Konstantinos Kallas

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Research The goal of my research is to enable the development of high-performance applications with robust correctness guarantees. To achieve this goal, I build practical programmable software systems that target realistic workloads in widely-used environments. I build my systems on solid foundations using formal specifications and techniques drawn from programming languages, compilers, and formal methods.

Contents

Education

University of Pennsylvania *September 2018 – present*
Computer and Information Science, PhD student
Advisor: Prof. Rajeev Alur

National Technical University of Athens *October 2012 – February 2018*
Electrical and Computer Engineering, Diploma
Thesis: *"HiPErJiT: A Profile-Driven Just-in-Time Compiler for Erlang"*
Advisor: Prof. Kostis Sagonas

Employment

Research Intern *Summer 2020*
Microsoft Research, Redmond, US
Internship in the RiSE group; advised by Sebastian Burckhardt.
Worked on Durable Functions, a programming model for serverless applications.

Research Intern *Summer 2019*
Amazon Web Services, New York, US
Internship in the Automated Reasoning Group; advised by Daniel Schwartz-Narbonne.
Worked on the verification of critical C code.

Big Data Application Developer *Summer 2016*
Everis, Barcelona, Spain
Internship at the Big Data Center of Excellence.
Developed Big Data Applications using tools in the Hadoop ecosystem.

Honors and Awards

Morris and Dorothy Rubinoff Award *2024*
Awarded to two graduating Penn CIS PhD students with most noteworthy research accomplishments.

A.G. Leventis Foundation PhD Grant *2021-2023*

ACM SRC Grand Finals *2021*
2nd place among SRC winners across all ACM conferences.

HotOS 2021 Distinguished Presentation Award *2021*
Awarded for "Unix Shell Programming: The Next 50 Years".

EuroSys 2021 Best Paper Award *2021*
Awarded for "PaSh: Light-touch Data-Parallel Shell Processing".

POPL Student Research Competition *2021*
1st place at the graduate category of the research competition.
Presented work on a parallelizing JiT compiler for shell scripts.

Gerondelis Foundation PhD Award *2020*

Publications

Mucache: a General Framework for Caching in Microservice Graphs.
Haoran Zhang*, Konstantinos Kallas*, Spyros Pavlatos, Rajeev Alur, Sebastian Angel, and Vincent Liu.
To appear in the 21th USENIX Symposium on Networked Systems Design and Implementation (NSDI 24).

DiSh: Dynamic Shell-Script Distribution.
Tammam Mustafa, Konstantinos Kallas, Pratyush Das, and Nikos Vasilakis. 20th USENIX Symposium on Networked Systems Design and Implementation (NSDI 23), pp. 341-356.
Citations: 0

Executing Microservice Applications on Serverless, Correctly.
Konstantinos Kallas*, Haoran Zhang*, Rajeev Alur, Sebastian Angel, and Vincent Liu. Proceedings of the ACM on Programming Languages (POPL 2023), pp. 367-395.
Citations: 2

Executing Shell Scripts in the Wrong Order, Correctly.
Georgios Liargkovas, Konstantinos Kallas, Michael Greenberg, and Nikos Vasilakis. Proceedings of the 19th Workshop on Hot Topics in Operating Systems (HotOS 23), pp. 103-109.
Citations: 0

Practically Correct, Just-in-Time Shell Script Parallelization.
Konstantinos Kallas, Tammam Mustafa, Jan Bielak, Dimitris Karnikis, Thurston Dang, Michael Greenberg, and Nikos Vasilakis. 16th USENIX Symposium on Operating Systems Design and Implementation (OSDI 22), pp. 769-785.
Citations: 4

Netherite: Efficient Execution of Serverless Workflows.
Sebastian Burckhardt, Badrish Chandramouli, Chris Gillum, David Justo, Konstantinos Kallas, Connor McMahon, Christopher S. Meiklejohn, and Xiangfeng Zhu. Proceedings of the VLDB Endowment 15 (VLDB 2022), pp. 1591-1604.
Citations: 35

