Matthew Andres Moreno

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Ann Arbor, MI 48103

Education

Dual Ph.D., in Computer Science and Ecology, Evolutionary Biology, & Behavior (GPA: 4.0/4.0) December 2022
Research Advisor: Dr. Charles Ofria
Michigan State University, East Lansing, MI

Bachelors of Science in Mathematics, Computer Science (GPA: 3.96/4.0) May 2017
Minor in Chemistry
University of Puget Sound, Tacoma, WA

Skills

Programming Languages: Python, C, C++
Miscellaneous: LaTeX, Git, HTML/CSS, Docker, Jekyll, Sphinx

Projects and Research Experience

Schmidt AI in Science Program — University of Michigan, Ann Arbor, MI September 2023 — present
- *Postdoctoral Fellow*

- Advisors: Dr. Luis Zaman and Dr. Kevin Wood
- Applied autoencoder-based unsupervised learning techniques to test hypotheses about origins and properties of biological evolvability.
- Appointed with Ecology and Evolutionary Biology Department, Center for the Study of Complex Systems, and the Michigan Institute for Data Science.

ZE3 Laboratory — University of Michigan, Ann Arbor, MI February 2023 — September 2023
- *Postdoctoral Scholar*

- Advisor: Dr. Luis Zaman
- Extended the Avida digital evolution system to study relationships between host heterogeneity and parasite evolvability in the context of host multicellularity and immune response.

Digital Evolution Laboratory — Michigan State University, East Lansing, MI June 2017 — December 2022
- *Graduate Student*

- Advisor: Dr. Charles Ofria
- Dissertation Committee: Dr. Charles Ofria, Dr. Emily Dolson, Dr. Bill Punch, Dr. Wolfgang Banzhaf
- Dissertation: "Engineering Scalable Digital Models to Study Major Transitions in Evolution"

Otis C. Chapman Honors Thesis — University of Puget Sound, Tacoma, WA Fall 2016, Spring 2017
- *Student Researcher*

- Conducted a review of evolutionary computing literature and synthesized a theoretical analysis of evolvability in collaboration with advisor Dr. America Chambers and reader Dr. Adam Smith.
- Performed computational experiments with Genetic Regulatory Network models to probe the relationship between phenotypic plasticity and evolvability.
- Prepared and delivered general-audience oral presentations at NW Honors Symposium and at the University of Puget Sound.

Mathematical Biosciences Institute (MBI) Research Experience for Undergraduates — Newark, NJ Summer 2016
- *Student Researcher*

- Designed and numerically evaluated an individual-based set of differential equations to model the foraging behavior of ants over uneven terrain, analyzed predictions of the model over various experimental conditions.
- Collaborated with advisors Dr. Jason Graham and Dr. Simon Garnier in the Swarm Lab at the New Jersey Institute of Technology to develop and execute project.
- Prepared and delivered oral and poster presentations at a capstone conference in Columbus, Ohio.
- Participated in seminars and workshops on mathematical biology coordinated by MBI at The Ohio State University.

NASA Undergraduate Research Scholarship — Tacoma, WA Summer 2015
- *Student Researcher*

- Designed, applied for grant funding, and carried out project to develop algorithms for automated extraction of mouse ultrasonic vocalizations from noisy recordings in collaboration with advisor Dr. Adam Smith.
- Developed and tested filtering algorithms inspired by the Sobel Edge detection method that, after being trained on human-annotated spectrograms of mouse vocalizations, distinguish between true mouse vocalization signals and background noise, achieving 75% accuracy at 25% recall.
- Presented results and methodology at a poster session on campus attended by faculty, summer research students, and other students.

US Department of Agriculture Horticultural Crops Research Unit — Corvallis, OR Jun. 2013 – Jun. 2017
- *Biological Science Aide*

- Collected data for patent applications, performed plant propagation, assisted with field maintenance.

John Fowler Laboratory at Oregon State University — Corvallis, OR Summer 2011, 2012
- *Laboratory Assistant*
- Performed experimental inquiry into the role of the exocyst complex in *Arabidopsis thaliana* culminating in a symposium presentation.

Publications

Journal Publications

[1] **Matthew Andres Moreno**, Santiago Rodriguez-Papa, & Emily Dolson. (2025). Ecology, spatial structure, and selection pressure induce strong signatures in phylogenetic structure. *Artificial Life*, *31*(2), 129–152. https://doi.org/10.1162/artl_a_00470

[2] **Matthew Andres Moreno**, Mark T. Holder, & Jeet Sukumaran. (2024). Dendropy 5: A mature python library for phylogenetic computing. *Journal of Open Source Software*, *9*(101), 6943. https://doi.org/10.21105/joss.06943

[3] Anya Vostinar, Alexander Lalejini, Charles Ofria, Emily Dolson, & **Matthew Andres Moreno**. (2024). Empirical: A scientific software library for research, education, and public engagement. *Journal of Open Source Software*, *9*(98), 6617. https://doi.org/10.21105/joss.06617

[4] **Matthew Andres Moreno**, Alexander Lalejini, & Charles Ofria. (2023). Matchmaker, matchmaker, make me a match: Geometric, variational, and evolutionary implications of criteria for tag affinity. *Genetic Programming and Evolvable Machines*, *24*(1), 4. https://doi.org/10.1007/s10710-023-09448-0

[5] **Matthew Andres Moreno**, Emily Dolson, & Charles Ofria. (2022). Hstrat: A python package for phylogenetic inference on distributed digital evolution populations. *Journal of Open Source Software*, *7*(80), 4866. https://doi.org/10.21105/joss.04866

[6] **Matthew Andres Moreno**, & Charles Ofria. (2022). Exploring evolved multicellular life histories in an open-ended digital evolution system. *Frontiers in Ecology and Evolution*, *10*. https://doi.org/10.3389/fevo.2022.750837

[7] Alexander Lalejini, **Matthew Andres Moreno**, & Charles Ofria. (2021). Tag-based regulation of modules in genetic programming improves context-dependent problem solving. *Genetic Programming and Evolvable Machines*, *22*(3), 325–355. https://doi.org/10.1007/s10710-021-09406-8

