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.
Publications


DiSh: Dynamic Shell-Script Distribution.

Executing Microservice Applications on Serverless, Correctly.

Executing Shell Scripts in the Wrong Order, Correctly.

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.

Netherite: Efficient Execution of Serverless Workflows.

Stream Processing with Dependency-Guided Synchronization.

PaSh: Light-touch Data-Parallel Shell Processing.
Best Paper Award.

Durable Functions: Semantics for Stateful Serverless.

An Order-aware Dataflow Model for Parallel Unix Pipelines.
Unix Shell Programming: The Next 50 Years.
Distinguished Presentation Award.

Charon: A Framework for Microservice Overload Control.

Synchronization Schemas.

Preventing Dynamic Library Compromise on Node.js via RWX-Based Privilege Reduction.

Code-level model checking in the software development workflow at Amazon Web Services.


Code-Level Model Checking in the Software Development Workflow.


HiPerJiT: A Profile-Driven Just-in-Time Compiler for Erlang.

Notes: * indicates equal contribution.

Software

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

PaSh (Github: binpash/pash)
A bolt-on system that automatically parallelizes arbitrary shell programs with theo-
retical and practical correctness guarantees.

*Hosted by the Linux Foundation.*

**DiSh** (Github: binpash/dish)
A system that automatically scales out shell scripts that operate on files in HDFS.

**mucache** (Github: eniac/mucache)
A system that automatically adds and manages caches in microservice applications.

**mu2sls** (Github: eniac/mu2sls)
A framework for correctly implementing stateful microservice applications on serverless using standard Python.

**Flumina** (Github: angelhof/flumina)
A programming model and system for stateful distributed streaming computations.

**DiffStream** (Github: fniksic/diffstream)
A differential testing library for stream processing applications in Apache Flink.

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**Selected Press**

- **Practically Correct, Just-in-Time Shell Script Parallelization** (link)

- **Faster computing results without fear of errors** (link)

- **The PaSh Project – Advancing the Unix Philosophy One Step Further** (link)

- **Linux Foundation to Host the PaSh Project, Accelerating Shell Scripting with Automated Parallelization for Industrial Use Cases** (link)

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**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 (Ezri) 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

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