

Matthew Milano

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CURRENT PROJECTS

Gallifrey

Gallifrey is a new programming language for distributed wide-area applications. Gallifrey programs share state via replication, granting fast access to data without introducing mandatory synchronization points, all while maintaining sequential consistency by default. Gallifrey aims to be easy-to-use, requiring a minimal annotation overhead atop an otherwise Java-like language. More details can be found at the [project page](#) for Gallifrey on my website.

I am leading the Gallifrey project, which also involves Rolph Recto, Patrick LaFontaine, Danny Yang, Chris Roman, Andrew Myers, and (with Lindsey Kuper) Matthew Rhea

Derecho

Derecho is a new framework for building replicated, fault-tolerant distributed systems within a datacenter. At its core, Derecho provides a best-in-class consistent multicast abstraction. Derecho's object-oriented programming layer makes it easy to build any distributed application with the same ease as writing a standard, single-machine application; individual classes are automatically replicated in user-specified configurations, and a straightforward, type-safe RPC mechanism allows easy communication between replica groups. More details can be found at the [project page](#).

I was the primary student contributor to the consistent multicast and fault-tolerance protocols at the core of Derecho. I also designed and implemented Derecho's RPC and serialization layers. Primary system implementation was carried out by [Sagar Jha](#). Current major contributors include [Edward Tremel](#) and [Weijia Song](#). [Ken Birman](#) is the driving force behind Derecho.

RESEARCH INTERESTS

My work leverages the power of programming languages to build principled, correct distributed systems. I'm broadly interested in developing new languages and systems, placing emphasis on compositionality, consistency, usability and scalability. I have wide-ranging interests within this space, with projects including core distributed systems protocols, efficient serializers and allocators, and new object-oriented languages.

AWARDS

- 2015 **NDSEG Fellowship**
- 2015 **NSF GRFP Honorable Mention**
- 2013 **Senior prize in Computer Science**
- 2012 **Rose Rosengard Subotnik prize**
for excellence in writing
- MULTIPLE **Cornell CS Department Service Award**

EDUCATION

- 2013 – 2020 **Doctor of Philosophy**
(expected) *Programming the Wide Area: Languages and Systems for Coordination-Averse Settings.*
ADVISED BY: ANDREW C. MYERS
Computer Science
Cornell University
- 2013 – 2017 **Master of Science**
Computer Science
Cornell University
- 2009 – 2013 **Bachelor of Science**
SENIOR PRIZE
Computer Science and Music
Brown University

PUBLICATIONS

A tour of Gallifrey, a language for geodistributed programming. *3rd Summit on Advances in Programming Languages (SNAPL)*, May 2019. Matthew Milano, Rolph Recto, Tom Magrino, and Andrew C. Myers. [BibTeX]

Derecho's Extensible, Intelligent Object Store. *Workshop on AI Systems (AISYS) at SOSP 2019*, October 2019. Weijia Song, Matthew Milano, Sagar Jha, Edward Tremel, Xinzhe Yang, Ken Birman

Derecho: Fast State Machine Replication for Cloud Services. *ACM Trans. Comput. Syst.* 36, 2, Article 4, April 2019. Sagar Jha, Jonathan Behrens, Theo Gkountouvas, Matthew Milano, Weijia Song, Edward Tremel, Robbert Van Renesse, Sydney Zink, and Kenneth P. Birman. [BibTeX]

MixT: a language for mixing consistency in geodistributed transactions. *39th ACM SIGPLAN Conf. on Programming Language Design and Implementation (PLDI)*, June 2018. Matthew Milano and Andrew C. Myers. [BibTeX]

A Coalgebraic Decision Procedure for NetKAT. *42nd ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages (POPL)*, January 2015. Nate Foster, Dexter Kozen, Matthew Milano, Alexandra Silva, and Laure Thompson. [BibTeX]

Python: The Full Monty. *28th ACM SIGPLAN Conf. on Object Oriented Programming Systems Languages & Applications (OOPSLA)*, October 2013. Joe Gibbs Politz, Alejandro Martinez, Matthew Milano, Sumner Warren, Daniel Patterson, Junsong Li, Anand Chitipothu, and Shriram Krishnamurthi. [BibTeX]