[8] **Matthew Andres Moreno**, & Charles Ofria. (2019). Toward Open-Ended Fraternal Transitions in Individuality. *Artificial Life*, *25*(2), 117–133. https://doi.org/10.1162/artl_a_00284

[9] Rex A Cole, Valera V Peremyslov, Savannah Van Why, Ibrahim Moussaoui, Ann Ketter, Renee Cool, **Matthew Andres Moreno**, Zuzana Vejlupkova, Valerian V Dolja, & John E Fowler. (2018). A broadly conserved NERD genetically interacts with the exocyst to affect root growth and cell expansion. *Journal of Experimental Botany*, *69*(15), 3625–3637. https://doi.org/10.1093/jxb/ery162

Book Chapters

[10] **Matthew Andres Moreno**. (2024). Methods for rich phylogenetic inference over distributed sexual populations. In Stephan Winkler, Leonardo Trujillo, Charles Ofria, & Ting Hu (Eds.), *Genetic programming theory and practice xx* (pp. 125–141). Springer International Publishing. https://doi.org/10.1007/978-981-99-8413-8_7

[11] Alexander Lalejini, **Matthew Andres Moreno**, Jose Guadalupe Hernandez, & Emily Dolson. (2024). Phylogeny-informed fitness estimation for test-based parent selection. Stephan Winkler, Leonardo Trujillo, Charles Ofria, & Ting Hu (Eds.), *Genetic programming theory and practice xx* (pp. 241–261). Springer International Publishing. https://doi.org/10.1007/978-981-99-8413-8_13

Conference Papers

[12] **Matthew Andres Moreno**, Sanaz Hasanzadeh Fard, Emily Dolson, & Luis Zaman. (2025a). Extending a phylogeny-based method for detecting signatures of multi-level selection for applications in artificial life, *The 2025 conference on artificial life*, MIT Press. https://doi.org/10.1162/ISAL.a.916

[13] Vivaan Singhvi, Joey Wagner, Emily Dolson, Luis Zaman, & **Matthew Andres Moreno**. (2025). A scalable trie building algorithm for high-throughput phyloanalysis of wafer-scale digital evolution experiments, *The 2025 conference on artificial life*, MIT Press. https://doi.org/10.1162/ISAL.a.890

[14] **Matthew Andres Moreno**, Anika Ranjan, Emily Dolson, & Luis Zaman. (2025b). Testing the inference accuracy of accelerator-friendly approximate phylogeny tracking, *2025 ieee symposium on computational intelligence in artificial life and cooperative intelligent systems (alife-cis)*, Trondheim, Norway, IEEE. https://doi.org/10.1109/ALIFE-CIS64968.2025.10979833

[15] **Matthew Andres Moreno**, Connor Yang, Emily Dolson, & Luis Zaman. (2024). Trackable agent-based evolution models at wafer scale, *The 2024 conference on artificial life*, MIT Press. https://doi.org/10.1162/isal_a_00830

[16] Alexander Lalejini, Marcos Sanson, Jack Garbus, **Matthew Andres Moreno**, & Emily Dolson. (2024). Runtime phylogenetic analysis enables extreme subsampling for test-based problems, *Proceedings of the genetic and evolutionary computation conference companion*, Melbourne, VIC, Australia, Association for Computing Machinery. https://doi.org/10.1145/3638530.3664090

[17] **Matthew Andres Moreno**, Emily Dolson, & Santiago Rodriguez-Papa. (2023). Toward phylogenetic inference of evolutionary dynamics at scale. https://doi.org/10.1162/isal_a_00694

[18] **Matthew Andres Moreno**, Emily Dolson, & Charles Ofria. (2022). Hereditary Stratigraphy: Genome Annotations to Enable Phylogenetic Inference over Distributed Populations. https://doi.org/10.1162/isal_a_00550

[19] **Matthew Andres Moreno**, Wolfgang Banzhaf, & Charles Ofria. (2018). Learning an evolvable genotype-phenotype mapping, *Proceedings of the genetic and evolutionary computation conference*, Kyoto, Japan, Association for Computing Machinery. https://doi.org/10.1145/3205455.3205597

Workshop Papers

[20] **Matthew Andres Moreno**, Santiago Rodriguez Papa, & Charles Ofria. (2021a). Case study of novelty, complexity, and adaptation in a multicellular system, *Oee4: The fourth workshop on open-ended evolution*, Prague, Czech Republic. https://doi.org/10.48550/arXiv.2405.07241

[21] **Matthew Andres Moreno**, Santiago Rodriguez Papa, & Charles Ofria. (2021b). Conduit: A c++ library for best-effort high performance computing, *Proceedings of the genetic and evolutionary computation conference companion*, Lille, France, Association for Computing Machinery. https://doi.org/10.1145/3449726.3463205

[22] **Matthew Andres Moreno**, Santiago Rodriguez Papa, & Charles Ofria. (2021c). Conduit: A c++ library for best-effort high performance computing [MSPDS/HPCS], *The 6th international workshop on modeling and simulation of and by parallel and distributed systems (mspds 2020)*, Barcelona, Spain. MSPDS/HPCS

[23] **Matthew Andres Moreno**, & Charles Ofria. (2018). Understanding fraternal transitions in individuality, *Oee3: The third workshop on open-ended evolution*, Tokyo, Japan

Extended Abstracts

[24] **Matthew Andres Moreno**, Emily Dolson, & Luis Zaman. (2025). Wafer-scale simulation of mutator allele dynamics in large asexual populations, *Sc25 research poster and acm student research competition poster archive*, St. Louis, Missouri

[25] **Matthew Andres Moreno**, Connor Yang, Emily Dolson, & Luis Zaman. (2024a). Trackable agent-based evolution models at wafer scale, *Sc24 research poster and acm student research competition poster archive*, Atlanta, Georgia

[26] **Matthew Andres Moreno**, Connor Yang, Emily Dolson, & Luis Zaman. (2024b). Trackable island-model genetic algorithms at wafer scale, *Proceedings of the genetic and evolutionary computation conference companion*, Melbourne, VIC, Australia, Association for Computing Machinery. https://doi.org/10.1145/3638530.3664090

[27] **Matthew Andres Moreno**. (2024). Methods to estimate cryptic sequence complexity, *The 2024 conference on artificial life*, MIT Press. https://doi.org/10.1162/isal_a_00776

