

# Natasha JARUS (she/her)

PHONE: (573) 202-1013  
EMAIL: [natasha@jarus.email](mailto:natasha@jarus.email)  
WEBSITE: [adjoint.space](http://adjoint.space)

## EDUCATION

---

|               |  |
|---------------|--|
| DECEMBER 2021 | Ph.D. in COMPUTER ENGINEERING<br><b>Missouri University of Science and Technology</b> , Rolla, MO<br>Doctoral Fellow, Graduate Assistantships in Areas of National Need Program,<br>US Department of Education<br>Advisor: Dr. Sahra SEDIGH SARVESTANI<br>Thesis: INSTRUMENTATION, MODELING, AND SOUND METAMODELING FOUNDATIONS FOR COMPLEX HYBRID SYSTEMS<br>GPA: 4.0/4.0 |
| DECEMBER 2013 | B.S. in COMPUTER SCIENCE<br>Minor in MATHEMATICS<br><b>Missouri University of Science and Technology</b> , Rolla, MO<br>Office for Undergraduate Research Experience Scholar<br>Advisor: Dr. Sriram CHELLAPAN<br>GPA: 3.7/4.0  |

## RESEARCH INTERESTS

---

Applications of Formal Methods, Abstract Algebra, Type Theory, and Category Theory to Model Transformation  
Stochastic Modeling of Complex Networked Systems  
Critical Infrastructure Protection and Dependability Analysis  
Prediction and Analysis of Failures in Embedded Systems

## EXPERIENCE

---

|   |   |
|---|---|
| OCT 2021 –<br>PRESENT                   | <p>Founding Senior Software Engineer &amp; Technical Lead at <b>ngrok</b>, Seattle, WA</p> <p>Developed software to enable programmers to introspect network traffic and to provide turn-key network service features including cluster-to-cluster communication, rate limiting, authentication, and latency-based routing.</p> <p>Developed the dataplane and controlplane portions of a Kubernetes Operator ingress, allowing secure and authenticated traffic ingress from customer clusters to endpoints not accessible from the public Internet.</p> <p>Led the design and implementation of endpoint bindings, a feature that cuts across the control and data planes. Mentored a junior engineer on this project. Collaborated with product management and engineering to orchestrate the design of this and interrelated features.</p> <p>Led the design and implementation of resilient and cross-region consistent sliding window rate limiting for customer traffic.</p> <p>Rewrote and de-crufted the namesake ngrok agent software, replacing a legacy bespoke network backend with one based on ngrok's open-source library. Improved API semantics for ngrok's open-source library and contributed to its documentation.</p> <p>Architected, operationalized, and led a latency-based traffic routing project, decreasing end-to-end latency and eliminating per-region isolation in ngrok's now-global network. (Also: designed commemorative pins for people who participated in the year-long effort.)</p> <p>Led an investigation into intermittent network errors which culminated in changing the cloud provider node types used for ngrok's datacenters. Improved observability by organizing dashboards, creating and fixing metrics and monitors, tailoring log data, and writing scripts to query production systems.</p> <p>Wrote internal presentations, documentation for internal systems, and operational guides based on learnings from incidents.</p> <p>Wrote the <a href="#">“Drive application performance and stability with global rate limiting”</a> blog post.</p> <p>Designed interview questions and rubrics. Interviewed more than 45 engineering, management, and leadership candidates.</p> |
| JAN 2014 –<br>DEC 2021                  | <p>Graduate Research Assistant (Ph.D.) at <b>Missouri S&amp;T</b>, Rolla, MO</p> <p>Advisor: Dr. Sahra SEDIGH SARVESTANI</p> <p>Performed doctoral research on modeling and analysis of complex systems, including smart power grids and embedded system peripherals.</p> <p>Created sound metamodeling foundations for complex hybrid systems. Formalized structural refinement and generalization for Markov imbedded structure reliability models. Detected, modeled, and analyzed the effects of electrostatic discharge and electromagnetic interference in embedded systems. Modeled energy flow in physical systems using bond graphs. Analyzed reliability and resilience of smart power grids.</p> <p>Graduate lead and supervisor of several projects involving multiple undergraduate and graduate students. Authored 8 conference papers, 4 journal papers, and one doctoral dissertation.</p>  |
| AUG 2018 –<br>DEC 2018                  | <p>Graduate Instructor at <b>Missouri S&amp;T</b>, Rolla, MO</p> <p>Haskell Special Topics — Computer Science 4000</p> <p>Full responsibility for curriculum development, instruction, and evaluation for a class of four senior students. Taught details of the Haskell programming language, including types, typeclasses, common data structures, and algebraic abstractions. Discussed aspects of lambda calculus, type theory, and applications of the Curry-Howard correspondence. Developed course curriculum as a readings class based on a textbook and supplemented by academic and industry articles.</p>  |
| SEPT 2018 –<br>NOV 2018                 | <p>Trigonometry — Math 1160</p> <p>Full responsibility for instruction and evaluation of two classes of 50 freshman and sophomore students each. Taught lectures on trigonometric functions, identities, and applications of trigonometry, including solving triangles, calculating distances and bearings, and complex numbers.</p>  |
| SUMMER 2017                             | <p>Discrete Mathematics — Computer Science 1200</p> <p>Full responsibility for instruction and evaluation of a class of 7 freshman and sophomore students. Taught logic, mathematical induction, number and set theory, probability and combinatorics, and graph theory.</p>  |
| SUMMER 2017<br>& JAN 2016 –<br>MAY 2016 | <p>Data Structures Laboratory — Computer Science 1001 (now 1585)</p> <p>Developed course curriculum, including topic selection, instructional materials, and student exercises. Full responsibility for instruction and evaluation of three classes totaling 80 freshman and sophomore students. This course is now required for all students majoring in computer science. Co-authored a textbook, <i>TOOLS FOR PROGRAMMERS</i>, based on the course material. Topics include program debugging, performance analysis, scripting, and version control.</p>   |
| AUG 2016 –<br>DEC 2016                  | <p>Introduction to C++ Programming — Computer Science 1570</p> <p>Full responsibility for instruction and evaluation of two classes of 50 freshman and sophomore students. Taught basics of computer programming, including object-oriented programming, in C++.</p>  |

