. Acceptance rate: 17.6% = 47/267. **Invited to appear in USENIX ;login:**

[C8] Xu Zhao, Yongle Zhang, **David Lion**, Muhammad Faizan Ullah, Yu Luo, Ding Yuan, and Michael Stumm. "lprof: A Non-intrusive Request Flow Profiler for Distributed Systems". In: *11th USENIX Symposium on Operating Systems Design and Implementation*. USENIX Association, Oct. 2014. Acceptance rate: 18% = 42/228.

Journal and Magazine Publications

[J1] **David Lion**, Adrian Chiu, Michael Stumm, and Ding Yuan. "Investigating Managed Language Runtime Performance: Why JavaScript and Python are 8x and 29x slower than C++, yet Java and Go can be Faster?" In: *USENIX ;login:* (June 2022).

[J2] **David Lion**, Adrian Chiu, Hailong Sun, Xin Zhuang, Nikola Grcevski, and Ding Yuan. "Don't Get Caught in the Cold, Warm-up Your JVM: Understand and Eliminate JVM Warm-up Overhead in Data-Parallel Systems". In: *USENIX ;login:* 42.1 (Mar. 2017).

Patents

[P1] Muhammad Faizan, **David Lion**, Yu Luo, Michael Stumm, Ding Yuan, Xu Zhao, and Yongle Zhang. "Systems and processes for computer log analysis". U.S. pat. 10,484,506. Nov. 19, 2019. (This is a continuation patent on US Patent 9,720,671.)

[P2] Muhammad Faizan, **David Lion**, Yu Luo, Michael Stumm, Ding Yuan, Xu Zhao, and Yongle Zhang. "Systems and processes for computer log analysis". U.S. pat. 9,720,671. Aug. 8, 2017.

Teaching Experience

University of Toronto

Course Instructor	Operating Systems (CSC369)	*Summer 2021*
Teaching Assistant	Operating Systems (ECE344)	*Fall 2015-2021, Winter 2015-2021*
Teaching Assistant	Computer Systems Programming (ECE454)	*Fall 2014*