Curriculum Vitae: Professor Hridesh Rajan

Kingland Professor and Chair, Department of Computer Science, Iowa State University (ISU)
With courtesy appointments in the Cybersecurity, Software Engineering and HCI Programs
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Professional Preparation & Appointments

Kingland Professor and Chair	ISU Dept of Computer Science	Fall 2019 - Present
Professor-In-Charge	ISU Data Science Program	2017 - 2019
Program Evaluator	ABET	2018 - Present
Visiting Faculty	University of Bristol	Fall 2018
Visiting Faculty	Harvard University	Fall 2017
Committee Chair	Graduate Admissions & Recruitment	2014 - 2019
Director	ISU Laboratory for Software Design	2006 - Present
Kingland Professor	Iowa State University	2016 - Present
Associate Professor	Iowa State University	2011 - 2016
Visiting Faculty	The University of Texas, Austin	Summer 2012
Assistant Professor	Iowa State University	2005 - 2011
Ph.D. Computer Science	The University of Virginia	2001 - 2005
M.S. Computer Science	The University of Virginia	2001 - 2004
Member of Technical Staff	Bell Labs, Lucent Technologies, India	2000 - 2001
B.Tech. Computer Sc. and Eng.	Indian Institute of Technology, Varanasi	1996 - 2000

Major Awards and Recognitions

- 2022 ISU Award for Early Achievement in Departmental Leadership
- 2020 American Association for the Advancement of Science (AAAS) Fellow
- 2020 Facebook Probability and Programming Award
- 2018-19 Fulbright U.S. Scholar
- 2017 ACM Distinguished Member
- 2016-17 Exemplary Mentor of Junior Faculty, Iowa State University
- 2016 Kingland Professorship
- 2016-17 Emerging Leaders Academy, a program to foster and enhance leadership development
- 2014 ACM Senior Member
- 2012 Big-12 Fellowship
- 2010 LAS Early Achievement in Research Award
- 2009 US National Science Foundation (NSF) CAREER Award
- Various best paper and distinguished paper awards

Accomplishments in Service and Leadership Roles

- Department Chair, Department of Computer Science (Sep 1, 2019 - Present). Interim Chair (Sep 1, 2019 - Oct 30, 2020). Responsible for the overall management of department including faculty and staff hiring with a commitment to faculty and staff success, department budget and space allocation, delivery and direction of the program, including curricular matters, continuous improvement and accreditation, teaching assignments, teaching assistantship support, student issues, management of the shared governance structures (e.g., faculty committees), and responsible stewardship of the financial and personnel resources. (938 CS Majors, 662 SE Majors, 240 Graduate Students, 41 faculty, 7 staff, general fund budget $7.19M, one-time funds $2.31M)

- **Initiated and facilitated the inclusive strategic planning process** (with M. Cohen), involving all stakeholders, resulting in a departmental strategic plan for 2022-2032.
- Led development of two **new degree programs and growth in existing programs**:
  - A Master's degree in Artificial Intelligence (with J. Tian)
  - A B.A. degree in Computer Science (with S. Chaudhuri and J. Lutz)
  - CS Graduate program grew by 39.3% (from 173 in fall 2019 to 240 in fall 2023).
  - CS B.S. program saw a 39.5% increase (from 672 in fall 2019 to 938 in fall 2023).
- Represented the department, the college, and the university on several international recruitment and yield trips, and the 2022 US-India Trade Mission by the US Dept. of State.
- Led **successful ABET re-accreditation of the CS B.S. program** in 2022, without any concerns, weaknesses or deficiencies, leveraging experience as an ABET program evaluator.
- Launched multiple **initiatives aimed at increasing quality and quantity of scholarship**:
  - *Fostered excellence in scholarship:* Introduced a publication award program to recognize and celebrate outstanding publications by graduate students, contributing to the CS department's publications-based ranking increase by 10 places.
  - *Facilitated interdisciplinary faculty collaboration:* Established a transdisciplinary initiative that awards a course release for faculty, enabling them to lead large teams and pursue ambitious, interdisciplinary research agendas. This initiative led to significant success, including a $3 million NSF Research Traineeship (NRT) grant. Guided a fivefold surge in proposal submission, from $10M in 2019 to $58M in 2022.
  - *Encouraged graduate research innovation:* Implemented an initiative that provides seed grants to graduate students and their advisors to lay the groundwork for strong proposals.
- Led **various diversity, equity, and inclusion initiatives**, prioritizing the following:
  - *Unified broadening participation in computing efforts:* Collaborated with W. Tavanapong and C. Quinn to develop a comprehensive Departmental Broadening Participation in Computing plan. This strategic framework focuses on boosting the number of domestic students earning computing degrees, particularly from underrepresented groups.
  - *Fostered inclusivity and representation:* Established a dynamic *Someone-like-me* campaign. Targeting underrepresented groups, especially females, this initiative aims to increase representation at both graduate and undergraduate levels. By creating and sharing inspiring success stories and role models, it fosters an inclusive environment.
- Collaborated with the ISU Foundation on several fund-raising initiatives leading to **643.3% increase in annual philanthropic commitments including scholarships, e.g.**:
  - Five new endowed scholarships for Women, Black, Indigenous, and People of Color (BIPOC). These include Thompson Scholarship, Nations Scholarship, Yi Scholarship, Sandve Scholarship, and Frank & Kay Troutner Memorial Scholarship.
  - Established Computer Science Chair Excellence fund to support initiatives that enhance students' academic experiences, and support faculty and staff professional development.
- **Leadership in faculty and staff development and recognition:**
  - *Strategically hired and integrated talent:* Hired thirteen new faculty members between 2019-2023, along with advocating for and filling four vital staff positions to support administrative and research functions such as growth of graduate program.
  - *Enhanced compensation and rewards:* Successfully negotiated performance-based raises for nine faculty (31%) and three staff (57%), recognizing and rewarding exceptional contributions, including spot awards for three staff members.

    - *Promoted recognition and professional development:* Created a proactive strategy to highlight both internal and external achievements of faculty and staff, and facilitated opportunities for professional growth, including Faculty Professional Development Assignments and nominations for awards.
    - *Facilitated academic advancements:* Spearheaded successful promotion and tenure cases, as well as mid-tenure and post-tenure reviews, and led two successful advancements from associate to teaching professorships.
    - *Improved departmental efficiency and impact*: Restructured committee assignments for enhanced outcomes and visibility, including the formation of a committee focused on Broadening Participation in Computing (BPC).
    - *Promoted continuous improvement:* Collaborated to establish an annual schedule for peer evaluations, encouraging a feedback-driven improvement process for all faculty.
    - *Nurtured emerging leaders:* Nominated three department members to the Emerging Leaders Academy (ELA), reinforcing a commitment to fostering leadership.
  - **Strategically engaged and communicated with key stakeholders:**
    - *Revitalized external advisory council:* Expanded the Departmental External Advisory Council to leverage insights from industry experts on AI, Data Science, and Healthcare.
    - *Strengthened community engagement:* Fostered connections with the Computing Research Association (CRA), including serving on its governance working group.
    - *Bridged academic and industry gap:* Initiated an industry lecture series, featuring speakers from leading tech companies and research institutions, to bring real-world insights into the department and provide networking opportunities.
    - *Showcased achievements:* Led the development of a departmental newsletter *Inside Atanasoff* to highlight alumni, students', faculty, and staff accomplishments.
    - *Enhanced online presence:* Redesigned the department's website to highlight the variety and volume of our achievements and streamline navigation.
    - *Developed marketing materials:* Created new marketing materials for the department, including highlights for the CRA. New materials include impact postcards highlighting student, faculty, and staff achievements, distributed to all CRA members.
  - **Initiated, raised funds for, and led facility development initiatives**:
    - *Fostered student collaboration:* Created open workspaces in the Computer Science building, enhancing student collaboration, fostering a sense of belonging, and directly contributing to student success.
    - *Supported interdisciplinary research:* Successfully proposed, funded, and constructed the Autonomy Lab to support research on autonomous systems. This initiative promoted faculty success by enabling cutting-edge research and strengthened industry partnerships, while enhancing the learning experience for students and prospects.
    - *Enhanced department environment:* Strategically improved the physical environment to foster collaboration, efficiency, and morale among faculty, staff, and students. This included dedicated renovated spaces for graduate program staff, faculty office remodels, and the addition of a new kitchenette, reflecting a strong commitment to the well-being and success of both faculty and staff.