[28] **Matthew Andres Moreno**, Emily Dolson, & Charles Ofria. (2022). Hereditary stratigraphy: Genome annotations to enable phylogenetic inference over distributed populations, *Proceedings of the genetic and evolutionary computation conference companion*, Boston, Massachusetts, Association for Computing Machinery. https://doi.org/10.1145/3520304.3533937

[29] Alexander Lalejini, **Matthew Andres Moreno**, & Charles Ofria. (2022). Tag-based module regulation for genetic programming, *Proceedings of the genetic and evolutionary computation conference companion*, Boston, Massachusetts, Association for Computing Machinery. https://doi.org/10.1145/3520304.3534060

Preprints

[30] **Matthew Andres Moreno**, Jeet Sukumaran, Luis Zaman, & Emily Dolson. (2026). Phyloframe: A dataframe-based library for fast, flexible phylogenetic computation. https://doi.org/10.48550/arXiv.2605.28545

[31] Carl P. Simon, James S. Koopman, Marisa C. Eisenberg, Luis Zaman, **Matthew Andres Moreno**, & Austin Polanco. (2026). An allele-based model of coronavirus evolution under population immunity. openRxiv. https://doi.org/10.1101/2025.09.15.25335781

[32] Connor Yang, Joey Wagner, Emily Dolson, Luis Zaman, & **Matthew Andres Moreno**. (2025). Downstream: Efficient cross-platform algorithms for fixed-capacity stream downsampling. https://doi.org/10.48550/arXiv.2506.12975

[33] **Matthew Andres Moreno**, Luis Zaman, & Emily Dolson. (2024a). Structured downsampling for fast, memory-efficient curation of online data streams. https://doi.org/10.48550/arXiv.2409.06199

[34] Emily Dolson, Santiago Rodriguez-Papa, & **Matthew Andres Moreno**. (2024). Phylotrack: C++ and python libraries for in silico phylogenetic tracking. https://doi.org/10.48550/arXiv.2405.09389

[35] **Matthew Andres Moreno**, Santiago Rodriguez Papa, & Emily Dolson. (2024b). Analysis of phylogeny tracking algorithms for serial and multiprocess applications. arXiv. https://doi.org/10.48550/arXiv.2403.00246

[36] **Matthew Andres Moreno**, Santiago Rodriguez Papa, & Emily Dolson. (2024c). Algorithms for efficient, compact online data stream curation. arXiv. https://doi.org/10.48550/arXiv.2403.00266

[37] **Matthew Andres Moreno**, & Charles Ofria. (2022). Best-effort communication improves performance and scales robustly on conventional hardware. arXiv. https://doi.org/10.48550/ARXIV.2211.10897

[38] **Matthew Andres Moreno**, Santiago Rodriguez Papa, Alexander Lalejini, & Charles Ofria. (2021). Signalgp-lite: Event driven genetic programming library for large-scale artificial life applications. arXiv. https://doi.org/10.48550/ARXIV.2108.00382

Presentations

Contributed Talks

Matthew Andres Moreno, Santiago Rodriguez Papa, Charles Ofria, Luis Zaman, & Emily Dolson. *Trust, but Verify: Rigorously Profiling Best-Effort High-Performance Computing for Digital Evolution.* Genetic Programming Theory and Practice XXIII, Ann Arbor, MI. June 2026.

Matthew Andres Moreno. *Hosting a Public-facing Class Blog with GitHub Pages and Jekyll.* AEdu — ALife Education

Virtual Workshop. May 2026.

Matthew Andres Moreno. *Building Cohort Community in a Virtual Classroom: Lessons Learned from the WAVES Workshop.* AEdu — ALife Education Virtual Workshop. May 2026.

Matthew Andres Moreno, Anika Ranjan, Emily Dolson, & Luis Zaman. *Testing the Inference Accuracy of Accelerator-friendly Approximate Phylogeny Tracking.* IEEE Symposium Series on Computational Intelligence, Trondheim, Norway. March 2025.

Matthew Andres Moreno. *Investigating the impact of available adaptive mutations on hypermutator fixation in large asexual populations.* ByteBoost Campus Champions. October 2024.

Matthew Andres Moreno, Connor Yang, Emily Dolson, & Luis Zaman. *Trackable Agent-based Evolution Models at Wafer Scale.* 3rd Annual Human Genetics Postdoctoral Symposium, Ann Arbor, MI. September 2024.

Matthew Andres Moreno. *Intro to Scientific Software.* bI/O Seminar at Parnall Correctional Facility, Jackson, MI. September 2024.

Matthew Andres Moreno, Connor Yang, Emily Dolson, & Luis Zaman. *Trackable Agent-based Evolution Models at Wafer Scale.* ALIFE, Copenhagen, Denmark. July 2024.

Matthew Andres Moreno. *Methods to Estimate Cryptic Sequence Complexity.* ALIFE, Copenhagen, Denmark. July 2024.

Acacia Ackles & **Matthew Andres Moreno**. *Hosting a Public-facing Class Blog with GitHub pages and Jekyll.* Enriching Scholarship Conference, Ann Arbor, MI. May 2024.

Matthew Andres Moreno, Emily Dolson, & Santiago Rodriguez Papa. *Toward Phylogenetic Inference of Evolutionary Dynamics At Scale.* ALIFE, Sapporo, Japan. July 2023.

Matthew Andres Moreno, Emily Dolson, & Santiago Rodriguez Papa. *Toward Phylogenetic Inference of Evolutionary Dynamics At Scale.* Evolution Conference, Albuquerque, NM. June 2023.

Matthew Andres Moreno. *Hereditary Stratigraphy Methods for Phylogenetic Inference over Distributed EC Populations.* Genetic Programming Theory and Practice XX, East Lansing, MI. June 2023.

Matthew Andres Moreno, Emily Dolson, & Charles Ofria. *Hereditary Stratigraphy: Genome Annotations to Enable Phylogenetic Inference over Distributed Digital Evolution Populations.* ALIFE, Trento, Italy. July 2022.

Matthew Andres Moreno, Emily Dolson, & Charles Ofria. *Hereditary Stratigraphy: Genome Annotations to Enable Phylogenetic Inference over Distributed Digital Evolution Populations.* Evolution, Cleveland, OH. June 2022.