OUTREACH

- Instructor, SPLASH 2013, 2015, 2016
- Instructor, Expanding Your Horizons
CS education outreach for middle-school girls
- Instructor, Elementary CS Education
1-3rd grade, Belle Sherman Elementary school

SERVICE

- Artifact Evaluation Committee: OOPSLA '15, POPL '17, PLDI '19
- Departmental Service:
 - IT Administrator (2010-2013)
 - Czar-Czar (coordinates department service) 2014-2016
 - CSGO (CS grad governing body) officer 2015-2017
 - Fellowship Application Coordinator 2014-2019
 - Programming Language Discussion Group (PLDG) Coordinator 2014-2018
 - Various other czarships and volunteering positions

PRESENTATIONS AND INVITED TALKS

- | | |
|-----------|---|
| TUTORIALS | “Derecho: Blindingly Fast RDMA Replication for Cloud and Edge Services.”
With co-presenters Ken Birman and Edward Tremel.
SOSP 2019 |
| TALKS | “A tour of Gallifrey, a language for geodistributed programming.”
3rd Summit on Advances in Programming Languages

“MixT: a language for mixing consistency in geodistributed transactions. PLDI 2018

“A tour of Gallifrey, a language for geodistributed programming.”
1st Eastern Great Lakes Programming Languages and Systems Symposium (EGLPLS) |
| POSTERS | “Derecho’s Extensible, Intelligent Object Store”.
AISYS at SOSP 2019. |

WORK EXPERIENCE

MAY 2017 – AUGUST 2017 (FT)

Microsoft Research Cambridge UK
Research Intern

Performed independent research in support of the Snowflake project on the programming languages and runtimes team, which remains internal to Microsoft Research. Advised by Manuel Costa

PERIODS BETWEEN 2008 – 2011 (FT)

Princeton Plasma Physics Lab
Research Intern

Built tools for the visualization and exploration of plasma fluid dynamics. Advised by Eliot Feibush.

TEACHING

Instructor, Cornell Computer Science Department: CS2043: UNIX Tools and Scripting (Spring 2019)

- Sole instructor of record
- Retooled curriculum for students with diverse backgrounds
- Enrollment of 130 students, with 13 TAs.

Student Instructor, Brown University: CS 195r: Compilers (Spring 2012)

- Developed new compilers course based on Andrew Appel’s curriculum
- Solely responsible for lectures, course management, curriculum, and assignments
- Advised by Pascal van Hentenryck

Course Development, Brown University:

- CS 195s: Fundamentals of Computer Systems
- CS 33: Introduction to Computer Systems
- CS 166: Introduction to Computer System Security

Teaching Assistant:

- Cornell Computer Science Department:
 - CS 6410: Advanced Systems (Fall 2014)
 - CS 4410: Operating Systems (Fall 2013)
- Brown Computer Science Department:
 - CS31, CS33, CS166, CS32, CS2

MENTORING AND ADVISING

I have had the opportunity to directly supervise several undergraduates and Masters students at Cornell.

Chris Roman lead development of a slab allocator optimized for creating compact, nearly-contiguous collections in memory. He also built a compiler front-end for the Gallifrey language. *AY 2018-2019, Fall 2019.*

Yijia Chen focused on taking a slab allocator and making it safe for concurrent access, in as lock-free as possible a style. *AY 2018-2019.*

Sahithi Kalvakota built relocatable “smart” pointers for C++ STL collections, supporting a zero-copy serialization framework. *AY 2018-2019.*

Alex Katz performed numerous experiments to assess the feasibility of sharing a C++ STL container between two processes with distinct memory layouts. *AY 2018-2019.*

Ning Ning Sun built the first compiler front-end for the Gallifrey project. *Spring 2019.*

Patrick LaFontaine integrated the Antidote distributed system with the Gallifrey language runtime, needed to manage replication and distribution of Gallifrey objects. *Fall 2019.*

Danny Yang implemented an explicit interpreter for the Gallifrey core language, used to build and debug the core Gallifrey type system. *Fall 2019.*