- *Founding professor-in-charge, ISU Data Science (DS) Program (Aug 2017 - Oct 2019)*, an interdisciplinary undergraduate program managed by the LAS College.
  - Led the development of a B.S. degree, minor, and certificate in Data Science (with A. Hallam and S. Sundararajan)

  - *Program development and staff success:* Created and implemented the program (with A. Froelich), including hiring staff, negotiating budgets (including scholarships), and coordinating with various departments.
  - *Curriculum management:* Managed course scheduling, instructor assignments, evaluations, and chaired the DS curriculum committee meetings.
  - *Student success initiatives:* Established clear processes for curricular matters, such as course substitutions, transfer requests, major and minor approvals, and fostered student engagement through club (with A. Sukul) and learning communities (with P. Morton).
  - *Outreach and recruitment:* Led the development of marketing, advertising, and recruitment strategies, and collaborated with community colleges on transfer paths.

- *Leader, ISU Theoretical and Applied Data Science Initiative*: Spearheading this transdisciplinary, multi-institutional research initiative, I engaged over 30 investigators from diverse fields including Computer Science, Statistics, Mathematics, Bioinformatics, Electrical Engineering, Mechanical Engineering, Sociology, Journalism and Mass Communications, Philosophy, and Religious Studies to collaboratively work on the foundations of data science.

  - *Facilitating transdisciplinary collaboration*: Members of this initiative have collaboratively applied for several grants totaling over $26 Million, and received over $9 Million in funding.
  - *NSF TRIPODS Leadership*: Led a successful NSF TRIPODS (Transdisciplinary Research in Principles of Data Science) Phase I team for establishing a D4 (Dependable Data-Driven Discovery) Institute. TRIPODS brings together various communities to develop the theoretical foundations of data science.

- Founded and organized four editions of the Midwest Big Data Summer School, a five-day event focused on getting early career researchers started with Data Science. The 2019 edition of the summer school was attended by 175+ attendees from diverse groups. Over 600 early career researchers have been trained in Data Science.

- Chair, CS Graduate Admissions and Recruitment Committee (Jan 2014 - June 2019).

  - Substantially increased diversity and quality of the graduate student body. Recruited several students from under-represented groups, from underrepresented countries such as Nigeria, Kenya, Ethiopia, Eritrea, and top international institutions such as IITs, Tsinghua.
  - Increased graduate student body from 104 to 185 during my leadership.
  - Increased female students in the graduate program from around 10% to over 29%.

- *Chair, ISU Information Technology Committee (2015 - 2019)*: As the chair of this university-level committee, charged to represent faculty interests regarding IT, I helped interface between the faculty senate and the CIO on university enterprise information system transition to Workday cloud-based enterprise software.

- LAS At-large Faculty Senator (2014-2019), LAS Representative Assembly (2011-2017), and LAS Representative Assembly Executive Committee (2012-2015). Alongside the late Alison Morris and Paul Griffiths, we meticulously prepared a comparative report on faculty salaries within the college in 2012 for the Dean. Our findings and recommendations were presented to the Provost, which led to initiatives aimed at addressing notable salary inequalities, particularly within the Humanities and Social Sciences.

- Steering Committee Member, the NSF Midwest Big Data Hub (MBDH). I worked on advising the hub on sustainability and governance, and on providing program guidance.

- Led design and execution of the *first* Association of Computing Machinery (ACM) hybrid conference, SPLASH 2021. This conference was organized both as a physical event in Chicago, IL and virtually. The hybrid conference was attended by over 800 participants. The conference combined virtual in-person Q&A sessions and introduced innovative features such as hybrid coffee breaks, a mirrored schedule for geographic inclusion, and time bands in the program.

- Served the community via the following leadership roles: General Chair *SPLASH 2021*; General Chair *SPLASH 2020*; Founder and Co-organizer of *VMIL 2007-17* workshop on virtual machines and intermediate languages; Program committee (PC) Chair for JVA Symposium 2023; PC Co-Chair of the *SETA Symposium of COMPSAC 2017*; PC Co-Chair of the *SETA Symposium 2016*; PC Chair *FOAL 2011*; Doctoral Symposium Chair *FSE 2018*; and *SPLASH 2012*.

Accomplishments in Research

- Foundational research in Data Science, Software Engineering and Programming Languages that has appeared at top-tier conferences and journals and also has had widespread impact.

  – Founded and led the **Boa** project that aims to democratize large scale data analysis through a domain specific language and cyberinfrastructure co-design, see: `https://boa.cs.iastate.edu`. Since its inauguration in May 2013, 1000+ researchers from over 35+ countries are registered to use Boa, who have published 48+ papers.

- Over 125 articles and papers, including 68 papers in highly-selective conference proceedings, and one textbook. Disseminated eight software systems, and gave 30 invited talks.

- Secured $8,925,220 in the form of 15 grants as the principal investigator (PI). 7 are NSF grants, one is a CAREER Award, and one is an HDR: TRIPODS Institute grant. Additionally, helped secure $5,325,349 with 4 NSF grants as a Co-PI. Also, secured $524,467 in internal grants as either the PI or a Co-PI.

Accomplishments in Training, Teaching, and Curriculum Development

- Led development, and approval of five new degree programs at Iowa State University: MS in Artificial Intelligence, B.A. in Computer Science, a Data Science (DS) Minor, a DS Certificate, and a DS B.S. Degree. Responsibilities included: developing consensus; organizing obtaining and acting on university-wide feedback; developing the program proposals with early and frequent feedback; presenting the program to university bodies; and helping negotiate program governance. Also, co-designed and co-developed four new core courses for these programs.

- Developed and revised a new pedagogy and a textbook draft to teach programming languages and functional programming to students who start in Computer Science programs that teach an imperative language such as Java that led to 20+% improvement in the student success rate.

  – The textbook appeared as: Hridesh Rajan, "An Experiential Introduction to Principles of Programming Languages," MIT Press, Cambridge, MA, pp. 304, May 2022.

- Contributed (or currently contributing) to the research-based training of a diverse body of 29 graduate students and over 45 undergraduate students between 2005-present.

1 Research and Educational Grants

1. Hridesh Rajan (PI), SHF:Small: More Modular Deep Learning, US National Science Foundation (NSF), 2022 - 2025, $580,000.

2. Wallapak Tavanapong (PI), Surya K Mallapragada (Co-PI), Daniel S Nettleton (Co-PI), Eric Weber (Co-PI), and Hridesh Rajan (Co-PI), NRT: Dependable Data Driven Discovery, US National Science Foundation (NSF), 2022 - 2027, $2,998,973.

