

# Filip Jerzy Pizlo

## *Résumé*

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**Summary.** I'm a systems programmer. I specialize in compilers, programming language runtimes, memory management, and concurrency. I have a decade of experience architecting and maintaining high-performance virtual machines for dynamic languages.

### Key Accomplishments

- One of the top contributors to the WebKit open source browser engine, which is used in virtually all of Apple's products. I mostly work on WebKit's JavaScript VM (virtual machine), called JSC (JavaScriptCore).
- I'm the architect of JSC's performance features, including the low-latency interpreter, type inference, optimizing JIT (just in time) compilers, GC (garbage collector), and concurrency primitives. I led the development of the FTL (Faster Than Light) and B3 (Bare Bones Backend) JIT compilers. I developed the Riptide concurrent GC mostly on my own.
- Long record of contributing to programming language runtimes and compilers. I contributed to Purdue OpenVM, Microsoft Bartok Research Compiler, Jikes RVM, Fiji VM, WebKit, and LLVM. I was on the core team of OpenVM and Jikes RVM. I wrote most of Fiji VM. I'm a WebKit reviewer and one of the top WebKit contributors.
- Co-author of 29 scholarly articles. I've done research in computer science (memory management, real-time systems, programming languages, compilers, and concurrency), physics (gamma-ray astrophysics and the imaging atmospheric Cherenkov technique), and psychology (phi phenomenon).

### Summary of Qualifications

- Expert C++ programmer.
- Expert assembly programmer.
- Expert GC developer.
- Expert compiler developer.
- Concurrency expert.

### Job Experience

**Apple Inc.** Cupertino, CA. *February 2017 — present. Manager of the JavaScriptCore team.* This team is responsible for all of JSC except the developer tools. In addition to line management responsibilities, I am the architect of JSC and I still write code.

**Apple Inc.** Cupertino, CA. *June 2011 — January 2017. Senior software engineer.* JSC VM engineer and architect of WebKit's JavaScript performance features. Most of my work for Apple is in the form of contributions to the WebKit open source project. Apple ships JavaScriptCore and WebKit as system frameworks, which are used by apps like Safari, Mail, and many others for running scripts and rendering web content. I developed major features for every Safari release since Safari 5.1.4, every macOS release since Mountain Lion, and every iOS release since iOS 6. I also helped craft the JSC team's recruiting strategy.

**Fiji Systems, Inc.** Indianapolis, IN. *May 2009 — August 2010. Founder and CEO.* Developed the Fiji VM and the Schism/cmr fragmentation-tolerant real-time garbage collector.

**Microsoft Research** Redmond, WA. *November 2006 — March 2007, June 2007 – August 2007. Research intern.* Invented three concurrent copying garbage collectors: Stopless, Clover, and Chicken.

**IBM Research** Hawthorne, NY. *June 2004 — August 2004. Research intern.* Worked on the X10 programming language.

## Education

**Purdue University** West Lafayette, IN. *Jan 2004 — May 2011.* PhD dropout. Worked towards a PhD dissertation on *Fragmentation Tolerant Hard Real Time Garbage Collection*. Did research in many areas, including real-time systems, garbage collection, compilers, locking algorithms, and programming languages. All of this work was done in the context of virtual machines. I worked on many VMs, including OpenVM, Jikes RVM, and Bartok. During this time, I also did astrophysics research on the side through my involvement in the VERITAS (Very Energetic Radiation Imaging Telescope Array System) telescope. VERITAS is one of the world's largest imaging atmospheric Cherenkov telescopes, and I was part of the team that built it. I dropped out of graduate school after completing the qualifying and preliminary exams.

**Purdue University** West Lafayette, IN. *Aug 1999 — Dec 2003.* B.S. in Computer Science and Math.

**Brebeuf Jesuit Preparatory School** Indianapolis, IN. *Aug 1995 — June 1999.* High school diploma.

## Blog Posts

1. F. Pizlo. *Concurrent JavaScript: It can work!* WebKit Blog, Aug 2017.  
<https://webkit.org/blog/7846/>
2. S. Barati, Y. Suzuki, F. Pizlo. *JSC loves ES6.* WebKit Blog, June 2017.  
<https://webkit.org/blog/7536/>
3. F. Pizlo. *Introducing Riptide: WebKit's Retreating Wavefront Concurrent Garbage Collector.* WebKit Blog, January 2017.  
<https://webkit.org/blog/7122/>
4. F. Pizlo. *Locking in WebKit.* WebKit Blog, May 2016.  
<https://webkit.org/blog/6161/>
5. F. Pizlo. *Introducing the B3 JIT Compiler.* WebKit Blog, February 2016.  
<https://webkit.org/blog/5852/>
6. F. Pizlo. *Announcing JetStream 1.1.* WebKit Blog, July 2015.  
<https://webkit.org/blog/3611/>
7. F. Pizlo. *Introducing the JetStream benchmark suite.* Surfin' Safari blog, June 2014.  
<https://webkit.org/blog/3418/>
8. F. Pizlo. *Introducing the WebKit FTL JIT.* Surfin' Safari blog, May 2014.  
<https://webkit.org/blog/3362/>
9. F. Pizlo. *Announcing SunSpider 1.0.* Surfin' Safari blog, April 2013.  
<https://webkit.org/blog/2364/>