Stream Processing with Dependency-Guided Synchronization.
Konstantinos Kallas*, Filip Niksic*, Caleb Stanford*, and Rajeev Alur. Proceedings of the 27th ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming (PPoPP 2022), pp. 1-16.
Citations: 5

PaSh: Light-touch Data-Parallel Shell Processing.
Nikos Vasilakis*, Konstantinos Kallas*, Konstantinos Mamouras, Achilleas Benetopoulos, and Lazar M. Cvetković. Proceedings of the Sixteenth European Conference on Computer Systems (EuroSys 2021), pp. 49-66.
Citations: 17
Best Paper Award.

Durable Functions: Semantics for Stateful Serverless.
Sebastian Burckhardt, Chris Gillum, David Justo, Konstantinos Kallas, Connor McMahon, and Christopher S. Meiklejohn. Proceedings of the ACM on Programming Languages (OOPSLA 2021), pp. 1-27.
Citations: 33

An Order-aware Dataflow Model for Parallel Unix Pipelines.
Shivam Handa*, Konstantinos Kallas*, Nikos Vasilakis*, and Martin Rinard. Proceedings of the ACM on Programming Languages (ICFP 2021), pp. 1-28.
Citations: 13

Unix Shell Programming: The Next 50 Years.
Michael Greenberg*, Konstantinos Kallas*, and Nikos Vasilakis*. Proceedings of the Workshop on Hot Topics in Operating Systems (HotOS 2021), pp. 104-111.
Citations: 12
Distinguished Presentation Award.

Charon: A Framework for Microservice Overload Control.
Jiali Xing, Max Demoulin, Konstantinos Kallas, and Benjamin C. Lee. Proceedings of the 18th ACM Workshop on Hot Topics in Networks (HotNets 2021), pp. 213-220.
Citations: 1

Synchronization Schemas.
Rajeev Alur, Phillip Hillard, Zachary G. Ives, Konstantinos Kallas, Konstantinos Mamouras, Filip Niksic, Caleb Stanford, Val Tannen, and Anton Xue. Invited Paper at Proceedings of the 40th Symposium on Principles of Database Systems (PODS 2021), pp. 1-18.
Citations: 4

Preventing Dynamic Library Compromise on Node.js via RWX-Based Privilege Reduction.
Nikos Vasilakis, Cristian-Alexandru Staicu, Grigoris Ntousakis, Konstantinos Kallas, Ben Karel, André DeHon, and Michael Pradel. Proceedings of the ACM SIGSAC Conference on Computer and Communications Security (CCS'21), pp. 1821-1838.
Citations: 25

Code-level model checking in the software development workflow at Amazon Web Services.
Nathan Chong, Byron Cook, Jonathan Eidelman, Konstantinos Kallas, Kareem Khazem, Felipe R. Monteiro, Daniel Schwartz-Narbonne, Serdar Tasiran, Michael Tautschnig, and Mark R. Tuttle. Software: Practice and Experience 2021, pp. 772-797.
Citations: 15

DiffStream: Differential Output Testing for Stream Processing Programs.
Konstantinos Kallas*, Filip Niksic*, Caleb Stanford*, and Rajeev Alur. Proceedings of the ACM on Programming Languages (OOPSLA 2020), pp. 1-29.
Citations: 17

Code-Level Model Checking in the Software Development Workflow.
Nathan Chong, Byron Cook, Konstantinos Kallas, Kareem Khazem, Felipe R. Monteiro, Daniel Schwartz-Narbonne, Serdar Tasiran, Michael Tautschnig, and Mark R. Tuttle. Proceedings of the ACM/IEEE 42st International Conference on Software Engineering: Software Engineering in Practice (ICSE-SEIP 2020), pp. 11-20.
Citations: 33

Security Criteria for a Transparent Encryption Layer.
Konstantinos Kallas, Clara Schneidewind, Benjamin C. Pierce, and Steve Zdancewic. Workshop on Foundations of Computer Security (FCS 2019).
Citations: 0

HiPErJiT: A Profile-Driven Just-in-Time Compiler for Erlang.
Konstantinos Kallas and Konstantinos Sagonas. Proceedings of the 30th Symposium on Implementation and Application of Functional Languages (IFL 2018), pp. 25-36.
Citations: 3

Notes: * indicates equal contribution. Citation counts exported from Google Scholar.