3. Hridesh Rajan (PI), Brian Nosek (Co-PI) and Tien N. Nguyen (Co-PI), CI-EN: Boa: A Collaboratory for Studying Software and its Evolution at a Large Scale, US National Science Foundation (NSF) 2021 - 2024, $1,499,999. (ISU and PI's Share: $824,474)

4. Daniel Linhares (PI), Edison Magalhaes (Co-PI), Giovani Trevisan (Co-PI), Gustavo De-Sousa-E-Silva (Co-PI), Chong Wang (Co-PI), Derald J Hiltkamp (Co-PI), Jason W Ross (Co-PI), and Hridesh Rajan (Co-PI), Integrating Data Streams For Causal Inference And Forecasting Application To Foster Precision Swine Health & Production Management, USDA National Institute of Food and Agriculture (NIFA), 2022 - 2025, $998,162.

5. Hridesh Rajan (PI), Pavankumar Aduri (Co-I, Computer Science), Chinmay Hegde (Co-I, Electrical and Computer Engineering), Daniel Nettleton (Co-I, Statistics), Eric Weber (Co-I, Mathematics), Michael J Catanzaro (Senior Personnel, Mathematics), Namrata Vaswani (Senior Personnel, Electrical and Computer Engineering), Vinodchandran Variyam (Senior Personnel, Computer Science), Li Wang (Senior Personnel, Statistics), Zhengyuan Zhu (Senior

Personnel, Statistics), HDR: TRIPODS: D4 (Dependable Data Driven Discovery) Institute, US National Science Foundation (NSF) 2019 - 2022, $1,499,994.

   (a) REU supplement: $32,000 for research experiences for undergraduates (awarded 2020),

6. Hridesh Rajan (PI), Robert Dyer (Co-PI) and Tien N. Nguyen (Co-PI), CI-EN: Boa: A Collaboratory for Studying Software and its Evolution at a Large Scale, US National Science Foundation (NSF) 2015 - 2021, $1,426,917.

7. Hridesh Rajan (PI), Manas: Big Code Assisted Neural Architecture Search, Facebook Probability and Programming Award 2020, $58,918.

8. Hridesh Rajan (PI), Jan Lauren Boyles (Co-PI, Greenlee School of Journalism and Communication), Gianfranco Ciardo (Co-PI, Computer Science), Heike Hofmann (Co-PI, Statistics), Stephen D. Holland (Co-PI, Aerospace Engineering), Matthew Hufford (Co-PI, Ecology, Evolution, and Organismal Biology), Glenn R. Luecke (Co-PI, Mathematics), Tien N. Nguyen (Co-PI, Electrical and Computer Engineering), James M. Reecy (Co-PI, Animal Science), Andrew Severin (Co-PI, Office of Biotechnology), Anuj Sharma (Co-PI, Civil, Construction, and Environment Engineering), Jin Tian (Co-PI, Computer Science), and Christopher K. Tuggle (Co-PI, Animal Science), Bridging the Digital Divide in Data Science: Invention and Refinement of Shared Data Science Infrastructures, the ISU Office of the Vice President for Research (VPR) 2016-2019, $450,000.

9. Hridesh Rajan (PI), Robert Dyer (Co-PI), Vasant Honavar (Co-PI), Gary T. Leavens (Co-PI), and Tien N. Nguyen (Co-PI), SHF: LARGE: Collaborative Research: Inferring Software Specifications from Open Source Repositories by Leveraging Data and Collective Community Expertise, US National Science Foundation (NSF) 2015 - 2019, $1,604,843.

10. Arun Somani (PI), Carolyn Lawrence-Dill (Co-PI), Hridesh Rajan (Co-PI), Baskar Ganapathysubramanian (Co-PI), and Alberto Passalacqua (Co-PI), MRI: Acquisition of a HPC System: Computing for Sustainability, US National Science Foundation (NSF) 2017 - 2019, $678,214.

11. Hridesh Rajan (PI), SHF:Small:Capsule-oriented Programming, US National Science Foundation (NSF) 2014 - 2019, $450,098.

12. Hridesh Rajan (PI), NSF CAREER Award: On Mutualism of Modularity and Concurrency. US National Science Foundation (NSF) (2009-2016) $425,000.

    (a) REU supplement: $15,996 for research experiences for undergraduates (awarded 5/2013),
    (b) REU supplement: $16,000 for research experiences for undergraduates (awarded 07/2012),
    (c) REU supplement: $16,000 for research experiences for undergraduates (awarded 11/2010),
    (d) REU supplement: $16,000 for research experiences for undergraduates (awarded 07/2009),
    (e) Equipment supplement: $20,573 for developing multicore infrastructure (awarded 09/2009),
    (f) Postdoctoral supplement: $40,366 for partial support for a postdoctoral fellow (awarded 02/2010).

13. Hridesh Rajan (PI), SHF:Small:Phase-Based Tuning for Better Utilization of Performance-Asymmetric Multicores, US National Science Foundation (NSF) 2011 - 2016, $416,000.

14. Hridesh Rajan (PI), Travel Grant to Attend Big Data in Software Engineering Track at the 2017 Midwest Big Data Summer School. US National Science Foundation (NSF) (2016-2017) $10,880.

15. Hridesh Rajan (PI), A Cloud-based Prototype of Boa (Amazon), 2016-2017, $40,000.

16. Hridesh Rajan (PI) and Pavan Aduri (Co-PI), A Proposal to Organize the Inaugural Midwest Big Data Summer School, NSF Midwest Big Data Hub (MBDH), May 2016 - Aug 2016, $20,000.

17. Hridesh Rajan (PI), Supplement Funds to Organize the Inaugural Midwest Big Data Summer School, ISU Office of the Vice President of Research, May 2016 - Aug 2016, $20,000.

18. Hridesh Rajan (PI) and Tien N. Nguyen (Co-PI), EAGER: Boa: A Community Research Infrastructure for Mining Software Repositories. US National Science Foundation (NSF) (2013-2015) $96,408.

19. Hridesh Rajan (PI), SHF:Small:Collaborative Research: Balancing Expressiveness and Modular Reasoning for Aspect-oriented Programming, US National Science Foundation (NSF) (2010 - 2013), $257,229.

    (a) REU supplement: $16,000 for research experiences for undergraduates (REU) (awarded 04/2011)

20. Hridesh Rajan (PI), Big-12 Faculty Fellowship. ISU Office of the Executive Vice President and Provost (2012-2012) $2,500.

21. Gary T. Leavens (PI), Hridesh Rajan (Co-PI), and Samik Basu (Co-PI), Collaborative Research: A JML Community Infrastructure – Revitalizing Tools and Documentation to Aid Formal Methods Research. US National Science Foundation (NSF) (2007-2010) $650,000.

22. Hridesh Rajan (PI) and Wensheng Zhang (Co-PI), CT-ISG: Specification and Verification Challenges for Security Protocols in Sensor Networks. US National Science Foundation (NSF) (2007-2010) $349,999.

    (a) REU supplement: $16,000 for research experiences for undergraduates (REU) (awarded 06/2009)

23. Morris Chang (PI) and Hridesh Rajan (Co-PI), Exploiting Managed Runtime Environment for Multicore Systems. The Information Infrastructure Institute (iCUBE), Iowa State University (2010) $25,000.

24. Hridesh Rajan (PI), Bootstrapping Trust in Service Oriented Architecture. NSF I/U CRC Center for Information Protection (2007-2007) $21,000.

