

# Alex Fuerst

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## OBJECTIVE

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Systems engineer with five years' development experience, expertise in low-level virtualization, operating systems, and high-level distributed systems, who can analyze and communicate findings to general audiences. Looking to design solutions to the inefficiencies and problems of modern computing in cloud-scale environments.

## EDUCATION

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<b>Computer Engineering, PhD</b> <i>Indiana University, Intelligent Systems Engineering</i>	July 2024 Major GPA 3.9
<b>Computer Engineering, MS</b> <i>Indiana University, Intelligent Systems Engineering</i>	Dec 2023 Major GPA 3.9
<b>Computer Science, Bachelor of Science</b> <i>Xavier University</i>	May 2017 Major GPA 3.6
<b>Diploma with Honors</b> <i>Medina High School</i>	May 2013 GPA 3.6

## PUBLICATIONS

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6. **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%
5. **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%
4. **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%
3. **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%
2. **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%
1. Prateek Sharma, **Alexander Fuerst**. Accountable Carbon Footprints and Energy Profiling For Serverless Functions. *ACM Symposium on Cloud Computing [SoCC] 2024*. Acceptance Rate = 30%

## EXPERIENCE

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<i>Google, Inc.</i>	<i>Mountain View, California</i>
<b>Software Engineering Intern</b>	May 2023 - August 2023
<ul style="list-style-type: none"><li>• Delved into performance of advanced Linux and KVM-based virtualization technologies under cloud workloads</li><li>• Explored techniques to seamlessly upgrade VMM and hypervisor with zero downtime to guest OS and applications</li><li>• Modified Linux kernel, KVM, and Cloud Hypervisor VMM to test possibilities for seamless upgrade</li><li>• Developed proof-of-concept experiments to show feasibility of designed techniques</li></ul>	
<i>Microsoft Research</i>	<i>Redmond, Washington</i>
<b>Research Intern</b>	May 2021 - August 2021

- Analyzed modern hypervisor and control plane's performance under strenuous runtime conditions
- Modified Azure control plane, hypervisor, and guest OS to improve cluster virtual memory management by 50%
- Collaborated with Azure team to alleviate production contentions and plan rollout across clusters
- Improved resource utilization by 20% in Azure without impact to hosted virtual machines or applications

*Indiana University*

*Bloomington, Indiana*

### **Research Assistant**

August 2021 - Present

- Performed advanced research in cloud resource management, serverless computing, and virtualization
- Developed novel techniques and algorithms improving resource utilization and latency in cloud control planes
- Designed experiments to showcase techniques' effectiveness and transform results into actionable data
- Published several first author papers and gave presentations at high-impact conferences

*Indiana University*

*Bloomington, Indiana*

### **Associate Instructor**

August 2019 - May 2020

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

*Hyland Software*

*Westlake, Ohio*

### **Developer 1 & 2**

June 2017 - July 2019

- Developed features and wrote tests for a cloud application capable of handling thousands of daily users
- Troubleshoot complex issues of a multiservice .Net SaaS application running in production
- Refactored monolith application into a microservice design and support autoscaling inside Kubernetes
- Modernized application CI/CD pipeline to halve time-to-deployment for features and enable rollback scenarios

*Xavier University*

*Cincinnati, Ohio*

### **Teaching Assistant**

August 2016 - December 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**

August 2013 - August 2017

- 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**

May 2016 - August 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**

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### **Ilúvatar FaaS Control Plane**

An open-source, fast, jitter-free control plane for Serverless function execution written in ~23k 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  $\mu$ ARM 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**

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*Programming:* Debugging, Problem Solving, Code Optimization, Git, Agile  
*Languages:* Rust, Python, C, C++, C#, Bash, PowerShell, SQL, L<sup>A</sup>T<sub>E</sub>X  
*Infrastructure:* Kubernetes, Docker, Redis, Octopus Deploy, Ansible, AWS, Azure  
*Technologies:* Linux, KVM, GPUs, GDB, OpenMP, MPI, Tensorflow, SQL Server

## **PRESENTATIONS**

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- 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**

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*Reserve Champion, Baked Goods Division*  
*HPDC Travel Grant*  
*ACM Travel Grant*  
*John F. Niehaus Scholarship*  
*John F. Niehaus Award*  
*Eagle Scout*  
*National Honors Society*  
*National Technical Honors Society*

Monroe County Fair 2023  
Travel grant to HPDC 2023  
Travel grant to ASPLOS 2022  
Xavier University  
Xavier University  
Boy Scouts of America  
Medina High School  
Medina County Career Center

## COURSE WORK

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- 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

## ACTIVITIES

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*Parish Pastoral Council, St. Paul's Catholic Center*  
*Young Adult Ministry, St. Paul's Catholic Center*

*Computer Science Club, Xavier University*

*Dean's Advisory Council, Xavier University*

Member, 2023-2024  
Vice Chair, 2023-2024  
Member, 2022-2023  
Vice President, 2016-2017  
Treasurer, 2015-2017  
Member, 2015 – 2017