Matthew Andres Moreno, Emily Dolson, & Charles Ofria. *Hereditary Stratigraphy: Genome Annotations to Enable Phylogenetic Inference over Distributed Digital Evolution Populations.* The Sixth Annual Ecology, Evolution, & Behavior Research Symposium, East Lansing, MI. May 2022.

Matthew Andres Moreno, Santiago Rodriguez Papa, & Charles Ofria. *Case Study of Novelty, Complexity, and Adaptation in a Multicellular System.* BEACON Congress, East Lansing, MI. August 2021.

Tait Weicht, **Matthew Andres Moreno**, & Charles Ofria. *Moving scientific computation into the browser.* BEACON Congress, East Lansing, MI. August 2021.

Santiago Rodriguez Papa, **Matthew Andres Moreno**, Alexander Lalejini, & Charles Ofria. *SignalGP-Lite: Event Driven Genetic Programming Library for Large-Scale Artificial Life Applications.* BEACON Congress, East Lansing, MI. August 2021.

Charles Ofria, Emily Dolson, & **Matthew Andres Moreno**. *Empirical: A Scientific Software Library for Research, Education, and Public Engagement.* BEACON Congress, East Lansing, MI. August 2021.

Matthew Andres Moreno. *Lessons Learned Administering a Summer Workshop.* BEACON Congress, East Lansing, MI. August 2021.

Matthew Andres Moreno, Santiago Rodriguez Papa, & Charles Ofria. *Case Study of Novelty, Complexity, and Adaptation in a Multicellular System.* The Fourth Workshop on Open-Ended Evolution (OEE4) at ALIFE, Prague, Czech Republic. July 2021.

Matthew Andres Moreno, Santiago Rodriguez Papa, & Charles Ofria. *Conduit: A C++ Library for Best-effort High Performance Computing.* ACM Workshop on Parallel and Distributed Evolutionary Inspired Methods (PDEIM) at GECCO, Lille, France. July 2021.

Matthew Andres Moreno& Charles Ofria. *Spatial constraints and kin recognition can produce major evolutionary transitions in individuality.* BEACON Congress, East Lansing, MI. August 2020.

Alexander Lalejini, **Matthew Andres Moreno**, & Charles Ofria. *Evolving Signal-driven Digital Organisms with SignalGP.* Evolution of Complex Life Conference, Atlanta, GA. May 2019.

Matthew Andres Moreno, Wolfgang Banzhaf, & Charles Ofria. *Learning an Evolvable Genotype-Phenotype Mapping.* BEACON Congress, East Lansing, MI. August 2018.

Matthew Andres Moreno& Charles Ofria. *Understanding Fraternal Transitions in Individuality.* The Third Workshop on Open-Ended Evolution (OEE3) at ALIFE, Tokyo, Japan. July 2018.

Matthew Andres Moreno, Wolfgang Banzhaf, & Charles Ofria. *Learning an Evolvable Genotype-Phenotype Mapping.* The Genetic and Evolutionary Computation Conference, Kyoto, Japan. July 2018.

Matthew Moreno, Jason Graham, & Simon Garnier. *Modeling the Collective Behavior of Ants on Uneven Terrain.* Phi Sigma Undergraduate Research Symposium, University of Puget Sound. April 2017.

Matthew Moreno, Jason Graham, & Simon Garnier. *Modeling the Collective Behavior of Ants on Uneven Terrain.* Joint

Mathematics Meetings, Atlanta, GA. January 2017.

Matthew Moreno. *Evolvability in Evolving Artificial Neural Networks.* NW Honors Research Symposium, Seattle Pacific University. November 2016.

Invited Talks

Matthew Andres Moreno. *Digital Evolution at Wafer Scale.* Emerging Researchers in Artificial Life (ERA) Town Hall. June 2026.

Matthew Andres Moreno. *Sampling- and Estimation-based Strategies for Data Collection in Wafer-Scale Evolution Simulations.* Neocortex User Webinar Series, Pittsburgh Supercomputing Center. March 2026.

Matthew Andres Moreno. *ByteBoost and Back Again.* ByteBoost Campus Champions. January 2026.

Matthew Andres Moreno. *ByteBoost and Beyond.* ByteBoost Cybertraining Workshop, Pittsburgh Supercomputing Center. August 2025.

Matthew Andres Moreno. *Applying Wafer-Scale Evolutionary Simulations to Investigate Hypermutator Dynamics in Large Asexual Populations.* Seminar Series in Ecology and Evolutionary Biology, San Diego State University. December 2024.

Matthew Andres Moreno. *Trackable Agent-based Evolution Models at Wafer Scale.* Emerging Researchers in Artificial Life (ERA) MiniCon. July 2024.

Matthew Andres Moreno. *Trackable Agent-based Evolution Models at Wafer Scale.* BEACON Digital Evolution Seminar, Michigan State University. June 2024.

Matthew Andres Moreno. *Survey of Software Engineering Tools & Techniques.* Undergraduate Research Opportunities Program Seminar, University of Michigan. January 2024.

Matthew Andres Moreno. *Workshop for Avida-Ed Software Development: Highlights and Outcomes.* Active LENS Congress. August 2022.

Matthew Moreno. *COMAP Mathematical Competition in Modeling 2017.* Spring Experiential Learning Symposium, University of Puget Sound. April 2017.

Tutorials

Emily Dolson, Jack Garbus, **Matthew Andres Moreno**, & Alexander Lalejini. *Phylogenies: how and why to track them in artificial life.* ALIFE, Copenhagen, Denmark. July 2024.

Emily Dolson, **Matthew Andres Moreno**, & Alexander Lalejini. *Phylogenies: how and why to track them in artificial life.* ALIFE, Sapporo, Japan. July 2023.

Posters

Matthew Andres Moreno, Emily Dolson, & Luis Zaman. *Wafer-Scale Simulation of Mutator Allele Dynamics in Large Asexual Populations.* The International Conference for High Performance Computing, Networking, Storage, and Analysis (SC25), St. Louis, MO. November 2025.