25. Hridesh Rajan (PI), Alfred Mueller Summer Research Grant for Undergraduate Honors Research. University Honors Program (2006-2006) $1,000.

26. Hridesh Rajan (PI), Preparing Information Technology Undergraduates for Cross-cultural Work Environments. ISU's Council on International Programs (2006-2006) $4,967.

Funding summary: Secured a total of $8,925,220 through 15 grants as the principal investigator (PI). Out of these 7 are regular NSF grants, one is a CAREER Award, one is an HDR: TRIPODS institute grant. Additionally, as a Co-PI, I contributed to securing $5,325,349 through 4 NSF grants. Also, secured $524,467 in 7 internal grants as either the PI or a Co-PI.

2 Scholarly Products: Publications, Talks, and Software

2.1 Textbooks

1. Hridesh Rajan, "An Experiential Introduction to Principles of Programming Languages," MIT Press, Cambridge, MA, ISBN: 9780262045452, pp. 304, May 2022.

2.2 Highly Selective Refereed Publications

2.

3. Shibbir Ahmed, Sayem Imtiaz, Samantha Khairunnesa, Breno Cruz and Hridesh Rajan, "Design by Contract for Deep Learning APIs," ESEC/FSE'2023: The 31st ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering, December, 2023.

4. Giang Nguyen, Sumon Biswas and Hridesh Rajan, "Fix Fairness, Don't Ruin Accuracy: Performance Aware Fairness Repair using AutoML," ESEC/FSE'2023: The 31st ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering, December, 2023.

5. Ali Ghanbari, Deepak-George Thomas, Muhammad Arbab Arshad and Hridesh Rajan, "Mutation-based Fault Localization of Deep Neural Networks," ASE'23: The 38th International Conference on Automated Software Engineering, September, 2023. (**ACM Distinguished Paper Award**).

6. Sumon Biswas and Hridesh Rajan, "Fairify: Fairness Verification of Neural Networks," ICSE'23: The 45th International Conference on Software Engineering, May, 2023.

7. Sayem Mohammad Imtiaz, Fraol Batole, Astha Singh, Rangeet Pan, Breno Dantas Cruz, and Hridesh Rajan, "Decomposing a Recurrent Neural Network into Modules for Enabling Reusability and Replacement," ICSE'23: The 45th International Conference on Software Engineering, May, 2023.

8. Usman Gohar, Sumon Biswas, and Hridesh Rajan, "Towards Understanding Fairness and its Composition in Ensemble Machine Learning," ICSE'23: The 45th International Conference on Software Engineering, May, 2023.

9. David OBrien, Sumon Biswas, Sayem Mohammad Imtiaz, Rabe Abdalkareem, Emad Shihab, and Hridesh Rajan, "23 Shades of Self-Admitted Technical Debt: An Empirical Study on Machine Learning Software," ESEC/FSE'2022: The 30th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering, November, 2022.

10. Rangeet Pan and Hridesh Rajan, "Decomposing Convolutional Neural Networks into Reusable and Replaceable Modules," ICSE'22: The 44th International Conference on Software Engineering, May, 2022.

11. Giang Nguyen, Md. Johirul Islam, Rangeet Pan and Hridesh Rajan, "Manas: Mining Software Repositories to Assist AutoML," ICSE'22: The 44th International Conference on Software Engineering, May, 2022.

12. Sumon Biswas, Mohammad Wardat and Hridesh Rajan, "The Art and Practice of Data Science Pipelines: A Comprehensive Study of Data Science Pipelines In Theory, In-The-Small, and In-The-Large," ICSE'22: The 44th International Conference on Software Engineering, May, 2022.

13. Mohammad Wardat, Breno Cruz, Wei Le and Hridesh Rajan, "DeepDiagnosis: Automatically Diagnosing Faults and Recommending Actionable Fixes in Deep Learning Programs," ICSE'22: The 44th International Conference on Software Engineering, May, 2022.

14. Menglu Yu, Bo Ji, Hridesh Rajan, and Jia Liu, "On Scheduling Ring-All-Reduce Learning Jobs in Multi-Tenant GPU Clusters with Communication Contention," MobiHoc'22: International Symposium on Theory, Algorithmic Foundations, and Protocol Design for Mobile Networks and Mobile Computing, Oct, 2022.

15. Tianxiang Gao, Hailiang Liu, Jia Liu, Hridesh Rajan, and Hongyang Gao, "A Global Convergence Theory for Deep ReLU Implicit Networks via Over-Parameterization," ICLR'22: The 10th International Conference on Learning Representations, April, 2022.

16. Menglu Yu, Ye Tian, Bo Ji, Chuan Wu, Hridesh Rajan, and Jia Liu, "GADGET: Online Resource Optimization for Scheduling Ring-All-Reduce Learning Jobs," INFOCOM'22: IEEE International Conference on Computer Communications, May 2022.

17. Sumon Biswas and Hridesh Rajan, "Fair Preprocessing: Towards Understanding Compositional Fairness of Data Transformers in Machine Learning Pipeline," ESEC/FSE'2021: The 29th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering, August, 2021.

18. Mohammad Wardat, Wei Le, and Hridesh Rajan, "DeepLocalize: Fault Localization for Deep Neural Networks," ICSE'21: The 43rd International Conference on Software Engineering, May, 2021.

19. Rangeet Pan and Hridesh Rajan, "On Decomposing a Deep Neural Network into Modules," ESEC/FSE'2020: The 28th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering, November, 2020 (**ACM Distinguished Paper Award**).

20. Sumon Biswas and Hridesh Rajan, "Do the Machine Learning Models on a Crowd Sourced Platform Exhibit Bias? An Empirical Study on Model Fairness," ESEC/FSE'2020: The 28th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering, November, 2020.

21. Md Johirul Islam, Rangeet Pan, Giang Nguyen, and Hridesh Rajan, "Repairing Deep Neural Networks: Fix Patterns and Challenges," ICSE'20: The 42nd International Conference on Software Engineering, May, 2020.

22. Ramanathan Ramu, Ganesha Upadhyaya, Hoan Nguyen, and Hridesh Rajan, "BCFA: Bespoke Control Flow Analysis for CFA at Scale," ICSE'20: The 42nd International Conference on Software Engineering, May, 2020.

23. Md Johirul Islam, Giang Nguyen, Rangeet Pan, and Hridesh Rajan, "A Comprehensive Study on Deep Learning Bug Characteristics," ESEC/FSE'19: The ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (ESEC/FSE), August, 2019.

24. Jackson Maddox, Yuheng Long, and Hridesh Rajan, "Large-scale Study of Substitutability in the Presence of Effects," ESEC/FSE'18: The ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (ESEC/FSE), Nov. 2018.

25. Ganesha Upadhyaya and Hridesh Rajan, "Collective Program Analysis," ICSE'18: The 40th International Conference on Software Engineering, Gothenberg, Sweden, May 27-June 3, 2018.

26. Tianyi Zhang, Ganesha Upadhyaya, Anastasia Reinhardt, Hridesh Rajan and Miryung Kim, "Are Code Examples on an Online Q&A Forum Reliable? A Study of API Misuse on Stack Overflow," ICSE'18: The 40th International Conference on Software Engineering, Gothenberg, Sweden, May 27-June 3, 2018.

27. Samantha Khairunnessa, Hoan Nguyen, Tien Nguyen and Hridesh Rajan, "Exploiting Implicit Beliefs to Resolve Sparse Usage Problem in Usage-based Specification Mining," SPLASH / OOPSLA'17: The ACM SIGPLAN conference on Object Oriented Programming, Systems, Languages, and Applications, Vancouver, Canada, October 2017.