## Software Artifacts

**WebKit.** One of the top contributors with over 3,000 commits. Over 190,000 lines of non-test code blames to me, which accounts for about one third of JSC. I've contributed to the JIT compilers, GC, bytecode infrastructure, runtime, inline caches, concurrency utilities, and many other components. I am the architect of WebKit's compiler pipeline and I review all major work in that area. I wrote WebKit's garbage collector, called *Riptide*, as one of my last major solo projects before becoming a manager. I designed the `WTF::Lock` and `WTF::ParkingLot` concurrency primitives.  
<http://www.webkit.org/>

- LLVM.** Committer. Contributed MCJIT and C API improvements. Helped design the patchpoint and stackmap intrinsics.  
<http://www.llvm.org/>
- Fiji VM.** Original developer. Wrote all of the compiler (including bytecode frontend, SSA-based IR, and x86 backend), runtime, and garbage collector from scratch.
- Jikes RVM.** Former core team member. Wrote the threading and locking implementation.  
<http://www.jikesrvm.org/>
- Open VM.** Former core developer. Wrote the real-time GC and the IO scheduler.
- Microsoft Bartok Research Compiler.** Intern. Wrote some real-time garbage collectors and some compiler optimizations and transformations for GC barriers.
- VERITAS.** Former research assistant. Wrote the backend data acquisition and real-time data analysis. Designed the data format.  
<http://veritas.sao.arizona.edu/>
- Typed Stream Format.** Sole author. Self-descriptive data format with high-performance data conversion and strong support for types and versioning.  
<http://www.filpizlo.com/tsf/>
- Stochastic Multi-CAS.** Sole author. Implementation of multi-CAS using random numbers. It's not meant to be practical.  
<http://www.filpizlo.com/smcas/>

## Publications

1. T. Kalibera, J. Hagelberg, P. Maj, **F. Pizlo**, B. Titzer, J. Vitek. *A family of real-time Java benchmarks*. Concurrency and Computation: Practice and Experience 23(14): 1679-1700 (2011)
2. T. Kalibera, **F. Pizlo**, A. L. Hosking, J. Vitek. *Scheduling real-time garbage collection on uniprocessors*. ACM Trans. Comput. Syst. 29(3): 8 (2011)
3. **F. Pizlo**, D. Frampton, A. L. Hosking. *Fine-grained Adaptive Biased Locking*. In Principles and Practice of Programming in Java (PPPJ) 2011.
4. **F. Pizlo**, L. Ziarek, P. Maj, A. L. Hosking, E. Blanton, J. Vitek. *Schism: Fragmentation-Tolerant Real-Time Garbage Collection*. In ACM SIGPLAN 2010 Conference on Programming Language Design and Implementation (PLDI 2010).
5. **F. Pizlo**, L. Ziarek, E. Blanton, P. Maj, J. Vitek. *High-level Programming of Embedded Hard Real-Time Devices*. In the ACM SIGOPS 2010 EuroSys Conference (EuroSys 2010).
6. J. Spring, **F. Pizlo**, J. Privat, R. Guerraoui, J. Vitek. *Reflexes: Abstractions for Integrating Highly Responsive Tasks into Java Applications*. ACM Transactions in Embedded Computing Systems (TECS), 2009.
7. T. Kalibera, **F. Pizlo**, A. L. Hosking, J. Vitek. *Scheduling Hard Real-Time Garbage Collection*. IEEE Real-Time Systems Symposium 2009: 81-92.
8. **F. Pizlo**, L. Ziarek, J. Vitek. *Real time Java on resource-constrained platforms with Fiji VM*. JTRES 2009: 110-119.
9. T. Kalibera, J. Hagelberg, **F. Pizlo**, A. Plsek, B. Titzer, J. Vitek. *CDx: a family of real-time Java benchmarks*. JTRES 2009: 41-50.
10. T. Wrigstad, **F. Pizlo**, F. Meawad, L. Zhao, J. Vitek. *Loci: Simple Thread-Locality for Java*. In the 2009 European Conference on Object-Oriented Programming (ECOOP 2009).
11. J. Baker, A. Cunei, T. Kalibera, **F. Pizlo**, J. Vitek. *Accurate Garbage Collection in Uncooperative Environments*. Concurrency and Computation: Practice and Experience, 2008.
12. **F. Pizlo**, E. Petrank, B. Steensgaard. *Path Specialization: Reducing Phased Execution Overheads*. In The 2008 International Symposium on Memory Management (ISMM 2008).

