

Marcin Copik

SERVERLESS · HPC · PHD RESEARCHER

ETH Zürich

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Summary

In my PhD research, I have been working on serverless programming models to bridge the gap between high-performance computing systems and cloud data centers. I developed tailored solutions for different levels of the FaaS computing stack: from computing and network devices to high-level optimizations, efficient system designs, and performance modeling.

Education

PhD in Computer Science

ETH ZÜRICH

- Thesis: High-Performance Serverless for HPC and Clouds
- Advisor: Prof. Torsten Hoefler

April 2018 - March 2024

Zürich, Switzerland

Master of Science (MSc) in Simulation Sciences

RWTH AACHEN

- Grade: 1.5. Interdisciplinary program. Major subject: High-Performance Computing
- Thesis: Parallel Prefix Algorithms for the Registration of Arbitrarily Long Electron Micrograph Series
- Advisor: Prof. Paolo Bientinesi, Prof. Benjamin Berkels

September 2014 - July 2017

Aachen, Germany

Summer School in Mathematics

UNIVERSITY OF PERUGIA

- Courses: Stochastic Processes, Functional Analysis

August 2014

Perugia, Italy

Bachelor of Science (BSc) in Mathematics

SILESIA UNIVERSITY OF TECHNOLOGY

- GPA: 4.6/5.0. Finished two of three years program

September 2012 - June 2014

Gliwice, Poland

Bachelor of Science in Engineering (BSc) in Computer Science

SILESIA UNIVERSITY OF TECHNOLOGY

- Grade 5(A). Major subject: Software Engineering
- Thesis: GPU-accelerated stochastic simulator engine for PRISM model checker
- Advisor: Prof. Tadeusz Czachorski

September 2010 - March 2014

Gliwice, Poland

Experience

Postdoctoral Researcher

ETH ZÜRICH

- Advising for Bachelor and Master thesis projects.
- Conducting interviews for PhD and PostDoc candidates.
- Teaching assistant for Bachelor and Master courses.

Zürich, Switzerland

May 2024 -

Research Assistant

ETH ZÜRICH

- Advising for Bachelor and Master thesis projects.
- Conducting interviews for PhD and PostDoc candidates.
- Teaching assistant for Bachelor and Master courses.

Zürich, Switzerland

April 2018 - April 2024

Research Intern

MICROSOFT

- Analyzing microarchitectural implications of serverless workloads.
- Supervisor: Bobbie Manne.

Redmond, WA, USA

June - October 2019

Mentor

GOOGLE SUMMER OF CODE

- Mentoring students working on HPX.
- Students: Ajai V George, Gabriel Laberge (co-mentored).

Organization: The STE||AR Group.

2017, 2018

Student Research Assistant

RWTH AACHEN, HIGH-PERFORMANCE AND AUTOMATIC COMPUTING

- Benchmarking linear algebra frameworks.
- Supervisor: Prof. Paolo Bientinesi.

Aachen, Germany

2016 - December 2017

Research Assistant

LOUISIANA STATE UNIVERSITY, STE||AR GROUP

- Integrating single-source GPU programming in HPX.
- Supervisor: Prof. Hartmut Kaiser.

Baton Rouge, LA, USA

April 2016 - August 2016

Student Research Assistant

JÜLICH SUPERCOMPUTING CENTRE

- Developing tools for performance analysis of parallel applications at Scalasca.
- Supervisor: Dr Pavel Saviankou.

Jülich, Germany

October 2014 - March 2016

Software Engineer

GOOGLE SUMMER OF CODE

- Integrating single-source GPU programming in HPX.
- Supervisor: Dr Hartmut Kaiser.

Organization: The STE||AR Group

2015

Software Engineer

GOOGLE SUMMER OF CODE

- Improving statistical model checking.
- Supervisor: Dr Vojtěch Forejt, Dr Dave Parker.

Organization: PRISM model checker

2014

Student Research Assistant

THE INSTITUTE OF THEORETICAL AND APPLIED INFORMATICS

- Implementing GPU simulator of Markov Chains.
- Supervisors: Dr Mateusz Nowak, Dr Artur Rataj.