28. Hridesh Rajan, "Bridging the Digital Divide in Data Science," SPLASH/SPLASH-I'17: The ACM SIGPLAN conference on Systems, Programming, Languages and Applications: Software for Humanity, Vancouver, Canada, October 2017.

29. Ganesha Upadhyaya and Hridesh Rajan, "On Accelerating Ultra-Large-Scale Mining," ICSE'17: The 39th International Conference on Software Engineering: NIER Track, Buenos Aires, Argentina, May 20-28, 2017.

30. Hung Phan, Hoan Nguyen, Tien Nguyen and Hridesh Rajan, "Statistical Learning for Inference between Implementations and Documentation," ICSE'17: The 39th International Conference on Software Engineering: NIER Track, Buenos Aires, Argentina, May 20-28, 2017.

31. Nitin M Tiwari, Ganesha Upadhyaya, Hoan Nguyen and Hridesh Rajan, "Candoia: A Platform for Building and Sharing Mining Software Repositories Tools as Apps," MSR'17: The International Conference on Mining Software Repositories, Buenos Aires, Argentina, May 20-22, 2017. (**Previously received Distinguished Poster Award at ICSE 2016**)

32. Yuheng Long, Yu David Liu, and Hridesh Rajan, "First-Class Effect Reflection for Effect-Guided Programming," SPLASH/OOPSLA'16: the ACM SIGPLAN conference on Object Oriented Programming, Systems, Languages, and Applications, Amsterdam, Netherlands, October 2016.

33. Gary T. Leavens, David Naumann, Hridesh Rajan and Tomoyuki Aotani, "Specifying and Verifying Advanced Control Features," IsoLA'16: 7th International Symposium On Leveraging Applications of Formal Methods, Verification and Validation, Imperial, Corfu, Greece, October 2016.

34. Yuheng Long, Mehdi Bagherzadeh, Eric Lin, Ganesha Upadhyaya, and Hridesh Rajan, "On Ordering Problems in Message Passing Software," MODULARITY'16: 15th International Conference on Modularity, Malaga, Spain, March 2016.

35. Yuheng Long, and Hridesh Rajan, "A Type-and-Effect System for Asynchronous, Typed Events," MODULARITY'16: 15th International Conference on Modularity, Malaga, Spain, March 2016.

36. Ganesha Upadhyaya and Hridesh Rajan, "Effectively Mapping Linguistic Abstractions for Message-passing Concurrency to Threads on the Java Virtual Machine," SPLASH/OOPSLA'15: the ACM SIGPLAN conference on Object Oriented Programming, Systems, Languages, and Applications, Pittsburgh, PA, October 2015.

37. Yuheng Long, Yu David Liu, and Hridesh Rajan, "Intensional Effect Polymorphism," ECOOP'15: The European Conference on Object-Oriented Programming, Prague, Czech Republic, July 2015.

38. Hridesh Rajan, "Capsule-oriented Programming," ICSE'15: The 37th International Conference on Software Engineering: NIER Track, Florence, Italy, May 2015.

39. Hridesh Rajan, Tien N. Nguyen, Gary T. Leavens, and Robert Dyer, "Inferring Behavioral Specifications from Large-scale Repositories by Leveraging Collective Intelligence," ICSE'15: The 37th International Conference on Software Engineering: NIER Track, Florence, Italy, May 2015.

40. Mehdi Bagherzadeh and Hridesh Rajan, "Panini: A Concurrent Programming Model for Solving Pervasive and Oblivious Interference," MODULARITY'15: The 12th International Conference on Modularity, Fort Collins, Colorado, USA, March 2015. (**Best Papers of Modularity**)

41. Mehdi Bagherzadeh, Robert Dyer, Rex D. Fernando, José Sánchez, and Hridesh Rajan, "Modular Reasoning in the Presence of Event Subtyping," MODULARITY'15: 12th International Conference on Modularity, Fort Collins, Colorado, USA, March 2015. (**Best Papers of Modularity**)

42. Hoan Nguyen, Robert Dyer, Tien N. Nguyen, and Hridesh Rajan, "Mining Preconditions of APIs in Large-scale Code Corpus," FSE'14: The 22nd International Symposium on Foundations of Software Engineering, Hong Kong, November 2014.

43. Robert Dyer, Hridesh Rajan, Hoan Nguyen, and Tien N. Nguyen, "Mining Billions of AST Nodes to Study Actual and Potential Usage of Java Language Features," ICSE'14: The 36th International Conference on Software Engineering, Hyderabad, India, June 2014.

44. Henrique Rebelo, Gary T. Leavens, Mehdi Bagherzadeh, Hridesh Rajan, Ricardo Massa Lima, Daniel Zimmerman, Marcio Cornelio and Thumas Thum, "AspectJML: Modular Specfication and Runtime Checking for Crosscutting Contracts," MODULARITY'14: The 13th International Conference on Modularity, Lugano, Switzerland, April 2014.

45. Hoan Nguyen, Anh Tuan Nguyen, Tung Thanh Nguyen, Tien N. Nguyen, and Hridesh Rajan, "A Study of Repetitiveness of Code Changes in Software Evolution," ASE'13: The 28th International Conference on Automated Software Engineering, Silicon Valley, CA, November 2013.

46. Robert Dyer, Hridesh Rajan and Tien N. Nguyen, "Declarative Visitors to Ease Fine-grained Source Code Mining with Full History on Billions of AST Nodes," GPCE'13: The 12th International Conference on Generative Programming: Concepts & Experiences, Indianapolis, IN, October 2013.

47. Robert Dyer, Hoan Nguyen, Hridesh Rajan and Tien N. Nguyen, "Boa: A Language and Infrastructure for Analyzing Ultra-Large-Scale Software Repositories," ICSE'13: The 35th International Conference on Software Engineering, San Francisco, CA, May 2013.

48. Mehdi Bagherzadeh, Hridesh Rajan and Ali Darvish, “On Exceptions, Events and Observer Chains," AOSD’13: The 12th International Conference on Aspect-Oriented Software Development, Fukuoka, Japan, March 2013.

49. Robert Dyer, Hridesh Rajan and Yuanfang Cai, “An Exploratory Study of the Design Impact of Language Features for Aspect-oriented Interfaces,” AOSD’12: The 11th International Conference on Aspect-Oriented Software Development, Potsdam, Germany, March 2012.

50. Bashar Gharaibeh, Hridesh Rajan and J. Morris Chang, “Analyzing Software Updates: Should You Build a Dynamic Updating Infrastructure?,” FASE’11: The 2011 Conference on Fundamental Approaches to Software Engineering, Germany, March-April 2011.

51. Tyler Sondag and Hridesh Rajan, “Phase-based Tuning for Better Utilization of Performance-Asymmetric Multicore Processors,” CGO’11: The International Symposium on Code Generation and Optimization, Chamonix, France, April 2011.

52. Mehdi Bagherzadeh, Hridesh Rajan, Gary T. Leavens and Sean Mooney, “Translucid Contracts: Expressive Specification and Modular Verification for Aspect-Oriented Interfaces,” AOSD’11: The 10th International Conference on Aspect-Oriented Software Development, Porto de Galinhas, Brazil, March 2011.

53. Hridesh Rajan, Steven M. Kautz, and Wayne Rowcliffe, “Concurrency by Modularity: Design Patterns, a Case in Point,” OOPSLA/Onward’10: the OOPSLA/SPLASH Onward! Conference, October 17-21, 2010, Reno-Tahoe, USA.

