Benjamin Berg
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Research Interests

Parallel Scheduling, Caching, Queueing Theory, Performance Modeling of Computer Systems

Education

Carnegie Mellon University, School of Computer Science   August 2016-August 2022

Ph.D. student, Computer Science Department
Advised by Mor Harchol-Balter

Duke University, Trinity School of Arts & Sciences   Graduated May 2013

Major in Computer Science, minors in Economics and Math

Professional Experience

Assistant Professor, Computer Science Department, UNC Chapel Hill   August 2022-Present

Research Assistant, Computer Science Department, Carnegie Mellon University   August 2016-August 2022

Working with Ph.D. advisor Mor Harchol-Balter on applications of queuing theoretic models to the analysis of computer systems. Served as teaching assistant for *Performance Modeling of Computer Systems* graduate course. Current research projects include:

- Optimal scheduling of parallelizable jobs in multicore systems to minimize average latency

- Server-side caching for web services to minimize tail latency of web requests

Developer and Researcher, Caching Team, Facebook   Summer 2019

Analyzed caching workloads and developed models for workload generation tools used to benchmark caching applications and hardware at Facebook.

Developer and Researcher, Production Kernel Team, Google   Summer 2018

Worked on linux scheduler for the production kernel used on Google Cloud VM hosting servers.

Developer and Researcher, Life Long Kindergarten Group, MIT Media Lab   August 2015 – August 2016

Developed new features for the Scratch programming language. Performed research based on usage data from the Scratch online community. Worked with researchers at the MIT Media Lab and University of Washington to model trends in collaboration in the Scratch online community. Described the influences of website design changes on patterns of user collaboration.

Technology Associate, Statistical Arbitrage, Susquehanna International Group   August 2013 – August 2015

Worked on the statistical arbitrage desk, which specializes in low latency trading of securities. Worked on the core of the low latency trading platform, as well as scalable monitoring, alerting, and process scheduling tools. Worked with SIG assistant traders to complete quantitative analysis of trading opportunities related to long dated options on U.S. equities.

Technology Summer Analyst, Barclays Capital   Summer 2012

Performed analysis of middle office equities trading systems.

Honors

2021 SOSP Best Paper Award

2019 Facebook Fellow in Compute Storage and Efficiency. Selected from over 900 applicants.

2018 NSF GRFP Honorable Mention.

2013, Magna Cum Laude, Duke University

2013, Thesis resulting in graduation with High Distinction in Computer Science, Duke University

2013, Alex Vasilos Memorial Award in Computer Science for outstanding research, coursework, and contributions as a teaching assistant, Duke University

2013, Phi Beta Kappa

Publications

Sara McAllister, Yucong Wang, Benjamin Berg, Daniel S. Berger, George Amvrosiadis, Nathan Beckmann, and Greg Ganger, *FairyWREN: A Sustainable Cache for Emerging Write-Read-Erase Flash Interfaces*. OSDI 2024. (To Appear)

Zhongrui Chen, Isaac Grosof, and Benjamin Berg. *Simple Policies for Multiresource Job Scheduling*. MAMA 2024. (To Appear)

Berg, Benjamin, Benjamin Moseley, Weina Wang, and Mor Harchol-Balter. *Asymptotically Optimal Scheduling of Multiple Parallelizable Job Classes*. arXiv preprint arXiv:2404.00346 2024.

Ghosh, Bineet, Clara Hobbs, Shengjie Xu, Don Smith, James H. Anderson, P. S. Thiagarajan, Benjamin Berg, Parasara Sridhar Duggirala, and Samarjit Chakraborty. *Statistical verification of autonomous system controllers under timing uncertainties*. Real-Time Systems 2024.

Benjamin Berg. *A Principled Approach to Parallel Job Scheduling*. Diss. Carnegie Mellon University Pittsburgh, PA, 2022.

Sara McAllister, Benjamin Berg, Julian Tutuncu-Macias, Juncheng Yang, Sathya Gunasekar, Jimmy Lu, Daniel Berger, Nathan Beckmann, and Gregory R. Ganger. *Kangaroo: Theory and Practice of Caching Billions of Tiny Objects on Flash.* Transactions on Storage 2022.

Benjamin Berg, Justin Whitehouse, Benjamin Moseley, Weina Wang, Mor Harchol-Balter. *The Case for Phase-Aware Scheduling of Parallelizable Jobs*. IFIP Performance 2021.

Sara McAllister, Benjamin Berg, Julian Tutuncu-Macias, Juncheng Yang, Sathya Gunasekar, Jimmy Lu, Daniel Berger, Nathan Beckmann, and Gregory R. Ganger. *Kangaroo: Caching Billions of Tiny Objects on Flash.* SOSP 2021. **Awarded best paper**.

Benjamin Berg, Mor Harchol-Balter. *Optimal Scheduling of Parallel Jobs with Unknown Service Requirements.* Handbook of Research on Methodologies and Applications of Supercomputing, 2021.

Benjamin Berg, Daniel Berger, Sara McAllister, Isaac Grosof, Sathya Gunasekar, Jimmy Lu, Michael Uhlar, Jim Carrig, Nathan Beckmann, Mor Harchol-Balter, Greg Ganger.
The CacheLib Caching Engine: Design and Experiences at Scale. OSDI 2020.

Benjamin Berg, Rein Vesilo and Mor Harchol-Balter.
heSRPT: Parallel Scheduling to Minimize Mean Slowdown. IFIP Performance 2020, PEVA.

