Matthew Burke

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Education

Cornell University 2017–2023 (Expected)
Ph.D. in Computer Science
Advisor: Lorenzo Alvisi

University of Southern California 2013–2017
B.S. in Computer Science
Summa cum laude
Advisor: Wyatt Lloyd

Interests

Distributed systems, databases, secure systems, data structures

Selected Research

Morty EuroSys'23
Scaling Concurrency Control with Re-Execution

Serializable, interactive transactions offer applications the abstraction of a centralized, easy to program storage system. Unfortunately, this abstraction suffers from low throughput under high contention workloads. To characterize the limitations of existing serializable systems, we introduce the notion of conflict windows. Through this lens, we develop a new concurrency control that leverages transaction re-execution to improve throughput scalability even under high contention. We implement this idea in Morty, a distributed and replicated transactional store that achieves up to 1.7x-96x the throughput of existing state-of-the-art systems, while retaining similar latency.

PRISM SOSP'21
Rethinking the RDMA Interface for Distributed Systems

Remote Direct Memory Access (RDMA) has been used to accelerate distributed systems. However, most of the distributed protocols used in these systems cannot easily be expressed in terms of the simple memory READs and WRITEs provided by RDMA. To address this dilemma, we introduce the PRISM interface, which adds new primitives that increase the expressivity of RDMA while still being implementable using the same underlying hardware features. We use them in the design of three new applications that require little to no server-side CPU involvement: (1) PRISM-KV, a key-value store; (2) PRISM-RS, a replicated block store; and (3) PRISM-TX, a distributed transactional store. Using a software-based implementation of the PRISM primitives, we show that these systems outperform prior RDMA-based equivalents

Gryff NSDI'20
Unifying Consensus and Shared Registers

Linearizability reduces the complexity of building correct applications. However, there is a tradeoff between using linearizability for geo-replicated storage and low tail latency. We present the design, implementation, and evaluation of Gryff, a system that offers linearizability and low tail latency by unifying consensus with shared registers using carstamps, a novel ordering mechanism. Our evaluation shows that Gryff's combination of an optimized shared register protocol with EPaxos allows it to provide lower service-level latency than state-of-the-art systems due to its much lower tail latency for reads.

Publications

Matthew Burke, Florian Suri-Payer, Jeffrey Helt, Lorenzo Alvisi, Natacha Crooks. Morty: Scaling Concurrency Control with Re-Execution. *To appear in Proceedings of the 18th European Conference on Computer Systems (EuroSys '23)*, May 2023.

Matthew Burke, Sowmya Dharanipragada, Shannon Joyner, Adriana Szekeres, Jacob Nelson, Irene Zhang, Dan R. K. Ports. PRISM: Rethinking the RDMA Interface for Distributed Systems. *In Proceedings of the 28th ACM Symposium on Operating Systems Principles (SOSP 21)*, October 2021.

Jeffrey Helt, **Matthew Burke**, Amit Levy, Wyatt Lloyd. Regular Sequential Serializability and Regular Sequential Consistency. *In Proceedings of the 28th ACM Symposium on Operating Systems Principles (SOSP 21)*, October 2021.

Florian Suri-Payer, **Matthew Burke**, Zheng Wang, Yunhao Zhang, Lorenzo Alvisi, Natacha Crooks. Basil: Breaking up BFT with ACID (transactions). *In Proceedings of the 28th ACM Symposium on Operating Systems Principles (SOSP 21)*, October 2021.

Matthew Burke, Audrey Cheng, Wyatt Lloyd. Gryff: Unifying Consensus and Shared Registers. *In Proceedings of the 17th USENIX Symposium on Networked Systems Design and Implementation (NSDI 20)*, Februrary 2020.

Natacha Crooks, **Matthew Burke**, Sitar Harel, Ethan Cecchetti, Rachit Agarwal, Lorenzo Alvisi. Obladi: Oblivious Serializable Transactions in the Cloud. *In Proceedings of the 13th USENIX Symposium on Operating Systems Design and Implementation (OSDI 18)*, October 2018.