54. Yuheng Long, Sean Mooney, Tyler Sondag and Hridesh Rajan, “Implicit Invocation Meets Safe, Implicit Concurrency,” GPCE’10: The Ninth International Conference on Generative Programming and Component Engineering, October 2010, Eindhoven, The Netherlands.

55. Tyler Sondag and Hridesh Rajan, “A More Precise Abstract Domain For Multi-level Caches for Tighter WCET Analysis,” RTSS ’10: The 31st IEEE Real Time Systems Symposium, November 2010.

56. Youssef Hanna, David Samuelson, Samik Basu and Hridesh Rajan, “Automating Cut-off for Multi-parameterized Systems,” ICFEM ’10: The 12th International Conference on Formal Engineering Methods, Shanghai, China, November 2010.

57. Tyler Sondag, Kian L. Pokorny, and Hridesh Rajan (2010) “Frances: A Tool For Understanding Code Generation,” SIGCSE ’10: The 41st ACM Technical Symposium on Computer Science Education, March 2010, Milwaukee, WI, USA.

58. Youssef Hanna, Samik Basu, and Hridesh Rajan, “Behavioral Automata Composition for Automatic Topology Independent Verification of Parameterized Systems,” ESEC/FSE’09: The 7th joint meeting of the European Software Engineering Conference and the ACM SIGSOFT Symposium on the Foundations of Software Engineering, August 2009, Amsterdam, The Netherlands.

59. Hridesh Rajan, Jia Tao, Steve Shaner, and Gary T. Leavens, “Tisa: A Language Design and Modular Verification Technique for Temporal Policies in Web Services," ESOP’09: The 18th European Symposium on Programming, March 2009, York, UK.

60. Hridesh Rajan and Gary T. Leavens, “Ptolemy: A Language with Quantified, Typed Events,” ECOOP’08: The 22nd European Conference on Object-Oriented Programming, July 2008, Paphos, Cyprus.

61. Robert Dyer and Hridesh Rajan, "Nu: a Dynamic Aspect-Oriented Intermediate Language Model and Virtual Machine for Flexible Runtime Adaptation," AOSD'08: The 7th International Conference on Aspect-oriented Software Development, March 31 - April 4, 2008, pp. 191-202, Brussels, Belgium.

62. Youssef Hanna, Hridesh Rajan, and Wensheng Zhang, "Slede: A Domain-Specific Verification Framework for Sensor Network Security Protocol Implementations," WiSec'08: The ACM Conference on Wireless Network Security, March 31 - April 2, 2008, Alexandria, Virginia, USA.

63. Mahantesh Hosamani, Harish Narayanappa, and Hridesh Rajan, "How to Trust Web Services Monitor Executing in an Untrusted Environment?" NWeSP '07: The 3rd International Conference on Next Generation Web Services Practices, October 2007, Seoul, Korea.

64. Hridesh Rajan (2007) "Design Patterns in Eos," PLoP '07: The Conference on Pattern Languages of Programs, September 2007, Monticello, IL, USA.

65. Kevin Sullivan, William Griswold, Yuanyuan Song, Yuanfang Cai, Macneil Shonle, Nishit Tewari, Hridesh Rajan, "Information Hiding Interfaces for Aspect-Oriented Design," ESEC / FSE'05: The Joint 10th European Software Engineering Conference and 13th ACM SIGSOFT Symposium on the Foundations of Software Engineering, 5-9 Sept 2005, Lisbon, Portugal.

66. Hridesh Rajan and Kevin Sullivan, "Classpects: Unifying Aspect- and Object-Oriented Language Design," ICSE'05: The 27th International Conference on Software Engineering, 15-21 May 2005, St. Louis, Missouri, USA.

67. Hridesh Rajan and Kevin Sullivan, "Aspect Language Features for Concern Coverage Profiling," AOSD'05: The Fourth International Conference on Aspect-Oriented Software Development, 14-18 March, 2005, Chicago, IL, USA.

68. Jia Xu, Hridesh Rajan and Kevin Sullivan, "Understanding Aspects via Implicit Invocation," ASE'04: The 19th IEEE International Conference on Automated Software Engineering, September 2004, Linz, Austria. Society.

69. Hridesh Rajan and Kevin Sullivan, "Eos: Instance-Level Aspects for Integrated System Design," ESEC/FSE'03: The 2003 Joint European Software Engineering Conference and ACM SIGSOFT Symposium on the Foundations of Software Engineering, September 2003, Helsinki, Finland.

2.3 Book Chapters and Refereed Journal Articles

70. Samantha Syeda Khairunnesa, Shibbir Ahmed, Sayem Mohammad Imtiaz, Hridesh Rajan, and Gary T. Leavens, "What Kinds of Contracts Do ML APIs Need?," Empirical Software Engineering Journal, To Appear, (2023).

71. Shibbir Ahmed, Md Johirul Islam, and Hridesh Rajan, "Semantics and Anomaly Preserving Sampling Strategy for Large-Scale Time Series Data," ACM/IMS Transactions on Data Science, January, 2022. ACM/IMS Transactions on Data Science, Volume 2, Issue 4, pp 1-–25, March 2022, ACM Press.

72. Hamid Bagheri, Usha Muppirala, Andrew J Severin, Hridesh Rajan, "Shared Data Science Infrastructure for Genomics Data," BMC Bioinformatics 20, Article number: 436, August 2019, Springer.

73. Md Johirul Islam, Anuj Sharma, Hridesh Rajan, “A Cyberinfrastructure for BigData Transportation Engineering,” Journal of Big Data Analytics in Transportation, Volume 1 (1), pp 83–94, June 2019.

74. Ganesha Upadhyaya and Hridesh Rajan, “On Accelerating Source Code Analysis At Massive Scale,” IEEE Transactions on Software Engineering, Volume 44 (7), pp. 669-688, July 2018, IEEE Press.

75. Mehdi Bagherzadeh, Robert Dyer, Rex D. Fernando, José Sánchez, and Hridesh Rajan, “Modular Reasoning in the Presence of Event Subtyping,” Trans. Modularity and Composition 1: 167-223, 2016, Springer LNCS.

76. Robert Dyer, Hoan Anh Nguyen, Hridesh Rajan and Tien N. Nguyen, “Boa: Ultra-Large-Scale Software Repository and Source Code Mining,” ACM Transactions on Software Engineering and Methodology (TOSEM) Volume 25 (1), 7:1-7:34, December 2015, ACM Press.

77. Robert Dyer, Hoan Anh Nguyen, Hridesh Rajan and Tien N. Nguyen, “Boa: an Enabling Language and Infrastructure for Ultra-large Scale MSR Studies,” Book Chapter in The Art and Science of Analyzing Software Data, Morgan-Kaufmann, 2015.

78. Robert Dyer, Hridesh Rajan and Yuanfang Cai, “Language Features for Software Evolution and Aspect-oriented Interfaces: An Exploratory Study," Transactions on Aspect-Oriented Software Development (TAOSD), special edition: Best papers of AOSD’12, Volume 10, April 2013, pp. 148-183, Springer LNCS.

79. Tyler Sondag, Kian Pokorny, and Hridesh Rajan, “Frances: A Tool For Understanding Computer Architecture and Assembly Language," ACM Transactions on Computing Education (TOCE), Volume 12 (4), November 2012, pp. 14:1–14:31, ACM Press.

