Alex Fuerst

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OBJECTIVE

Experienced systems engineer with experience in both low-level virtualization and OS, and high-level distributed systems looking to tackle inefficiencies and problems of modern computing environments who can analyze and communicate findings to general audiences.

EDUCATION

Computer Engineering, PhD — Expected May 2024
Indiana University, Intelligent Systems Engineering — Major GPA 3.9
Computer Engineering, MS — Dec 2023
Indiana University, Intelligent Systems Engineering — Major GPA 3.9
Computer Science, Bachelor of Science — May 2017
Xavier University — Major GPA 3.6
Diploma with Honors — May 2013
Medina High School — GPA 3.6

PUBLICATIONS

5. **Alexander Fuerst**, Abdul Rehman, and Prateek Sharma. Ilúvatar: A Fast Control Plane for Serverless Computing. *International ACM Symposium on High-Performance Parallel and Distributed Computing [HPDC] 2023*. Acceptance Rate = 21%

4. **Alexander Fuerst**, and Prateek Sharma. Locality-aware Load-Balancing For Serverless Clusters. *International ACM Symposium on High-Performance Parallel and Distributed Computing [HPDC] 2022*. Acceptance Rate = 19%

3. **Alexander Fuerst**, Stanko Novakovic, Inigo Goiri, Gohar Irfan Chaudhry, Prateek Sharma, Kapil Arya, Kevin Broas, Eugene Bak, Mehmet Iyigun, and Ricardo Bianchini. Memory-Harvesting VMs in Cloud Platforms. *International Conference on Architectural Support for Programming Languages and Operating Systems [ASPLOS] 2022*. Acceptance Rate = 20%

2. **Alexander Fuerst**, and Prateek Sharma. FaasCache: Keeping Serverless Computing Alive With Greedy-Dual Caching. *International Conference on Architectural Support for Programming Languages and Operating Systems [ASPLOS] 2021*. Acceptance Rate = 18.8%

1. **Alexander Fuerst**, Ahmed Ali-Eldin, Prashant Shenoy, and Prateek Sharma. Cloud-scale VM-deflation for Running Interactive Applications On Transient Servers. *International ACM Symposium on High-Performance Parallel and Distributed Computing [HPDC] 2020*. Acceptance Rate = 22%

EXPERIENCE

Google, Inc. — *Mountain View, California*
Software Engineering Intern — Summer 2023

- Worked on advanced Linux and KVM-based virtualization technologies to support cloud workloads
- Explored techniques to seamlessly upgrade VMM and hypervisor without downtime to guest OS and applications
- Modified Linux kernel, KVM, and Cloud Hypervisor VMM to test possibilities for seamless upgrade
- Developed proof-of-concept experiments to show feasibility of designed techniques

Microsoft Research — *Redmond, Washington*
Research Intern — Summer 2021

- Analyzed modern hypervisor and control plane's performance under strenuous runtime conditions
- Modified cloud control plane, hypervisor, and guest OS to improve cluster virtual memory management
- Improved resource utilization in Azure without impact to VMs or applications

Indiana University   *Bloomington, Indiana*
Research Assistant   2021-Present

- Identify opportunities for enhancing cloud computing and distributed systems
- Develop cutting-edge techniques and algorithms to improve the state-of-the-art
- Design experiments and transformed results into understandable and actionable data
- First author on several published papers and gave presentations at high-impact conferences

Indiana University   *Bloomington, Indiana*
Associate Instructor   2019-2020

- Assisted with Engineering Cloud Computing & Distributed Computing Engineering course work
- Create assignments and exams given to students
- Host lab and office hours to discuss project design and assist with student questions

Hyland Software   *Westlake, Ohio*
Developer 1   2017-2018
Developer 2   2018-2019

- Developed features and wrote tests for a cloud application capable of handling thousands of daily users
- Troubleshot complex issues of multi-service .Net SaaS application running in production
- Refactored monolith application to run as microservices and support autoscaling inside Kubernetes
- Modernized application CI/CD pipeline to improve time-to-deployment and rollback

Xavier University   *Cincinnati, Ohio*
Teaching Assistant   2016

- Work with students during class exercises
- Host office hours answering questions and giving guidance on assignments

Xavier University   *Cincinnati, Ohio*
Student Technician Tier II   2013-2016

- Troubleshoot complex technology issues and provide onsite service and repair for faculty, staff and public computing
- Provide software, hardware and network problem resolution
- Handle tickets escalated from Tier I

Salisbury University   *Salisbury, Maryland*
NSF REU Researcher   Summer 2016

- Applied emerging parallel computing models using GPU and CPU parallelism with NVIDIA's CUDA
- Tackled data and compute-intensive problems in geographic information systems
- Presented findings to GIS professionals and Salisbury Faculty