Matthew Andres Moreno, Connor Yang, Emily Dolson, & Luis Zaman. *Trackable Agent-Based Evolution Models at Wafer Scale.* The International Conference for High Performance Computing, Networking, Storage, and Analysis (SC24), Atlanta, GA. November 2024.

Matthew Andres Moreno, Emily Dolson, & Luis Zaman. *Studying Hypermutator Dynamics at Wafer Scale.* ByteBoost Workshop The International Conference for High Performance Computing, Networking, Storage, and Analysis (SC24), Atlanta, GA. November 2024.

Matthew Andres Moreno, Connor Yang, Emily Dolson, & Luis Zaman. *Trackable Agent-based Evolution Simulations at Wafer Scale.* Michigan Institute for Data Science and AI Fellows Research Pitch, Ann Arbor, MI. September 2024.

Matthew Andres Moreno, Connor Yang, Emily Dolson, & Luis Zaman. *Trackable Island-model Genetic Algorithms at Wafer Scale.* The Genetic and Evolutionary Computation Conference (GECCO), Melbourne, AUS. July 2024.

Matthew Andres Moreno. *Toward an Experimental Framework to Study Unsupervised Learning as an Analog for Evolvability in Genotype-Phenotype Maps.* University of Michigan Data Science and AI Summit, Ann Arbor, MI. November 2023.

Matthew Andres Moreno. *Hereditary stratigraphy: genome annotations to enable phylogenetic inference over distributed populations.* The Genetic and Evolutionary Computation Conference (GECCO), Boston, MA. July 2022.

Matthew Andres Moreno, Santiago Rodriguez Papa, & Charles Ofria. *Conduit: A C++ Library for Asynchronous High-performance Computing Applications.* The 6th International Workshop on Modeling and Simulation of and by Parallel and Distributed Systems (MSPDS), Barcelona, Spain. March 2021.

Matthew Andres Moreno & Charles Ofria. *Empirical: a C++ library to support efficient, reliable, and accessible scientific software.* CppCon Poster Session, Aurora, CO. September 2019.

Matthew Andres Moreno & Charles Ofria. *A Digital Framework for Fraternal Transitions in Individuality.* Evolution of Complex Life, Atlanta, GA. May 2019.

Matthew Andres Moreno. *Plasticity and Evolvability in a Genetic Regulatory Network Model.* BEACON Congress, East Lansing, MI. August 2017.

Matthew Andres Moreno. *Plasticity and Evolvability in a Genetic Regulatory Network Model.* ALIFE, Tokyo, Japan. July 2017.

Matthew Moreno, Jason Graham, & Simon Garnier. *Modeling the Collective Behavior of Ants on Uneven Terrain.* Fall Symposium, University of Puget Sound. September 2016.

Matthew Moreno & Adam Smith. *Automated Extraction of Mouse Vocalizations from Noisy Recordings.* Fall Symposium, University of Puget Sound. September 2015.

Seminar Presentations

Matthew Andres Moreno. *Applying Wafer-Scale Evolutionary Simulations to Investigate Hypermutator Dynamics in Large Asexual Populations.* Ecology and Evolutionary Biology Tuesday Lunch Seminar Series, Ann Arbor, MI. November 2024.

Matthew Andres Moreno. *Survey of Software Engineering Tools & Techniques.* Michigan Institute for Data and AI in Science Fellows Bootcamp, Ann Arbor, MI. September 2024.

Matthew Andres Moreno. *Unsupervised Learning as an Analog for Evolvability in Genotype-Phenotype Maps.* Ecology and Evolutionary Biology Tuesday Lunch Seminar Series, Ann Arbor, MI. September 2023.

Matthew Andres Moreno, Emily Dolson & Charles Ofria. *Hereditary Stratigraphy: Genome Annotations to Enable Phylogenetic Inference over Distributed Digital Evolution Populations.* Summer Research Opportunities Program (SROP) Facilitator Chalk Talks, East Lansing, MI. June 2021.

Matthew Andres Moreno & Charles Ofria. *Developing Digital Models of Multicellularity.* Summer Research Opportunities Program (SROP) Facilitator Chalk Talks, East Lansing, MI. June 2020.

Matthew Andres Moreno & Charles Ofria. *Developing Digital Models of Multicellularity.* Summer Research Opportunities Program (SROP) Facilitator Chalk Talks, East Lansing, MI. June 2019.

Matthew Andres Moreno & Charles Ofria. *Understanding Fraternal Transitions in Individuality.* BEACON Seminar, East Lansing, MI. September 2018.

Matthew Moreno. *Investigating the Relationship Between Plasticity and Evolvability in a Genetic Regulatory Network Model.* Math/CS Day, University of Puget Sound. April 2017.

Jordan Fonseca, Jesse Jenks, & **Matthew Moreno**. *MCM: Impact of Autonomous Vehicles on Seattle Traffic.* Math/CS Day, University of Puget Sound. April 2017.

Matthew Moreno. *Evolvability and Plasticity in a Genetic Regulatory Network Model.* Math & Computer Science Department Seminar, University of Puget Sound. April 2017.

Matthew Moreno. *Evolvability: What Is It and How Do We Get It?.* Otis C. Chapman Honors Program Thesis Presentation, University of Puget Sound. March 2017.

Matthew Moreno & Becky Hanscam. *Relieving the Space Jam: Assessment of a Quick-Response Satellite Mission to Neutralize Debris from Orbital Fragmentation Events.* Math/CS Day, University of Puget Sound. April 2016.

Matthew Moreno. *Mathematical Contest in Modeling: Eradicating Ebola.* Math/CS Day, University of Puget Sound. May 2015.

Guest Lectures

Matthew Andres Moreno. *Harnessing AI/ML High-performance Computing Hardware for Agent-based Evolution Simulations.* CS 361: Artificial Life and Digital Evolution, Carleton College. May 2025.

Matthew Andres Moreno. *Near-future Digital Evolution Power-ups.* CS 361: Artificial Life and Digital Evolution, Carleton College. November 2022.

Matthew Andres Moreno. *NP Completeness.* CSE 431: Algorithm Engineering Guest Lecture, Michigan State University. November 2021.

Alexander Lalejini & **Matthew Andres Moreno**. *Digital Evolution.* CSE 848: Survey of Evolutionary Computation Guest Lecture, Michigan State University. October 2019.