Gliwice, Poland

2012 - 2013

Student Research Assistant

SILESIA UNIVERSITY OF TECHNOLOGY

- Implementing algorithms for registration of respiratory motion.
- Supervisor: Dr Dominik Spinczyk.

Gliwice, Poland

2012 - 2013

Honors & Awards

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| 2023 | SIGHPC Travel Grant , awarded for travel to ACM/IEEE Supercomputing 2023. |
| 2022 | ACM/IEEE George Michael Memorial HPC Fellowship , awarded for contributions into high-performance serverless. |
| 2020 | Gold Medal at the ACM Student Research Competition , ACM/IEEE Supercomputing 2022 |
| 2022 | AWS Cloud Credit for Research Application |
| 2022 | Google Cloud Research Credits |
| 2021 | Microsoft Research PhD Fellowship , awarded for the 2021/2022 academic year. |
| 2019 | Gold Medal at the ACM Student Research Competition , ACM/IEEE Supercomputing 2019 |

Peer-reviewed Publications

FaaSKeeper: Learning from Building Serverless Services with ZooKeeper as an Example

ACM HPDC

COPIK M., CALOTOIU A., ZHOU P., TARANOV K., HOEFLE T.

2024

- Acceptance Rate 17.3% (26/150)

XaaS: Acceleration as a Service to Enable Productive High-Performance Cloud Computing

IEEE CISE

HOEFLE T., COPIK M., BECKMAN P., JONES A., FOSTER I., PARASHAR M., REED D., TROYER M., SCHULTHESS T., ERNST D.,

2024

DONGARRA J.

Software Resource Disaggregation for HPC with Serverless Computing

IEEE IPDPS

COPIK M., CHRAPEK M., SCHMID L., CALOTOIU A., HOEFLE T.

2024

- Acceptance Rate 26.1% (88/337)

User-guided Page Merging for Memory Deduplication in Serverless Systems

IEEE Big Data

QIU W., COPIK M., WANG Y., CALOTOIU A., HOEFLE T.

2023

- Acceptance Rate 17.5% (92/526)

FMI: Fast and Cheap Message Passing for Serverless Functions

COPIK M., BÖHRINGER R., CALOTOIU A., HOEFLE T.

- Acceptance Rate 29.4% (40/136)

ACM ICS

2023

rFaaS: Enabling High Performance Serverless with RDMA and Leases

COPIK M., TARANOV K., CALOTOIU A., HOEFLE T.

- Acceptance Rate 25.7% (95/369)

IPDPS

2023

Performance-Detective: Automatic Deduction of Cheap and Accurate Performance Models

SCHMID L., COPIK M., CALOTOIU A., WERLE D., REITER A., SELZER M., KOZIOLEK A., HOEFLE T.

- Acceptance Rate 24.2% (39/161)

ACM ICS

2022

MOM: Matrix Operations in MLIR

CHELINI L., BARTHELS H., BIENTINESI P., COPIK M., GROSSER T., SPAMINATO D.

IMPACT

2022

Work-stealing Prefix Scan: Addressing Load Imbalance in Large-scale Image Registration

COPIK M., GROSSER T., HOEFLE T., BIENTINESI P., BERKELS B.

IEEE TPDS

2021

SeBS: A Serverless Benchmark Suite for Function-as-a-Service Computing

COPIK M., KWASNIEWSKI G., BESTA M., PODSTAWSKI M., HOEFLE T.

- Acceptance Rate 31% (33/107)

ACM/IFIP Middleware

2021

Extracting Clean Performance Models from Tainted Programs

COPIK M., CALOTOIU A., GROSSER T., WICKI N., WOLF F., HOEFLE T.

- Acceptance Rate 21% (31/150)

ACM PPOPP

2021

GraphMineSuite: Enabling High-Performance and Programmable Graph Mining Algorithms with Set Algebra

BESTA M. [AND 18 OTHERS, INCLUDING COPIK M.]

VLDB

2021

SISA: Set-Centric Instruction Set Architecture for Graph Mining on Processing-in-Memory Systems

BESTA M. [AND 18 OTHERS, INCLUDING COPIK M.]

IEEE MICRO

2021

The Generalized Matrix Chain Algorithm

BARTHELS H., COPIK M., BIENTINESI P.