|  |  |
|--|--|
| JAN 2015 –<br>MAY 2015                             | <p>Digital Network Design — Computer Engineering 5410</p> <p>Shared responsibility for instruction and evaluation of a course of 45 senior and graduate students. This course is required for all undergraduate students majoring in computer engineering. Taught principles of computer networking beginning from physical media and continuing through each layer of the OSI stack.</p>  |
|  | Graduate Teaching Assistant at <b>Missouri S&amp;T</b> , Rolla, MO   |
| JAN 2018 –<br>MAY 2018<br>& JAN 2017 –<br>MAY 2017 | <p>Object-Oriented Numerical Modeling in C++ — Computer Science 5201</p> <p>Taught lectures on memory safety, the curiously recursive template pattern, and modern C++ features, including lambdas, closures, and combinators provided in the standard library. Graded projects and provided feedback on program design and implementation for classes of 30 and 45 senior and graduate students.</p>  |
| AUG 2017 –<br>DEC 2017                             | <p>Introduction to Operating Systems — Computer Science 3800</p> <p>Developed homework assignments covering multithreaded programming, diagnosing and fixing deadlock, memory allocation, and process scheduling. Developed a small kernel for students to use as a basis for class projects. Graded homework assignments for two classes of 60 sophomore and junior students.</p>   |
| AUG 2015 –<br>DEC 2015                             | <p>Calculus II Laboratory — Math 1215</p> <p>Guided groups of freshman and sophomore students through solving problems in an inquiry-based learning environment. Taught three classes of 30 students each. Provided tutoring assistance to students and proctored and graded exams for the associated lecture.</p> <p>These classes are a pilot run of a new calculus laboratory format. Provided input on problem selection and wrote solutions for the exercises.</p>  |
| AUG 2014 –<br>DEC 2014                             | <p>Grader at <b>Missouri S&amp;T</b>, Rolla, MO</p> <p>Digital Network Design — Computer Engineering 5410</p>  |
| JAN 2012 –<br>DEC 2013                             | <p>Undergraduate Research Assistant at the <b>Missouri S&amp;T Center for Electromagnetic Compatibility</b>, Rolla, MO</p> <p>Advisor: Dr. Sahra SEDIGH SARVESTANI</p> <p>Developed software-based instrumentation and analytical models for detection and analysis of the effects of electrostatic discharge on an embedded system. Modified Linux drivers to gather hardware state information. Developed methods for analyzing state information to statistically determine if a sequence of states demonstrates electrostatic discharge.</p> <p>Work resulted in one journal and one conference publication.</p> |
| AUG 2013 –<br>DEC 2013                             | <p>Software Developer at <b>Lumate</b>, Rolla, MO</p> <p>Designed and developed a platform to facilitate data sharing between large heterogeneous databases.</p>   |
| JAN 2010 –<br>DEC 2013                             | <p>System Administrator at <b>Missouri S&amp;T Information Technology</b>, Rolla, MO</p> <p>Developed a FUSE filesystem wrapper to support advanced Linux filesystem operations on a network filesystem. Developed and integrated a system for real-time 3D visualization of large data sets. Developed software to convert a generic dataset to a specific format for the visualization system. Supported research projects with both hardware and software.</p> <p>Managed all campus Linux machines. Migrated campus Linux distribution from Red Hat to Ubuntu.</p>   |
| AUG 2010 –<br>DEC 2012                             | <p>Tutor at <b>Missouri S&amp;T</b>, Rolla, MO</p> <p>Introduction to C++ — Computer Science 1570 and 1971</p> <p>Taught programming concepts, answered questions, and provided homework guidance to freshman and sophomore students.</p>  |
| SUMMER 2013  | <p>Software Development Engineering Intern at <b>Amazon</b>, Seattle, WA</p> <p>Developed an Identity Broker service to vend temporary resource access credentials to clients based on their identity. Deployed service to production and configured monitoring and alarms.</p>  |
| SUMMER 2012  | <p>Software Development Engineering Intern at <b>Amazon</b>, Seattle, WA</p> <p>Deployed to production a self-service scaling web service that reduced developer time spent on new clients. The service also predicted hardware requirements each quarter based on individual client growth estimates. Developed a MapReduce log parsing system to monitor actual service use and provide real-life scaling data for better accuracy.</p>  |