Software

try (Github: binpash/try) Stars: 4885, Forks: 64
A tool that lets you run a command and inspect its effects before committing them to your system.

PaSh (Github: binpash/pash) Stars: 510, Forks: 36

A bolt-on system that automatically parallelizes arbitrary shell programs with theoretical and practical correctness guarantees.
Hosted by the Linux Foundation.

DiSh (Github: binpash/dish) Stars: 15, Forks: 3
A system that automatically scales out shell scripts that operate on files in HDFS.

mu2sls (Github: eniac/mu2sls) Stars: 9, Forks: 4
A framework for correctly implementing stateful microservice applications on serverless using standard Python.

Flumina (Github: angelhof/flumina) Stars: 12, Forks: 1
A programming model and system for stateful distributed streaming computations.

DiffStream (Github: fniksic/diffstream) Stars: 6, Forks: 1
A differential testing library for stream processing applications in Apache Flink.

Selected Press

Practically Correct, Just-in-Time Shell Script Parallelization (link)
Disseminate Podcast Episode 20, hosted by Jack Waudby. January 2023.

Faster computing results without fear of errors (link)
MIT News Article, written by Adam Zewe. June 2022.

The PaSh Project – Advancing the Unix Philosophy One Step Further (link)
I-Programmer News Article, written by Nikos Vaggalis. November 2021.

Linux Foundation to Host the PaSh Project, Accelerating Shell Scripting with Automated Parallelization for Industrial Use Cases (link)
Linux Foundation Press Release, written by Kristin OConnell. September 2021.

Research Mentoring

Mayank Keoliya (UPenn, PhD) *2023 – present*
LLMs for Unix command specification.

Dimitra Leventi (NTUA, BSc) *2023 – present*
Characterization of shell workloads and development of a benchmark suite.

Nikos Pagonas (NTUA, BSc) *2023 – present*
Design and development of a serverless shell.

Spyros Pavlatos (UPenn, PhD) *2022 – present*
Development of correctness criteria for microservice applications.

Akis Giannoukos (UPenn, PhD) *2022 – present*
Overload control for microservice applications.

Giorgos Liargovas (AUEB, BSc) *2022 – present*
Out-of-order execution of shell scripts (paper at HotOS 2023).

Tianyu (Eric) Zhu (Stevens, BSc) *2022 – present*
Design and development of `try`, a lightweight isolation tool for Linux (over 4k stars on Github).

Jiali Xing (UPenn, PhD) *2021 – present*
Overload control for microservice applications (paper at HotNets 2021).

Tammam Mustafa (MIT, BSc → Google) *2021 – 2023*
Design and development of DiSh (papers at OSDI 2022 and NSDI 2023).

Achilles Benetopoulos (NTUA, BSc → UCSC, PhD) *2019 – 2021*
Development of PaSh's runtime and benchmarking of shell programs (paper at EuroSys 2021).

Lazar Cvetkovic (University of Belgrade, BSc → ETH, PhD) *2019 – 2021*
Specification framework for POSIX and GNU Coreutils commands (paper at EuroSys 2021).

Outreach

CS PhD MentoRes *2021 – present*
Co-organizer of mentoring initiative for students that are interested in applying for PhD programs in CS but lack adequate resources. We have provided mentoring and resources to more than 40 students since the initiative's start.

SIGPLAN-M *2021 – present*
Participating mentor for students in the programming languages community.

SOSP Mentoring *2023*
Student mentor in SOSP 2023.