Benjamin Berg, Mor Harchol-Balter, Ben Moseley, Weina Wang, Justin Whitehouse.
Optimal Resource Allocation for Elastic and Inelastic Jobs. SPAA '20.

Benjamin Berg, Rein Vesilo, Mor Harchol-Balter.
heSRPT: Optimal Scheduling of Parallel Jobs with Known Sizes. MAMA 2019.

Daniel S. Berger, Benjamin Berg, Timothy Zhu, Siddhartha Senn, and Mor Harchol-Balter.
RobinHood: Tail Latency Aware Caching -- Dynamic Reallocation from Cache-Rich to Cache-Poor. OSDI 2018.

Benjamin Berg, Jan-Pieter Dorsman, and Mor Harchol-Balter. *Towards optimality in parallel scheduling.* ACM Sigmetrics 2018, Proceedings of the ACM on Measurement and Analysis of Computing Systems, Vol. 1.

The Case for Dynamic Cache Partitioning for Tail Latency. Poster presented at NSDI 2017. Daniel S. Berger, Benjamin Berg, Timothy Zhu, and Mor Harchol-Balter.

Talks and Workshops

Benjamin Berg. Asymptotically Optimal Scheduling of Multiple Parallelizable Job Classes. MAPSP Workshop. Kolding Denmark. June 2024.

Zhouzi Li, Benjamin Berg, Arpan Mukhopadhyay, Mor Harchol-Balter. How to Rent GPUs on a Budget. EPEW Workshop. Venice, Italy. June 2024.

Benjamin Berg. *Optimal Scheduling of Elastic and Inelastic Jobs.* Systems Lunch at UNC. April 2024.

Benjamin Berg. *Optimal Scheduling of Elastic and Inelastic Jobs.* ACO Seminar at Carnegie Mellon University. December 2023.

Benjamin Berg. *Optimal Scheduling of Elastic and Inelastic Jobs.* STOR Colloquim at UNC Chapel Hill. November 2023.

Benjamin Berg. *Optimal Parallel Scheduling For Elastic and Inelastic Jobs.* INFORMS 2021.

Benjamin Berg. *Optimal Resource Allocation for Parallelizable Jobs*. Talk presented at Georgia Tech, April 2021.

Benjamin Berg. *Optimal Resource Allocation for Parallelizable Jobs*. Talk presented at Caltech, April 2021.

Benjamin Berg. *The CacheLib Caching Engine: Design and Experiences at Scale*. Talk presented at Columbia University, April 2021.

Benjamin Berg. *Optimal Resource Allocation for Parallelizable Jobs*. Invited talk at Red Hat Research Day, September 2020.

Benjamin Berg. *Optimal Resource Allocation for Parallelizable Jobs*. Talk presented at UC Berkeley RISE Lab, March 2020.

Benjamin Berg. *Optimal Parallel Scheduling: From EQUI to heSRPT.* Talk presented at USC, Los Angeles, March 2019

Benjamin Berg. *Optimal Parallel Scheduling For Elastic and Inelastic Jobs.* INFORMS 2020.

Benjamin Berg. Optimal Parallel Scheduling of Jobs with Known Sizes. INFORMS 2019.

Benjamin Berg. *RobinHood: Tail Latency Aware Caching -- Dynamic Reallocation from Cache-Rich to Cache-Poor.* Talk presented at UMass Amherst, November 2018.

Benjamin Berg. *Towards optimality in parallel job scheduling*. Talk presented at INFORMS 2017.

Benjamin Berg. *Towards optimality in parallel job scheduling*. Talk presented at IFORS 2017.

Funding

Title: NSF-CIF Towards optimal scheduling for parallelizable machine learning training workloads
PI: Benjamin Berg
Co-PI: Mor Harchol-Balter, Weina Wang
Agency: NSF-CISE/CCF (CIF)
Status: Recommended by PM
Dates: June 2024-June 2027 (projected)
Amount: $363,266
Support: 33% SU
Award No.: 2403195
PM: Alfred Hero

Title: NSF-III High-Performance Scheduling for Modern Database System
PI: Benjamin Berg
Co-PI: Mor Harchol-Balter
Agency: NSF-CISE/IIS (III)
Status: Awarded
Dates: April 2024-April 2027
Amount: $275,000
Support: 16% SU
Award No.: 2322974
PM: Judith Cushing

Teaching

University of North Carolina at Chapel Hill
Fall 2024 – COMP 790, Performance Modeling of Computer Systems
Spring 2023 – COMP 790, Computer Systems Design: A Quantitative Approach
Fall 2022 – COMP 790, Performance Modeling of Computer Systems

Professional Service

MLSys Program Committee, 2025
SIGMETRICS Program Committee, 2025
NSF-OE ad-hoc reviewer, 2024.
2023-2024 UNC Chapel Hill Graduate Admissions Committee
2024 The Web Conference (WWW) reviewer
2023 SOSP Student Research Competition and Poster Session reviewer
2022-2023 UNC Chapel Hill Graduate Admissions Committee
2021-2022 Carnegie Mellon Tartan Scholars Mentor

Advising

Ph.D Students
Zhongrui Chen, 2022-Present

Thesis Committee
Shengjie Xu, 2024-Present

Zelin Tong, 2023-Present
Shareef Ahmed, 2023-Present