- SUMMER 2011 | Software Engineering Intern at **Garmin International**, Kansas City, KS  
Modified the map routing algorithm to log better statistical data. Created software to analyze generated routes and determine overall fitness of the routing algorithm. Developed a system to allow other engineers to easily test routing algorithm changes.
- SUMMER 2010 | Software Engineering Intern at **Softek Solutions Inc.**, Kansas City, KS  
Developed an Android application that queried a REST web interface. Developed an Android library for future company applications.

## PUBLICATIONS

---

- N. Jarus**, M. Woodard, K. Marashi, S. Sedigh Sarvestani, J. Lin, A. Faza, and P. Maheshwari.  
“Survey on Modeling and Design of Cyber-Physical Systems”.  
In preparation.
- N. Jarus**, S. Sedigh Sarvestani, and A. R. Hurson.  
“Refinement and Generalization of Component State-Based Reliability Models”.  
In preparation.
- N. Jarus**, J. Schott, L. Klingbeil, and S. Sedigh Sarvestani.  
“Observation, Analysis, Modeling, and Classification of USB Host Controller Operation Under Electro-Magnetic Interference”.  
In preparation.
- N. Jarus**, A. Sabatini, P. Maheshwari, and S. Sedigh Sarvestani.  
“Detection, Analysis, and Prediction of the Effects of Electrostatic Discharge on a USB Host Controller”.  
Under review at *IEEE Transactions on Electromagnetic Compatibility*
- 2021 | **N. Jarus**.  
“Instrumentation, Modeling, and Sound Metamodeling Foundations for Complex Hybrid Systems”.  
Doctoral dissertation.
- 2020 | **N. Jarus**, A. Sabatini, P. Maheshwari, and S. Sedigh Sarvestani.  
“Software-Based Monitoring and Analysis of a USB Host Controller Subject to Electrostatic Discharge”.  
In *Proceedings of the International Symposium on Real-Time and Embedded Systems and Technologies (RTEST)*, Tehran, Iran, pp. 1–7
- 2019 | **N. Jarus**, S. Sedigh Sarvestani, and A. Hurson.  
“Towards Refinement and Generalization of Component State-Based Reliability Models”.  
In *Proceedings of Resilience Week 2019 (RWS)*, San Antonio, TX, USA, pp. 153–159  
(co-sponsored by Idaho National Laboratory)
- N. Jarus**, S. Sedigh Sarvestani, and A. Hurson.  
“Formalizing Cyber-Physical System Model Transformation via Abstract Interpretation”.  
In *Proceedings of the 19<sup>th</sup> IEEE International Symposium on High Assurance Systems Engineering (HASE)*, Hangzhou, China, pp. 107–114
- 2018 | **N. Jarus**, S. Sedigh Sarvestani, and A. Hurson.  
“Facilitating Model-Based Design and Evaluation for Sustainability”.  
In *Proceedings of the 9<sup>th</sup> IEEE International Green and Sustainable Computing Conference (IGSC)*, Pittsburgh, PA, USA, pp. 1–2