80. Robert Dyer and Hridesh Rajan, “Supporting Dynamic Aspect-oriented Features," ACM Transactions on Software Engineering and Methodology (TOSEM) Volume 20 (2), August 2010, pp. 7:1–7:34, ACM Press.

81. Kevin Sullivan, William Griswold, Hridesh Rajan, Yuanyuan Song, Yuanfang Cai, Macneil Shonle, Nishit Tewari, “Modular Aspect-Oriented Design with XPIs," ACM Transactions on Software Engineering and Methodology (TOSEM), Volume 20 (2), August 2010, pp. 5:1–5:42, ACM Press.

82. Hridesh Rajan and Kevin J. Sullivan, “Unifying Aspect- and Object-Oriented Design for Improved Separation of Integration and Higher-order Crosscutting Concerns," ACM Transactions on Software Engineering and Methodology (TOSEM), Volume 19 (1), August 2009, pp. 3:1–3:41, ACM Press.

83. Hridesh Rajan and Mahantesh Hosamani, “Tisa: Towards Trustworthy Services in a Service-oriented Architecture," IEEE Transactions on Service Computing, Volume 1 (4), Dec 2008, pp. 201 - 213, IEEE Press.

84. William Griswold, Kevin Sullivan, Yuanyuan Song, Macneil Shonle, Nishit Tewari, Yuanfang Cai, Hridesh Rajan, “Modular Software Design with Crosscutting Interfaces," IEEE Software, Special Issue on Aspect-Oriented Programming, Volume 23 (1), Jan/Feb 2006, pp. 51-60, IEEE Press.

2.4 Other Refereed Conference/Workshop Publications

85. Sumon Biswas, Md Johirul Islam, Yijia Huang and Hridesh Rajan, "Boa Meets Python: A Boa Dataset of Data Science Software in Python Language," Mining Software Repositories Conference (MSR), Montreal, Canada, May 2019.

86. Mehdi Bagherzadeh and Hridesh Rajan, "Order Types: Static Reasoning about Message Races in Asynchronous Message Passing Concurrency," AGERE'17: The 7th International Workshop on Programming based on Actors, Agents, and Decentralized Control, October 2017, Vancouver, Canada.

87. Ganesha Upadhyaya, and Hridesh Rajan, "An Automatic Actors to Threads Mapping Technique for JVM-Based Actor Frameworks," AGERE'14: The 4th International Workshop on Programming based on Actors Agents & Decentralized Control, October 2014, Portland, Oregon, USA.

88. Rex Fernando, Robert Dyer, and Hridesh Rajan, "Event Type Polymorphism," FOAL'12: The Foundations of Aspect-Oriented Languages workshop, March 2012, Potsdam, Germany.

89. Hridesh Rajan, "Building Scalable Software Systems in the Multicore Era," FOSER'10: The FSE/SDP Workshop on the Future of Software Engineering, November 2010, Santa Fe, NM, USA.

90. Harish Narayanappa, Mukul S. Bansal, and Hridesh Rajan, "Property-Aware Program Sampling," PASTE '10: The 9th ACM SIGPLAN-SIGSOFT Workshop on Program Analysis for Software Tools and Engineering, June 2010, Toronto, Canada.

91. Robert Dyer, Mehdi Bagherzadeh, Hridesh Rajan and Yuanfang Cai, "A Preliminary Study of Quantified, Typed Events," ESCOT'10: The Empirical Evaluation of Software Composition Techniques, March 2010, Rennes and St. Malo, France.

92. Mehdi Bagherzadeh, Hridesh Rajan, and Gary T. Leavens, "Translucid Contracts for Aspect-oriented Interfaces," FOAL'10: The Foundations of Aspect-Oriented Languages workshop, March 2010, Rennes and St. Malo, France.

93. Robert Dyer and Hridesh Rajan, "A Decision Tree-based Approach to Dynamic Pointcut Evaluation," VMIL'08: The 2nd workshop on Virtual machines and intermediate languages for emerging modularization mechanisms, October 2008, Nashville, TN, USA.

94. Hridesh Rajan, "Mining Software Repositories for Evaluating Software Engineering Properties of Language Designs," ACoM'08: The 2nd Workshop on Assessment of Contemporary Modularization Techniques, October 2008, Nashville, TN, USA.

95. Steve M. Shaner, Hridesh Rajan, and Gary T. Leavens, "Model programs for preserving composite invariants," SAVCBS'08: The Workshop on Specification and Verification of Component-Based Systems Workshop, November 2008.

96. Tyler Sondag, Viswanath Krishnamurthy and Hridesh Rajan, "Predictive Thread-to-Core Assignment on a Heterogeneous Multi-core Processor," PLOS'07: the ACM SIGOPS 4th Workshop on Programming Languages and Operating Systems, October 2007, Skamania Lodge, Stevenson, Washington, USA.

97. Mahantesh Hosamani, Harish Narayanappa, Hridesh Rajan, "Monitoring the Monitor: An Approach Towards Trustworthiness in Service Oriented Architecture," IW-SOSWE'07: The 2nd International Workshop on Service Oriented Software Engineering, Dubrovnik, Croatia.

98. Hridesh Rajan, "A Case for Explicit Join Point Models for Aspect-oriented Intermediate Languages," VMIL'07: The First Workshop on Virtual Machines and Intermediate Languages for Emerging Modularization Mechanisms, March 2007, Vancouver, Canada.

99. Jing Liu, Robyn Lutz and Hridesh Rajan, "The Role of Aspects in Modeling Product Line Variabilities," AOPLE'06: The Workshop on Aspect-oriented Product Line Engineering, October 2006, Portland, Oregon, USA.

100. Hridesh Rajan, Robert Dyer, Youssef Hanna, Harish Narayanappa, "Preserving Separation of Concerns through Compilation," SPLAT'06: The Workshop on Software Engineering Properties of Languages and Aspect Technologies, March 2006. Bonn, Germany.

101. Jia Xu, Hridesh Rajan and Kevin Sullivan, "Understanding Aspects via Implicit Invocation," FOAL'04: the workshop on Foundations of Aspect-oriented Languages, co-located with AOSD 2004.

102. Hridesh Rajan and Kevin Sullivan, "Need for instance level aspect language with rich pointcut language," SPLAT'03: The Workshop on Software Engineering Properties of Languages for Aspect Technologies, March 2003, Boston, MA, USA.

2.5 Demonstration, Tutorial, and Poster Papers (Refereed)

103. Ganesha Upadhyaya, Hridesh Rajan, Robert Dyer, and Tien N. Nguyen, "Program Analysis on Thousands of Projects," Tutorial at the 32nd IEEE/ACM International Conference on Automated Software Engineering (ASE 2017), Nov 3, 2017. Champaign, IL, USA.

104. Nitin M Tiwari, Ganesha Upadhyaya, and Hridesh Rajan, "Candoia: A Platform and Ecosystem for Mining Software Repositories Tools," ICSE'16: The International Conference on Software Engineering, Austin, Texas, May 2016. (**Distinguished Poster Award**)

105. Robert Dyer, Hridesh Rajan, Tien N. Nguyen and Hoan Anh Nguyen, "Mining Programming Language Usage with Boa," Tutorial at the 6th International Conference on Systems, Programming, Languages, and Applications: Software for Humanity (SPLASH 2015), Oct 30, 2015. Pittsburgh, PA, USA.