Critchfield, Critchfield & Johnston, Ltd.   *Medina, Ohio*
Paralegal Intern   August 2012-June 2013

- Prepared and delivered documents to county offices
- Finalized legal binders for delivery to clients

PROJECTS

Ilúvatar FaaS Control Plane

An open-source, fast, jitter-free control plane for Serverless function execution written in ~20k lines of Rust. Ilúvatar provides a 3x reduction in overhead compared to popular open-sourced examples under normal load, and under high load has a 100x reduction in p99 latency. Additionally, it enables unique usability and extensibility designed to accelerate FaaS research.

FaasCache

Introduced caching insights into the Function-As-A-Service paradigm. Enhanced the open source FaaS application OpenWhisk using Greedy-Dual caching. Reduced cold-start overhead for functions by up to 3x and can reduce constrained system resources by up to 30%. These high cache reuse results allow for increased ability to serve functions and lower latency for users.

CompuCell3D Tissue Modeling Parallel Rendering

CompuCell3D is a 3D modeling software for large-scale cellular, tissue, and biochemical simulation. The modeling steps used an OpenMP Cellular Potts Model algorithm, but the 3D rendering of cell states and positions was done serially. This project re-wrote the rendering code in ~1000 lines of OpenMP C, achieving a near-linear scaling with the increase in threads. Overall, some simulations were accelerated by up to 50% over the serial implementation.

Dynamically Typed Racket Compiler

A scratch built compiler supporting a subset of statically typed and dynamically typed Racket.

Tensorflow NanoParticle Simulator

Implementation of the Lennard-Jones potential in a simulated cube and electrostatic forces of colliding ions in a confined nano-channel. THe simulator Achieved performance similar to MPI/C++ code performing the same simulation.

Jae OS

Just Another Educational Operating System. A port of the Kaya OS project to the new μARM emulator. Wrote the student guide and the canonical implementation of Jae OS.

Kaya OS

Wrote a complete operating system from scratch. The final product, in addition to support a multitude of peripheral devices, successfully ran eight concurrent processes, each running in their own virtual address space.

Parallel GIS Raster Calculator

Developed a tool combining CPU based parallelism and NVIDIA's CUDA technology for GPU calculation for performing GIS raster calculations. Achieved 2 - 5 times performance increase over traditional analysis tools due to GPU performance.

Eagle Scout Project

Installed commemorative plaques on veterans' graves at local cemetery. Led a group of 15 scouts to plan and accomplish this project.

SKILLS

Programming	Debugging, Problem Solving, Code Optimization, Git, Agile
Languages	Rust, C#, Python, C, C++, Bash, PowerShell, Java, Scheme, SQL, LaTeX
Infrastructure	Kubernetes, Docker, Redis, Octopus Deploy, Ansible, AWS, Azure
Technologies	Linux, KVM, GDB, OpenMP, MPI, Tensorflow, SQL Server

COURSE WORK

- Engineering Cloud Computing
- Engineering Distributed Systems
- Graph Analytics
- Deep Learning Systems
- Engineering Compilers

- Programming Languages

- Engineering Operating System
- Simulating Nanoscale Systems
- High Performance Computing
- Computational Modeling for Virtual Tissues
- Databases

PRESENTATIONS

- Ilúvatar: A Fast Control Plane for Serverless Computing. HPDC 2023. Slides
- Locality-aware Load-Balancing For Serverless Clusters. HPDC 2022. Slides Video
- Memory-Harvesting VMs in Cloud Platforms. ASPLOS 2022. Slides Video
- FaasCache: Keeping Serverless Computing Alive With Greedy-Dual Caching. ASPLOS 2021. Slides Video
- Cloud-scale VM-deflation for Running Interactive Applications On Transient Servers. HPDC 2020. Slides Video

AWARDS

Reserve Champion, Baked Goods Division	Monroe County Fair 2023
HPDC Travel Grant	Travel grant to HPDC 2023
ACM Travel Grant	Travel grant to ASPLOS 2022
Boy Scouts of America	Eagle Scout
National Honors Society	
National Technical Honors Society	
Xavier University	John F. Niehaus Scholarship
Xavier University	John F. Niehaus Award

ACTIVITIES

Young Adult Ministry, St. Paul's Catholic Center	Member, 2022-2023
	Vice Chair, 2023-2024
Computer Science Club, Xavier University	Treasurer, 2015-2017
	Vice President, 2016-2017
Dean's Advisory Council, Xavier University	Member, 2015 – 2017