Grants & Fellowships

- Schmidt AI in Science Carpentry Project ($500; institutional award; 2024)
  - Project title: "Assessing the Capability of Large Language Models to Reason About Hierarchical Data in Biological Ancestry Trees"
  - Project lead: Matthew Andres Moreno, Co-I: James Boyko and Jacob Berv
  - received funding for OpenAI and Anthropic API credits to test LLM capabilities on "tree thinking" tasks
- UMich UROP Supplementary Funding Program ($720; institutional award; 2024)
  - funded ChatGPT and Replit subscriptions to support work by mentees Connor Yang and Vivaan Singhvi
- UMich UROP Research Scholars Fellowship ($4.5k; institutional award; 2024)
  - collaborated with mentee Connor Yang to develop and conduct project entitled "Software to Improve Observability of Large-scale Parallel and Distributed Agent-based Evolution Simulations"
  - received two semesters of research funding for Connor through competitive application process
- DOE Exploratory Research in Extreme-Scale Science (EXPRESS) Award Number DE-SC0025634 (2024; $300k)
  - Project title: "Dynamic Space-Time Memory Curation for Traceable Wafer-Scale Agent-Based Models"
  - PI: Luis Zaman and Emily Dolson; Key Personnel: Matthew Andres Moreno
- NSF ACCESS Innovative Projects Allocation BIO240102 (2024)
  - Project title: "Characterization of Phylogenetic Structure Across Population Scales using Wafer-scale Agent-based Evolution Simulation"
  - PI: Matthew Andres Moreno, Co-PI: Emily Dolson and Luis Zaman
  - 100 hours Cerebras CS-2 Wafer-Scale Engine AI Accelerator at PSC Neocortex
  - Renewed with 100 additional CS-2 hours as NSF ACCESS Explore Allocation (2025)
  - Renewed with 200,000 ACCESS Credits as NSF ACCESS Explore Allocation (2026)

- ByteBoost Cybertraining Workshop Project (2024)
  - Project title: "Foundations for Agent-based Evolution Simulation on Emerging HPC Accelerators"
  - travel and lodging to attend one week workshop at Pittsburgh Supercomputing Center
- OxRSE Research Software Engineering Workshop Project (2024)
  - Project title: "LLMs for extracting domain-specific data from literature"
  - Project leads: Nanta Sophonrat and Matthew Andres Moreno, Co-I: Ritesh Kumar and Stephanie Khuu
  - travel and lodging to attend one week workshop at University of Oxford
- Justice, Equity, Diversity, and Inclusion (JEDI) Small Grants Fund Award ($250; departmental award; 2023)
  - mileage and web hosting expenses for bI/O Seminar Series at Parnall Correctional Facility
  - University of Michigan Ecology and Evolutionary Biology Department
- Kwan/Yiu Complex Systems Postdoctoral Research Support ($5k; departmental award; 2023)
- Eric and Wendy Schmidt AI in Science Postdoctoral Fellowship (institutional award; 2022)
- BEACON Luminaries Undergraduate Summer Fellowship ($6k; departmental award; 2021)
  - collaborated with mentee Santiago Rodriguez Papa to develop and conduct project entitled "Using Event-Driven Genetic Programming to Evolve Complex Social and Environmental Interactions"
  - received summer stipend support for Santiago through competitive application process
- National Science Foundation Graduate Research Fellowship (national award; 17% acceptance rate; 2018)
- Blake and Mary Krueger University Distinguished Fellowship (institutional award; 0.2% acceptance rate; 2017)
- BEACON Science and Technology Center Top Up Fellowship (departmental award; 2017)

Service Activities

Institutional Service

- UMich Ecology and Evolutionary Biology Thursday Seminar Series speaker host (2026)
- UMich MIDAS AI in Science fellows bootcamp panelist (2025)
- Developed and co-presented data science domain track workshop at Michigan Louis Stokes Alliance for Minority Participation (MI-LSAMP) NxtGEN Summer Institute, comprising four half-day sessions (2024)
- Developed and co-led UMich MIDAS high school summer camp data visualization day (2024)
- UMich Ecology and Evolutionary Biology Graduate Student Website-building Workshop presenter (2023)
- UMich Center for the Study of Complex Systems Festifall Outreach Table (2023)
- UMich Ecology and Evolutionary Biology NSF-GRFP Short Course coach (2023)
- Michigan State University Alliance for the Advancement of the Professoriate (AGEP) GRFP Workshop Series peer coach (2020-21)
- Contributed talks session moderator for BEACON Congress (2021)
- Michigan State University College of Engineering Out for Undergrad (O4U) LGBTQ2+ Outreach Table (2020)
- Michigan State University College of Engineering GRFP Workshop peer coach (2019)

Professional Service

- Project mentor for ByteBoost Cybertraining Workshop at Pittsburgh Supercomputing Center (2025)
- Lead maintainer for DendroPy Phylogenetic Computing Library (2023-present)
  - Automated release process to ensure regular updates to package on PyPi.
  - Incorporated modern software engineering practices such as Continuous Integration (CI), code coverage reports, code linting, and automated documentation builds.
  - Wrote bug fixes and developed software features.
  - Collaborated with undergraduate researcher Connor Yang to triage untested code with smoke tests.
  - Prepared v5.0 release [2].
  - Triaged unresolved tickets on issue tracker.
- Peer review for Artificial Life journal (2026)
- Peer review for IEEE Symposium on Computational Intelligence in Artificial Life and Cooperative Intelligent Systems (2024)
- Online Encyclopedia of Integer Sequences (OEIS) contributions (2024)
- Grad School Panel Discussion, GVSU visit @ BEACON (2024)
- Peer review for Methods in Ecology and Evolution (2024)
- Peer review for Journal of Open Source Software (2024)
- Peer review for SoftwareX (2023)
- Peer review for Theory in Biosciences (2023)
- Peer review for Genetic Programming Theory and Practice (2023, 2024)
- ALIFE Conference Program Committee (2022-2026)
- Genetic and Evolutionary Computation Conference (GECCO) Complex Systems Track Program Committee (2026)
- Parallel Problem Solving from Nature (PPSN) Conference Program Committee (2026)

Graduate Research Mentees

- Sanaz Hasanzadeh Fard (2025)
  - Michigan State University graduate student co-mentored with Dr. Emily Dolson.
  - Performed simulation experiments investigating signatures of epidemiological dynamics in pathogen phylogenies.
  - Co-author on one conference paper [12].