13. **F. Pizlo**, E. Petrank, B. Steensgaard. *A Study of Concurrent Real-time Garbage Collectors*. In the ACM SIGPLAN 2008 Conference on Programming Language Design and Implementation (PLDI 2008). (Acceptance rate: 18)
14. **F. Pizlo**, D. Frampton, E. Petrank, B. Steensgaard. *Stopless: A Real-Time Garbage Collector for Modern Platforms*. In The 2007 International Symposium on Memory Management (ISMM 2007), October 2007.
15. **F. Pizlo**, A. Hosking, J. Vitek. *Hierarchical Real-time Garbage Collection*. In the ACM SIGPLAN/SIGBED Conference on Languages, Compilers, and Tools for Embedded Systems (LCTES'07).
16. J. Spring, **F. Pizlo**, R. Guerraoui, J. Vitek. *Reflexes: Programming Abstractions for Highly Responsive Systems*. In the 2007 ACM International Conference on Virtual Execution Environments (VEE'07).
17. J. Baker, A. Cuneì, **F. Pizlo**, J. Vitek. *Accurate Garbage Collection in Uncooperative Environments with Lazy Pointer Stacks*. In Compiler Construction, 16th International Conference, CC 2007.
18. A. Armbuster, J. Baker, A. Cuneì, C. Flack, D. Holmes, **F. Pizlo**, E. Pla, M. Prochazka, J. Vitek. *A Real-Time Java Virtual Machine with Applications in Avionics*. In ACM Transactions in Embedded Computing Systems (TECS), 2006.
19. **F. Pizlo**, J. Vitek. *An Empirical Evaluation of Memory Management Alternatives for Real-time Java*. Proceedings of the 27th IEEE Real-Time Systems Symposium (RTSS), 2006.
20. J. Baker, A. Cuneì, C. Flack, **F. Pizlo**, M. Prochazka, J. Vitek, A. Armbuster, E. Pla, D. Holmes. *Real-time Java in Avionics Applications*. In Proceedings of the 12th IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS), 2006.
21. **F. Pizlo**. *First in, first out memory*. Presented at The 3rd Workshop on Java Technologies for Real-time and Embedded Systems, October 2005.
22. **F. Pizlo**, J. Fox, D. Holmes, J. Vitek. *Real-time Java scoped memory: design patterns, semantics*. In Proceedings of the IEEE International Symposium on Object-oriented Real-Time Distributed Computing (ISORC'04), pp 101112, Vienna, Austria, May 2004.
23. **F. Pizlo**, M. Prochazka, S. Jaggannathan, J. Vitek. *Transactional lock-free data structure for Real Time Java*. In the Workshop on Concurrency and Synchronization in Java Programs, July 2004.

### Publications in Other Disciplines

1. VERITAS collaboration. *A connection between star formation activity and cosmic rays in the starburst galaxy M82*. Nature, Volume 462, pp. 770-772.
2. V. A. Acciari et al. *VERITAS Observations of a Very High Energy  $\gamma$ -ray Flare from the Blazar 3C 66A*. Astrophysical Journal Letters, 2009.
3. J. Holder et al. *The first VERITAS telescope*. Astroparticle Physics, Volume 25, Issue 6, p. 391-401. July 2006.
4. E. T. Linton et al. *A new search for primordial black hole evaporations using the Whipple gamma-ray telescope*. Journal of Cosmology and Astroparticle Physics, Issue 01, pp. 013. January 2006.
5. A. D. Falcone et al. *A Search for TeV Gamma-Ray Emission from High-peaked Flat-Spectrum Radio Quasars Using the Whipple Air Cerenkov Telescope*. The Astrophysical Journal, Volume 613, Issue 2, pp. 710-715. October 2004.
6. Steinman, R.M., Pizlo, Z., **Pizlo, F.** *Phi is not beta, and why Wertheimer's discovery launched the Gestalt revolution: a minireview*. Vision Research, 40, 2257-2264. 2000.

**Logistics.** US citizen. Polish citizen. Fluent in English and Polish. I usually go by "Phil".

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