Qi Huang, Petchean Ang, Peter Knowles, Tomasz Nykiel, Iaroslav Tverdokhlib, Amit Yajurvedi, Paul Dapolito VI, Xifan Yan, Maxim Bykov, Chuen Liang, Mohit Talwar, Abhishek Mathur, Sachin Kulkarni, **Matthew Burke**, Wyatt Lloyd. SVE: Distributed Video Processing at Facebook Scale. *In Proceedings of the 26th ACM Symposium on Operating Systems Principles (SOSP 17)*, October 2017.

Presentations & Posters

Matthew Burke, Audrey Cheng, Wyatt Lloyd. Gryff: Unifying Consensus and Shared Registers. *USENIX Symposium on Networked Systems Design and Implementation (NSDI 20)*, Februrary 2020.

Matthew Burke. Vulnerability in Floating Point Implementation of Exponential Mechanism. *Theory and Practice of Differential Privacy (TPDP 17)*, October 2017.

Dana Thomas, **Matthew Burke**. Optimizing Base Camp Selection for PAWS: Protection Assistant for Wildlife Security. *Southern California Conference for Undergraduate Research (SCCUR 15)*, November 2015.

Work Experience

Microsoft Research May 2018–August 2018
Research Intern

I worked on new primitives for remote memory that enable the efficient and correct implementation of a range of distributed systems protocols that are used as building blocks in large-scale intra-datacenter systems.

Facebook June 2016–August 2016
Research Scientist Intern

I designed a production-ready standalone video encoding service to be used as a component in SVE, Facebook's distributed video encoding engine. I also investigated various optimizations to the video encoding process, including the use of GPUs for video encoding and modification of existing video encoding tools for better parallelization of encoding workloads.

Facebook June 2015–August 2015
Software Engineering Intern

I designed a native C++ HDFS client library for efficiently performing writes directly to HDFS data nodes.

Smart Scheduling May 2014–August 2014
Software Engineering Intern

I designed an automated machine learning system which generated training data, trained a neural network model, and deployed the model to production on a nightly basis. I also performed full-stack development duties, such as optimizing database queries, implementing new functionality in the web application, and improving the user interface.

Teaching Experience

Principles of Distributed Computing (CS 5414) January 2023–May 2023
Graduate Teaching Assistant

Principles of Distributed Computing (CS 5414) August 2020–December 2020
Graduate Teaching Assistant

Operating Systems (CS 4410) January 2019–May 2019
Graduate Teaching Assistant

Data Structures and OOP (CSCI 104) January 2017–May 2017
Undergraduate Teaching Assistant

Data Structures and OOP (CSCI 104) August 2016–December 2016
Undergraduate Teaching Assistant

Data Structures and OOP (CSCI 104) January 2016–May 2016
Undergraduate Teaching Assistant

Data Structures and OOP (CSCI 104) August 2015–December 2015
Undergraduate Teaching Assistant

Data Structures and OOP (CSCI 104) January 2015–May 2015
Undergraduate Teaching Assistant

Data Structures and OOP (CSCI 104) August 2014–December 2014
Undergraduate Teaching Assistant

Service

SOSP 2021, Artifact Evaluator 2021

Cornell University High School Programming Contest, Mentor 2018–2021

OSDI 2020, Artifact Evaluator 2020

SOSP 2019, External Reviewer 2019

EuroSys 2019, External Reviewer 2019

OPODIS 2018, External Reviewer 2018

ICDCS 2019, External Reviewer 2018

Microsoft Research Undergraduate Mentor 2018

NSDI 2017, External Reviewer 2016

Facebook University (FBU) Mentor 2015

Awards & Honors

Outstanding Teaching Assistant, Distributed Computing (Fall 2020) 2021
Cornell Computer Science Department

Outstanding Teaching Assistant, Operating Systems (Spring 2019) 2019
Cornell Computer Science Department

University Fellowship 2017
Cornell University

Computer Science Award for Outstanding Research 2017
USC Computer Science Department

Dean's List 2013-2017
University of Southern California

Kohlenberger Scholarship 2016
University of Southern California

Phi Beta Kappa, University of Southern California Chapter 2016

ACM International Collegiate Programming Contest (ACM-ICPC) 2015
Southern California Regional: 5th Place

USC Fall Programming Contest 2015
1st Place

USC Spring Programming Contest 2015
2nd Place

W.V.T. Rusch Engineering Honors Program 2014
University of Southern California

Dean's Scholarship 2013
University of Southern California