- Tait Weicht (2021 WAVES Workshop)
  - Graduate student in mathematics at UC Davis.
  - Built tools and documentation for Empirical "prefab" web interface components toolkit.

Postbac Research Mentees

- Cameron Haynes (2024 → PhD Program at Moffitt Cancer Center)
  - Conducted experiments assessing impact of gene duplication on evolution of complex traits using Avida digital evolution platform.

Undergraduate Research Mentees

- Vivaan Singhvi (2024-25 UMich UROP, 2025-26 → Oak Ridge National Lab, Old Mission Capital)
  - Refined and optimized end-to-end phylogeny reconstruction workflow for the hstrat package, boosting throughput by $> 1,000\times$.
  - Delivered oral presentation at 2025 National Conference on Undergraduate Research (NCUR).
  - Selected to present at Mathematical, Computing, & Statistical Sciences Division showcase webinar by the Council on Undergraduate Research and awarded $150 prize for excellence in research.
  - Awarded the Rick Riolo Undergraduate Research Prize ($500) by the U-M Center for the Study of Complex Systems.
  - First author on one conference paper [13].
- Joey Wagner (2024-25 MSU Professorial Assistant)
  - Performed benchmarking experiments for hstrat and downstream software.
  - Presented research poster at 2025 MSU University Undergraduate Research and Arts Forum (UURAF).
  - Co-author on one conference paper [13] and one preprint [32].
- Connor Yang (2023-25 UMich UROP → Microsoft, Amazon)
  - Prepared DendroPy for v5.0 release, with a particular focus on triaging test coverage.
  - Developed C++, Zig, and Cerebras Wafer-Scale Engine (WSE) algorithm implementations for the Downstream package; engineered cross-language testing framework.
  - First author on one preprint [32]. Co-author on one conference paper [15] and two extended abstracts [26, 25].
- Ishan Kunam (2024 UMich UROP)
  - Self-directed project applying agent-based modeling/complex systems approaches in international political economy, focusing on integrating international affairs and international financial market models.
- Anika Ranjan (2023-24 UMich UROP)
  - Investigated effects of ecological dynamics on phylogenetic structure using the Gen3sis eco-evolutionary simulation system.
  - Co-author on one conference paper [14].
- Sara Boyd (2020 WAVES → SparkCognition)
  - Led initial development of the "prefab" Empirical web interface components toolkit.
- Katherine Perry (2019 → National Security Agency)
  - Contributed to development of a native back-end for the Empirical library web canvas API.
- Santiago Rodriguez Papa (2019-2023 → Apple)
  - Assisted extensively with C++ development and benchmarking with the Conduit, DISHTINY, hstrat, and SignalGP-Lite libraries.
  - Co-author on one journal paper [1], one conference paper [17], one extended abstract [28], four preprints [34, 35, 36, 38], and three workshop papers [20, 21, 22].
- Nathan Rizik (2018-19 → Microsoft)
  - Developed C++ library software to support tag-matching experiments.

Academic Awards

- IEEE Artificial Life Conference Best Paper Award, nominated (conference award; 25% nomination rate; 2025)
- Justice, Equity, Diversity, and Inclusion (JEDI) Award, bI/O team (annual departmental award; $500; 2024)
- Artificial Life Conference Best Paper Award, nominated (conference award; 6% nomination rate; 2023)
- MSU EEB Research Symposium Best Contributed Talk, 3rd Place (departmental award; 40% acceptance rate; 2022)
- Outstanding Doctoral Student Mentor Award, nominated (institutional award; 2022)
- COMAP Mathematical Competition in Modeling Finalist (international award; 0.7% acceptance rate; 2017)
- Recipient of National Science Foundation Graduate Research Fellowship Program Honorable Mention (national award; 2017)
- Recipient of Edward Goman Outstanding Senior Award (departmental award, mathematics and computer science; 2017)
- Recipient of Roderick MacArthur Award for an Outstanding Honors Thesis Presentation (departmental award; 2017)
- Member of Otis C. Chapman Honors Program (2013-2017)
- Member of Phi Beta Kappa, Pi Mu Epsilon, Phi Kappa Phi, Upsilon Pi Epsilon

STEM Community Activities

- University of Michigan, Bringing knowledge exchange Inside and Outside of correctional facilities (bI/O) Seminar Series organizer (2023-2025)
  - Co-organized quarterly seminar events to bring Ecology and Evolutionary Biology department members into conversation with Parnall Incarceration Facility inmates.
  - Recruited and scheduled science presenters in role as executive officer for seminar programming.
  - Developed and maintained program webpage, https://bioio.org.