Service

POPL 2023 Student Volunteer Co-Chair *2023*

OOPSLA 2023 External Review and Artifact Evaluation Committee *2023*

POPL 2022 Student Volunteer Co-Chair *2022*

HotOS 2021 Co-organizer of a panel on the future of the shell (link) *2021*

VMCAI 2021 Artifact Evaluation Committee *2021*

POPL 2020 External Reviewer *2020*

Teaching

Teaching Assistant *Fall 2021*
Institution: University of Pennsylvania
Course: *Computer-Aided Verification*, Graduate level
Professor: Rajeev Alur

Teaching Assistant *Fall 2019*
Institution: University of Pennsylvania
Course: *Software Foundations*, Graduate level
Professor: Benjamin Pierce

Lab Assistant *Fall 2017*
Institution: National Technical University of Athens
Course: *Introduction to Programming*, Undergraduate level
Professors: S. Zachos, N. Papaspyrou, V. Kantere, and P. Potikas

Invited Talks

PaSh: Practically Correct, Just-in-Time Shell Script Parallelization. *2023*
Event: Invited lecture at Programming Language and Translators (COMS 4115) @ Columbia University.
Host: Baishakhi Ray.

PaSh: Practically Correct, Just-in-Time Shell Script Parallelization. *2023*
Event: Compute Seminar @ Technical University of Denmark (DTU).
Host: Christian Gram Kalhauge.

Executing Microservices on Serverless, Correctly. *2023*
Event: Sysread Seminar @ Brown University.
Host: Shriram Krishnamurthi.

Advancing the Serverless Paradigm. *2023*
Event: Invited Lecture at Systems Transforming Systems Course @ Brown University.
Host: Nikos Vasilakis.

PaSh: Practically Correct, Just-in-Time Shell Script Parallelization. *2023*
Event: Portland Programming Languages Seminar @ Portland State University.
Host: Yao Li.

Executing Microservices on Serverless, Correctly. *2023*
Event: Programming Languages Seminar @ Harvard University.
Host: Stephen Chong.

PaSh: Practically Correct, Just-in-Time Shell Script Parallelization. *2023*
Event: CSLab Computing Systems Day @ National Technical University of Athens.
Host: Georgios Goumas.

PaSh: Practically Correct, Just-in-Time Shell Script Parallelization. *2022*
Event: Invited Lecture at Systems Transforming Systems Course @ Brown University.
Host: Nikos Vasilakis.

PaSh: Practically Correct, Just-in-Time Shell Script Parallelization. *2022*
Event: New England Programming Languages and Systems Symposium (NEPLS) @ Harvard University.

PaSh: Practically Correct, Just-in-Time Shell Script Parallelization. *2022*
Event: New Jersey Programming Languages and Systems Seminar (NJPLS) @ Stevens University.

PaSh: Practically Correct, Just-in-Time Shell Script Parallelization. *2022*
Event: Languages, Systems, and Data Group Seminar @ University of California Santa Cruz.
Host: Lindsey Kuper.

PaSh: Data-parallel shell scripting. *2022*
Event: Programming Research Laboratory Seminar @ Northeastern University (Virtual).
Host: Arjun Guha.

Flumina: Correct Distribution of Stateful Streaming Computations. *2020*
Event: Programming Languages Tea @ University of California San Diego.
Host: Nadia Polikarpova.

HiPErJiT: A Profile-Driven Just-in-Time Compiler for Erlang. *2018*
Event: Athens Programming Languages Seminar @ National Technical University of Athens.
Host: Kostis Sagonas and Nikos Papaspirou.

References

Rajeev Alur
Zisman Family Professor, Department of Computer and Information Science, University of Pennsylvania

Sebastian Burckhardt
Senior Principal Researcher, Microsoft Research

Vincent Liu
Assistant Professor, Department of Computer and Information Science, University of Pennsylvania

Nikos Vasilakis
Assistant Professor, Department of Computer Science, Brown University

Keith Winstein
Associate Professor, Department of Computer Science, Stanford University