- 2016 | **N. Jarus**, S. Sedigh Sarvestani, and A. Hurson.  
 “Models, Metamodels, and Model Transformation for Cyber-Physical Systems”.  
 In *Proceedings of the 7<sup>th</sup> IEEE International Green and Sustainable Computing Conference (IGSC)*, Hangzhou, China, pp. 1–8.
- 2014 | M. Albasrawi, **N. Jarus**, K. Joshi, and S. Sedigh Sarvestani.  
 “Analysis of Reliability and Resilience for Smart Grids”.  
 In *Proceedings of the 38<sup>th</sup> IEEE International Computer Software and Applications Conference (COMPSAC)*, Vasteras, Sweden, pp. 529–534.  
 Recognized by the [NSA Science of Security Index](#) as Significant Research in Cyber Security
- 2013 | A. Sabatini, **N. Jarus**, P. Maheshwari, and S. Sedigh.  
 “Software Instrumentation for Failure Analysis of USB Host Controllers”.  
 In *Proceedings of the IEEE International Instrumentation and Measurement Technology Conference (I<sup>2</sup>MTC)*, Minneapolis, MN, USA, pp. 1109–1114.
- 2012 | **N. Jarus**.  
 “Old Ideas in a New Age: Descartes’ Influence on Modern Animal Farming”.  
 In *Missouri S&T Undergraduate Research Conference*.  
 First place in Arts and Humanities

## HONORS AND AWARDS

---

- JUL 2021 | The Council of Graduate Students of Missouri S&T:  
 CGS Graduate Student Leadership Award
- OCT 2019 | National Science Foundation:  
 10<sup>th</sup> International Conference on Green and Sustainable Computing Travel Grant (\$1200)
- JAN 2019 – DEC 2021 | US Department of Education Doctoral Fellowship:  
 Graduate Assistantships in Areas of National Need (GAANN) Program (covered all educational expenses and need-based stipend) (\$34,000)
- OCT 2018 | National Science Foundation:  
 9<sup>th</sup> International Conference on Green and Sustainable Computing Travel Grant (\$1200)
- AUG 2015 | NSA Science of Security Index:  
 “Analysis of Reliability and Resilience for Smart Grids” cited as significant research in cyber security
- MAR 2015 | National Science Foundation:  
 13<sup>th</sup> International Conference on Pervasive Computing and Communication Travel Grant (\$500)
- JAN 2014 – AUG 2015 | US Department of Education Doctoral Fellowship:  
 Graduate Assistantships in Areas of National Need (GAANN) Program (covered all educational expenses and need-based stipend) (\$30,000)
- SEPT 2012 – MAY 2014 | Missouri S&T:  
 Office for Undergraduate Research Experience (OURE) Scholarship (\$2,000)  
 Access Missouri Scholarship (\$2,200)