  - Engaged with > 60 attendees over presentations and discussion panels about research projects and career paths in science.
  - Organizing team won the UMich EEB department's 2024 Justice, Equity, Diversity, and Inclusion (JEDI) award.
  - Provided science communication coaching during practice presentations before seminars.
  - Prepared IRB proposal for pre/post survey.
- Michigan State University, Summer Research Opportunities Program (SROP) facilitator (2019, 2020, 2021, 2022)
  - Led weekly chalk talk sessions for sixteen students to practice and iteratively develop the foundation for their final presentations, providing verbal coaching and written feedback.
  - Prepared written feedback on iterative drafts of student documents: annotated bibliography, resume, personal statement, and final research paper.
  - Held weekly one-on-one meetings with eight students to check in on their personal wellbeing, make sure they were receiving adequate support from their research group, plan for upcoming deadlines, outline new documents, and discuss feedback on draft documents.
  - Cohort consisted of majority underrepresented students.
- Michigan State University, Workshop for Avida-ED Software Development (WAVES) lead coordinator (2020, 2021)
  - Led proposal to redirect unspent Avida-ED funds for Summer 2020 to create paid, 10-week fully-remote research opportunities for early-career scientists and software engineers; reprised workshop in 2021.
  - Negotiated approval from grant stakeholders, distributed call for applicants, designed workshop admissions criteria, organized reviewer pool, and chaired committee to reach consensus-based and equity-minded admissions decisions on 91 (2020) workshop applications.
  - Recruited 13 (2020), 8 (2021) graduate, post-graduate, and faculty mentors to work one-on-one with workshop participants on software or science projects of mutual choosing.
  - Served 17 (2020), 10 (2021) early-career participants with 76% (2020), 70% (2021) self-identifying as members of underadvantaged groups in computer science.
  - Wrote and delivered four full-day asynchronous onboarding tutorials introducing Avida-ED, C++, WebAssembly, and web design.
  - Arranged and co-led weekly 90-minute topic-driven seminars with lecture and discussion components.
  - Facilitated weekly all-hands meetings to check in on progress, troubleshoot barriers, and spitball ideas.
  - Created workshop website and organized participant blog posts on project work and outcomes.
  - Devised and implemented community-building interventions, such as weekly social "warm-up" activities leading into enrichment seminars.
  - Performed *post hoc* analysis of participant survey data, revealing success in building programming language-specific proficiency among participants, particularly with respect to "catching up" members of underadvantaged groups.
- Gwinnett School District Covid-19 Dashboard, developer and maintainer (2020)
  - Collaborated with a colleague at Georgia Institute of Technology to share near real-time Covid-19 case counts and trend analysis with Gwinnett County community members.
  - Administered pipeline to scrape case count data from PDF documents and deploy data in an R Shiny application.
  - Negotiated in-kind support for hosting expenses from R Studio.
- Michigan State University, Alliance for Graduate Education and the Professoriate (AGEP) peer tutor (2022)
- Michigan State University, MSU High School Programming Competition proctor & tech support (2021)
- Michigan State University, PyGame workshop co-lead instructor (2018, 2019)
  - Prepared and co-instructed a one-week intensive introduction to Python and video game design for high school students.
  - Worked one-on-one with students to design video games for live demonstration at an end of the week symposium and tackle programming challenges along the way.
- Macdonald Middle School, assistant in general and intervention mathematics classrooms (2017-2018)
  - Worked four hours weekly in a sixth grade geometry classroom and a seventh grade math intervention classroom.
  - Worked one-on-one and with small groups of students outside of the classroom to help students keep up with class material or cover new topics.
  - In the classroom, assisted students with questions and worked one-on-one to keep students engaged with class material.
- BEACON Elementary Science Nights outreach at Donley, Marble, Whitehills, Glencairn, Murphy, Hiawatha, and Beagle Elementary Schools (2017-2018)
- BEACON outreach at MSU Science and Engineering Festival (2018)
  - Along with other NSF BEACON members, led hands-on activities to engage kids with key evolutionary ideas like natural selection and natural history.
- University of Puget Sound Center for Writing, Learning, & Teaching, tutor and academic consultant (2015-2017)
  - Helped mathematics students work through assignments, led study sessions to prepare students for examinations, and provided a safe and supportive environment to discuss frustrations and build self-confidence.
  - Conducted academic advising appointments, working with students to develop organization, communication, and time-management skills, particularly in the context of executive function or other impairments.
  - Liaised with faculty members to discuss coursework and support students.
  - Developed, led, and participated in professional development activities for student staff.
- University of Puget Sound, computer science departmental mentoring program co-coordinator (2017)
  - Recruited upperclassmen mentors to lead small groups of underclassmen in computer science activities.
  - Planned and led social, brain teaser, and coding activities.
  - Publicized program through departmental announcement, posters, and classroom visits.

- National Conference on Peer Tutoring in Writing, session chair and volunteer (2016)
- Jason Lee Middle School Access to College Days, student panelist (2016)
- University of Puget Sound Access Services, access coach for Tuesday Night Tutoring (2016)
  - Met with local middle and high school students for two hours weekly in an informal helproom setting on the University of Puget Sound campus.
  - Tutored homework material, shared study skills, and worked to make higher education feel approachable by building relationships with students and discussing college life.
- Oakland High School, volunteer (2016)
  - Worked with Communities in Schools for two hours weekly at a credit-recovery-focused alternative high school in Tacoma, WA.
  - Co-led an after-school Homework Club, aiming to help students complete assignments and feel more connected to the school.
  - Served as a classroom assistant, answering student questions and keeping students engaged with class material.

Professional Development Activities
- Global Young Scientists Summit one-week networking event in Singapore (Spring 2025)
- ByteBoost Cybertraining Workshop one-week training on testbed HPC architectures (Summer 2024)
- Oxford Research Software Engineering Group one-week Software Engineering workshop (Summer 2024)
- Certification in College Teaching Institute three-day workshop (Summer 2022)
- Introduction to Evidence-Based Undergraduate STEM Teaching eight-week Massive Open Online Course (MOOC) via the Center for the Integration of Research, Teaching, and Learning (CIRTL) (Summer 2022)
- Teaching assistant and guest lecturer for MSU CSE 431 Algorithm Engineering (Fall 2021)
- Lead instructor for MSU CSE 491 Advanced C++ Seminar (Spring 2020)

Software Projects
- *downstream* (2024): Python, C++, Zig, and Cerebras Software Language (CSL) libraries providing efficient, constant-space implementations of stream curation algorithms
- *DendroPy v5* (2024): Python library for phylogenetic scripting, simulation, data processing and manipulation [2]
- *joinem* (2024): CLI for fast, flexible concatenation of tabular data using polars
- *pecking* (2024): identifies the set of lowest-ranked groups and set of highest-ranked groups in a dataset using nonparametric statistical tests
- *Empirical* (2024): C++ tools for scientific software development, with emphasis on building web interfaces using Emscripten [3]
- *outset* (2023): utility to plot zoom indicators, insets, and magnified panels in matplotlib/seaborn visualizations
- *phylotrackpy* (2023): Python phylogeny tracker for *in silico* evolution experiments [34]
- *hstrat* (2022): phylogenetic inference on distributed digital evolution populations [5]
- *conduit* (2021): C++ library for best-effort multithread/multiprocess communication in HPC simulation
- *DISHTINY* (2021): a platform for studying open-ended evolutionary transitions in individuality
- *signalgp-lite* (2020): event-driven genetic programming designed for large-scale artificial life applications [38]