- Acceptance Rate 28.6% (30/105)

CGO

2018

Using SYCL as an Implementation Framework for HPX.Compute

COPIK M., KAISER H.

DHPCC++ Workshop, IWOC

2017

A GPGPU-based Simulator for Prism: Statistical Verification of Results of PMC

COPIK M., RATAJ A., WOŻNA-SZCZĘŚNIAK B.

CS&P

2016

Methods for abdominal respiratory motion tracking

SPINCZYK D., KARWAN A., COPIK M.

Computer Aided Surgery

2014

Presentations and Talks

Benchmarking Serverless with SeBS: Past, Present, and Future

THIRD INTERNATIONAL WORKSHOP ON SERVERLESS COMPUTING EXPERIENCE 2024

June 2024

High Performance Serverless for HPC and Cloud

INVITED TALK, INTELLIGENT SERVERLESS AND CLOUD APPLICATIONS SYMPOSIUM, ZURICH UNIVERSITY OF APPLIED SCIENCES.

June 2024

Evaluating FaaS Systems with the Serverless Benchmark Suite SeBS

SEATED WORKSHOP ON SERVERLESS AT THE EDGE, HPDC 2024

June 2024

Cppless: Productive and Performant Serverless Programming in C++

LIGHTNING TALK, LLVM-HPC AT ACM/IEEE SUPERCOMPUTING 2023.

November 2023

High Performance Serverless for HPC and Clouds

POSTER PRESENTATION AT DOCTORAL SHOWCASE, SC 2023.

November 2023

Serverless As a Bridge Between HPC and Clouds

INVITED TALK, AWS CLOUD FOR RESEARCH AT ETH.

May 2023

Serverless As a Bridge Between HPC and Clouds

INVITED TALK, 5TH WORKSHOP ON PARALLEL AI AND SYSTEMS FOR THE EDGE (PAISE), IPDPS 2023.

May 2023

Serverless As a Bridge Between HPC and Clouds

POSTER PRESENTATION AT PHD FORUM, IPDPS 2023.

May 2023

Software Resource Disaggregation for HPC with Serverless Computing

ACM/IEEE SUPERCOMPUTING 2022 POSTER, **GOLD MEDAL AT THE ACM STUDENT RESEARCH COMPETITION.**

November 2022

Software Resource Disaggregation for HPC with Serverless Computing

SUPERCOMPCLOUD AT ACM/IEEE SUPERCOMPUTING 2022.

November 2022

Interactive Computing with Serverless Functions in rFaaS

LIGHTNING TALK, URGENTHPC AT ACM/IEEE SUPERCOMPUTING 2022.

November 2022

Extracting Clean Performance Models from Tainted Programs"

SIAM CONFERENCE ON PARALLEL PROCESSING FOR SCIENTIFIC COMPUTING (PP22) MINISYMPOSIUM

February 2022

perf-taint: Taint Analysis for Automatic Many-Parameter Performance Modeling

ACM/IEEE SUPERCOMPUTING 2019 POSTER, **GOLD MEDAL AT THE ACM STUDENT RESEARCH COMPETITION.**

November 2019

Parallel Prefix Algorithms for the Registration of Arbitrarily Long Electron Micrograph Series

ACM/IEEE SUPERCOMPUTING 2017 POSTER, ACM STUDENT RESEARCH COMPETITION.

November 2017

HPX and GPU-parallelized STL

C++NOW 2016 CONFERENCE.

May 2016

Skills

Programming Technologies	Experienced: C++, Python, Java Familiar: Matlab, Julia, Mathematica, R, Pascal, x86 ASM
Tools	MPI, OpenMP, LLVM, OpenCL, SYCL, C++AMP, Docker, Kubernetes
Experience	Git, SVN, Mercurial, CMake, autotools, SLURM
Languages	serverless computing, parallel programming, cloud computing, performance modeling, GPU programming, model checking
	English, German, Polish