|                         |   |
|-------------------------|---|
| APR 2012                | Missouri S&T:<br>“Old Ideas in a New Age: Descartes’ Influence on Modern Animal Farming” awarded<br>First Place in Arts and Humanities section of the Missouri S&T Undergraduate Research<br>Conference |
| SEPT 2009 –<br>MAY 2014 | Missouri S&T:<br>Bright Flight Scholarship (\$10,000)   |
| SEPT 2009 –<br>MAY 2013 | Missouri S&T:<br>Curators’ Scholarship (\$14,000)<br>Excellence Scholarship (\$4,000)<br>First Robotics Scholarship (\$2,000)<br>Miner Alumni Association Silver Scholarship (\$5,000)                  |
| SEPT 2009 –<br>MAY 2010 | Missouri S&T:<br>Dean’s Scholarship (\$750)<br>Computer Science Dept. Scholarship (\$250)   |

## TECHNICAL SKILLS

---

|           |  |
|-----------|--|
| LANGUAGES | C++, Python, Rust, Haskell, C, Ruby, Java, Javascript, Shell Scripting   |
| SOFTWARE  | Postgres, Kafka, Clickhouse, Redis, GRPC, Kubernetes, Docker, L <sup>A</sup> T <sub>E</sub> X, Git, Make                                       |
| HARDWARE  | KiCad, Soldering, Oscilloscopes/Signal Generators/&c., ESD/EMI sources including<br>Transmission Line Pulsers, Micrometers/Dial Indicators/&c. |

## PROFESSIONAL DEVELOPMENT

---

|      |  |
|------|--|
| 2020 | Missouri S&T Center for Advancing Faculty Excellence — Student Learning and Assessment<br>in 2020  |
| 2018 | Missouri S&T Center for Advancing Faculty Excellence — Authentic Assessment Techniques<br>Missouri S&T Student Diversity Initiatives — Safe Space Training |
| 2015 | Missouri S&T Mathematics Graduate Teaching Seminar   |
| 2014 | Presenting Data and Information Workshop by Edward TUFTE<br>Missouri S&T Graduate Teaching Assistant Workshop  |

## PROFESSIONAL SERVICE AND AFFILIATIONS

---

|             |  |
|-------------|--|
| MEMBERSHIPS | Institute of Electrical and Electronic Engineers<br>IEEE Eta Kappa Nu Honors Society<br>Association for Computing Machinery<br>American Mathematical Society<br>Association for Women in Mathematics<br>Missouri S&T Intelligent Systems Center<br>Missouri S&T Center for Electromagnetic Compatibility |
| CONFERENCES | 13 <sup>th</sup> IEEE International Conference on Pervasive Computing and Communication<br>(PERCOM) 2015 — Volunteer   |

|             |  |
|-------------|--|
| PEER REVIEW | IEEE International Conference on Software Quality, Reliability & Security (QRS) 2020   |
|             | Resilience Week Symposium 2019   |
|             | International Symposium on High Assurance Systems Engineering (HASE) 2019  |
|             | International Conference on Computing, Networking, and Communications (ICNC) 2018  |
|             | International Conference on Computing, Networking, and Communications (ICNC) 2017  |
|             | 39 <sup>th</sup> IEEE International Computers, Software & Applications Conference (COMP-SAC) 2015  |
|             | IEEE International Conference on Software Quality, Reliability & Security (QRS) 2015   |
|             | International Workshop on Model-Based Design for Cyber-Physical Systems (MB4CP) 2015 (in conjunction with the 45 <sup>th</sup> IEEE International Conference on Dependable Systems and Networks (DSN)) |
|             | 16 <sup>th</sup> IEEE International Conference on Information Reuse and Integration (IRI) 2014   |