Service

2025	IEEE International Parallel & Distributed Processing Symposium (IPDPS)	Program Committee
2024	Journal of Systems Architecture	Reviewer
2024	Workshop on Parallel AI and Systems for the Edge (PAISE)	Organizing committee
2023	ACM/IEEE Supercomputing	Student Volunteer
2022	ACM/IEEE Supercomputing	Student Volunteer
2022	International Journal of High Performance Computing Applications	Reviewer
2020	LLVM-HPC Workshop	Reviewer
2019	ISC High Performance	Reviewer

Teaching

Fall 2024	Information Systems for Engineers	ETH Zürich
Spring 2024	Parallel Programming	ETH Zürich
Fall 2023	Big Data	ETH Zürich
Spring 2023	Parallel Programming	ETH Zürich
Spring 2022	Parallel Programming	ETH Zürich
Fall 2021	Information Systems for Engineers	ETH Zürich
Spring 2021	Parallel Programming	ETH Zürich
Fall 2020	Compiler Design	ETH Zürich
Spring 2020	Parallel Programming	ETH Zürich
Fall 2019	Design of Parallel and High-Performance Computing	ETH Zürich
Spring 2019	Parallel Programming	ETH Zürich
Fall 2018	Numerical Methods for Computational Science and Engineering	ETH Zürich

Andrea Jiang	Co-supervised Master Thesis: Serverless and Cloud Runtimes for Graph-of-Thoughts	2024, ETH Zürich
Entiol Liko	Semester Project: Serverless Co-location with ML	2024, ETH Zürich
Oana Rosca	Semester Project: Long-Term Serverless Performance Variability	2024, ETH Zürich
Constantin Dragancea	Master Thesis: Adoption and evolution of C++ in HPC Applications	2024, ETH Zürich
Prajin Khadka	Co-supervised Google Summer of Code Student: Expanded serverless benchmarks	2024, GSoC
Syed Mujtaba	Google Summer of Code Student: Using serverless ZooKeeper in Apache projects	2024, GSoC
Abhishek Kumar	Co-supervised Google Summer of Code Student: New serverless benchmarks	2024, GSoC
Matt Nappo	Co-supervised Google Summer of Code Student: Libfabric Implementation of rFaaS	2023, GSoC
Boyan Zhou	Master Thesis: Adoption and evolution of C++ in HPC Applications	2023, ETH Zürich
Gyorgy Rethy	Master Thesis: Process-as-a-Service computing on modern serverless platforms	2022, ETH Zürich
Laurin Brandner	Master Thesis: Serverless workflows benchmarking	2022, ETH Zürich
Lukas Möller	Bachelor Thesis: Serverless C++ Executor	2022, ETH Zürich
Malte Wächter	Bachelor Thesis: Profiling and optimizations of serverless functions	2022, ETH Zürich
Qiu Wei	Master Thesis: Serverless memory deduplication	2022, ETH Zürich
Lukas Tobler	Master Thesis: Serverless GPU functions	2022, ETH Zürich
Arnet Colin	Bachelor Thesis: Verification of representativeness of benchmarking suite	2021, ETH Zürich
Roman Böhringer	Master Thesis: Serverless collectives.	2021, ETH Zürich
Emir İşman	Bachelor Thesis: FaaSStest collectives: reliable communication in serverless world	2021, ETH Zürich
Konrad Handrick	Co-supervised Bachelor Thesis: Offloading serverless with sPIN	2021, ETH Zürich
Tobias Lüscher	Bachelor Thesis: TaintImpact: Taint-Based Change Impact Analysis	2021, ETH Zürich
Siegfried Hartogs	Bachelor Thesis: Code-driven Language Development: Framework for Analysis of C/C++ Open-Source Projects	2021, ETH Zürich
Lukas Gygi	Bachelor Thesis: CppBuild: Large-Scale, Automatic Build System for Open Source C++ Repositories	2021, ETH Zürich
Nicolas Wicki	Bachelor Thesis: Control Flow Taint Analysis for Performance Modeling in LLVM	2020, ETH Zürich
Philipp Bomatter	Co-supervised Bachelor Thesis: Towards Extreme-Scale Cache Coherence Protocols and Simulations	2019, ETH Zürich
Gabriel Laberge	Co-supervised Google Summer of Code Student: Alternative smart executors	2018, GSoC
Ajai V George	Google Summer of Code Student: Work on Parallel Algorithms	2017, GSoC