## OUTREACH AND COMMUNITY ENGAGEMENT

---

|      |   |
|------|---|
| 2020 | <p>Missouri S&amp;T Council of Graduate Students — Electrical and Computer Engineering Department Representative</p> <p>Represented the interests of Electrical and Computer Engineering graduate students to CGS. Collaborated with other members of the Council to create a graduate student bill of rights, advocate for policy changes, and plan educational and social events for graduate students.</p>   |
| 2019 | <p>Society for Women Engineers — “It’s Electrifying” Soldering Workshop</p> <p>Led a workshop where 30 middle school students assembled an electronics kit. Guided students through component assembly and making their first solder joints!</p> <p>Kaleidoscope Discovery Center — Introduce a Girl to Engineering Day</p> <p>Created logic gate demonstration breadboard and ran a booth introducing 25 middle school students to electrical engineering.</p>   |
| 2018 | <p>Expanding Your Horizons — Microcontroller Programming Workshop</p> <p>Led a workshop teaching 40 middle school students the basics of Intel 8051 assembly and microcontroller programming.</p> <p>Society for Women Engineers — “It’s Electrifying” Soldering Workshop</p> <p>Led a workshop where 30 middle school students assembled an electronics kit. Guided students through component assembly and making their first solder joints!</p> <p>Phelps County Master Gardeners — Earth Day Booth on Native Flora</p> <p>Assisted at a booth teaching college students about native flora, making biodegradable planters, and giving away native flora seedlings.</p>  |
| 2017 | <p>Expanding Your Horizons — Microcontroller Programming Workshop</p> <p>Led a workshop teaching 40 middle school students the basics of Intel 8051 assembly and microcontroller programming.</p> <p>Society for Women Engineers — “It’s Electrifying” Soldering Workshop</p> <p>Led a workshop where 30 middle school students assembled an electronics kit. Guided students through component assembly and making their first solder joints!</p> <p>ACM — Presentation on Linux Basics</p> <p>Presented an overview of Linux shell tools and shell scripting to 30 college students.</p> <p>EcoGirl — Presentation on Cyber-Physical Systems</p> <p>Presented to 35 high school students on my thesis project, cyber-physical system modeling, and what it is like to be a graduate student.</p> <p>Missouri S&amp;T Biological Sciences — Local Pollinator Conservation Project</p> <p>Assisted in preparing land and planting native flowering plants as part of a pollinator conservation project.</p> |

|      |  |
|------|--|
| 2016 | <p>Introduction to the Computer Science Department for Prospective Students</p> <p>Discussed the field of computer science, course offerings, and tips for new undergraduates to two groups totaling 80 high school seniors and their parents.</p> |
|------|--|

---

## SELECTED ORIGINAL PROJECTS IN ADDITION TO GRADUATE RESEARCH

---

|                                      |   |
|--------------------------------------|---|
| TOOLS FOR<br>PROGRAMMERS<br>textbook | <p>This lab textbook teaches computer science and engineering students practical computer and software engineering skills that empower them to understand what their software is doing and enable them to effectively use the tools at their disposal when programming. It serves as both an introduction to and a reference for topics including version control, debugging, and memory safety. Students leave this course prepared for industry work, challenging coursework, and personal projects.</p> <p><a href="https://learnyou.somecomputer">learnyou.somecomputer</a></p>                   |
| ASSIGNER<br>software                 | <p>This tool for instructors automates creating and managing git repositories for homework assignments. With just a few commands, instructors can create a repository complete with necessary files for an assignment, assign that homework to their students, collect submissions, and much more. Repositories are created using GitLab, giving students experience with industry-standard tools. It also integrates with the Canvas LMS, allowing instructors to sync their course roster and upload grades.</p> <p><a href="https://github.com/redkyn/assigner">github.com/redkyn/assigner</a></p> |
| HASHPIPE<br>software                 | <p>Hashpipe is an Internet Relay Chat client which is designed to be used with Unix pipes. It sets up the connection to the IRC server and offers both a simple user interface for sending messages to channels and receiving channel and private messages as well as a more advanced user interface providing access to the underlying protocol commands. It is an essential tool for conducting Serious Business with friends as well as automated IRC server management.</p> <p><a href="https://github.com/linuxmercedes/hashpipe">github.com/linuxmercedes/hashpipe</a></p>                      |
| SHREDDED<br>WHEAT<br>electronics     | <p>Serial that is high in fiber. A fiber-optic transceiver designed for transmitting serial UART signals in harsh EMI environments. These devices are low cost, EMI-robust, and capable of transmitting and receiving any binary signal between 0 and 50 megabaud. They have been tested to withstand, with appropriate shielding, a 135 kV/m field while communicating with an unshielded device exposed to the same field.</p> <p><a href="https://github.com/sendecomp/shredded-wheat">github.com/sendecomp/shredded-wheat</a></p>   |