106. Robert Dyer, Hridesh Rajan, Tien N. Nguyen and Hoan Anh Nguyen, "Demonstrating Programming Language Feature Mining Using Boa," Demonstration at the 6th International Conference on Systems, Programming, Languages, and Applications: Software for Humanity (SPLASH 2015), Oct 30, 2015. Pittsburgh, PA, USA.

107. Hoan Anh Nguyen, Robert Dyer, Hridesh Rajan and Tien N. Nguyen, "Consensus-based Mining of API Preconditions in Big Code," Demonstration at the 6th International Conference on Systems, Programming, Languages, and Applications: Software for Humanity (SPLASH 2015), Oct 30, 2015. Pittsburgh, PA, USA.

108. Robert Dyer, Hoan Anh Nguyen, Hridesh Rajan and Tien N. Nguyen, "Efficiently Mining Source Code with Boa," Tutorial at the 36th International Conference on Software Engineering (ICSE 2014), Jun 02, 2014. Hyderabad, India.

109. Robert Dyer and Hridesh Rajan, "Mining Ultra-Large-Scale Software Repositories with Boa," Tutorial at the 2013 SPLASH Conference, Oct 2013, Indianapolis, IN, USA.

110. Robert Dyer, Hoan Nguyen, Hridesh Rajan, Tien N. Nguyen, "Mining Source Code Repositories with Boa," Demonstration at the 2013 SPLASH Conference, Oct 2013, Indianapolis, IN, USA.

111. Eric Lin and Hridesh Rajan, "Panini: a capsule-oriented programming language for implicitly concurrent program design," Demonstration at the 2013 SPLASH Conference, Oct 2013, Indianapolis, IN, USA.

112. Sean L. Mooney, Bryan Shrader, Loránd Szakács, and Hridesh Rajan, "Capsule-Oriented Programming: Concurrency Made Simple," Tutorial at the 2013 SPLASH Conference, Oct 2013, Indianapolis, IN, USA.

113. Robert Dyer, Hoan Nguyen, Hridesh Rajan, Tien N. Nguyen, "Analyzing ultra-large-scale code corpus with Boa," Tutorial at the 2012 SPLASH Conference, Tucson, Arizona, USA.

114. Robert Dyer, Hoan Nguyen, Hridesh Rajan, Tien N. Nguyen, "Boa: analyzing ultra-large-scale code corpus," Demonstration at the 2012 SPLASH Conference, Tucson, Arizona, USA.

115. Hridesh Rajan, Gary T. Leavens and Robert Dyer, "Modularizing Crosscutting Concerns with Ptolemy," Tutorial at the 26th International Conference on Automated Software Engineering (ASE 2011), Nov 08, 2011. Lawrence, KS, USA.

116. Hridesh Rajan, Sean Mooney, Gary T. Leavens, Robert Dyer, Rex D. Fernando, Mohammad Ali Darvish Darab and Bryan Welter, "Modularizing Crosscutting Concerns with Ptolemy," Demonstration at the 2nd International Conference on Systems, Programming, Languages, and Applications: Software for Humanity (SPLASH 2011), Oct 26, 2011. Portland, OR, USA.

117. Hridesh Rajan, Sean Mooney, Gary T. Leavens, Robert Dyer, Rex D. Fernando, Mohammad Ali Darvish Darab and Bryan Welter, "Modularizing Crosscutting Concerns with Ptolemy," Demonstration at the 25th European Conference on Object-Oriented Programming (ECOOP 2011), Jul 27, 2011. Lancaster, United Kingdom.

118. Hridesh Rajan, Gary T. Leavens, Sean Mooney, Robert Dyer and Mehdi Bagherzadeh, "Modularizing Crosscutting Concerns with Ptolemy," Tutorial at the 10th International Conference on Aspect-Oriented Software Development (AOSD 2011), Mar 22, 2011. Porto de Galinhas, Pernambuco, Brazil.

119. Yuheng Long, Hridesh Rajan, and Sean L. Mooney, "Reconciling Concurrency and Modularity with Panini's Asynchronous Typed Events," Poster at the SPLASH/OOPSLA Conference, Oct 17-21, 2010.

120. Sean L. Mooney, Hridesh Rajan, Steven M. Kautz and Wayne Rowcliffe, "Almost Free Concurrency! (Using GOF Patterns)," Poster at the SPLASH/OOPSLA Conference, Oct 17-21, 2010.

121. Hridesh Rajan and Mehdi Bagherzadeh, "Introduction to Ptolemy and its Development Environment," Poster at the 9th Annual Aspect-Oriented Software Development Conference (AOSD) 2010, Rennes and Saint-Malo, France.

122. Kian Pokorny, Tyler Sondag, and Hridesh Rajan, "Connecting High-level Programming Constructs to Assembly Language using Frances," Tutorial at CCSC: Central Plains 2010 conference, Parkville, MO, USA.

123. Hridesh Rajan, Curtis Clifton, Gary T. Leavens, Joseph R. Kiniry and Robby, "Introduction to JML," Tutorial at the ACM SIGPLAN International Conference on Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA) 2009, Orlando, Florida, USA.

124. Youssef Hanna and Hridesh Rajan, "Slede: Framework for Automatic Verification of Sensor Network Security Protocol Implementations," Demonstration at the 31st International Conference on Software Engineering (ICSE 2009), Vancouver, Canada, May 16-24, 2009.

125. Juri Memmert, Hridesh Rajan, "Osiris: Generating Concern Models from Source Code," SIGSOFT Softw. Eng. Notes, vol 31 (6) (Nov. 2006).

126. Youssef Hanna, Hridesh Rajan, "SLEDE: Event Based Specification of Sensor Network Protocols," SIGSOFT Softw. Eng. Notes, vol 31 (6) (Nov. 2006).

127. Robert Dyer, Harish Narayanappa, Hridesh Rajan, "Nu: Preserving Design Modularity in Object Code," SIGSOFT Softw. Eng. Notes, vol 31 (6) (Nov. 2006).

2.6 Technical Reports (Either submitted or unpublished work)

1. John L. Singleton, Gary T. Leavens, Hridesh Rajan, David R. Cok, "Inferring Concise Specifications of APIs," CoRR abs/1905.06847, 2019.

2. Rangeet Pan, Md Johirul Islam, Shibbir Ahmed, Hridesh Rajan, "Identifying Classes Susceptible to Adversarial Attacks," CoRR abs/1905.13284, 2019.

3. Md Johirul Islam, Giang Nguyen, Rangeet Pan, Hridesh Rajan, "A Comprehensive Study on Deep Learning Bug Characteristics," CoRR abs/1906.01388, 2019.

4. Mehdi Bagherzadeh and Hridesh Rajan, "Order Types: An Information Hiding Abstraction to Enable Modular Reasoning and Blame Assignment for Message Orders," Technical Report, Computer Science, Iowa State University, July 2015.

5. Tyler Sondag and Hridesh Rajan, "Staged Tuning: A Hybrid (Compile/Install-time) Technique for Improving Utilization of Performance-asymmetric Multicores," Technical Report, Computer Science, Iowa State University, June 2015.

6. Eric Lin, Ganesha Upadhyaya, Sean Mooney, and Hridesh Rajan, "Duck Futures: A Generative Approach to Transparent Futures," Technical Report, Computer Science, Iowa State University, June 2015.

7. Hridesh Rajan, Steven M. Kautz, Eric Lin, Sean L. Mooney, Yuheng Long, and Ganesha Upadhyaya, "Capsule-oriented programming in the Panini language," Technical Report 14-08, Iowa State U., 2014.

8. Yuheng Long, Mehdi Bagherzadeh, and Hridesh Rajan, "Open Effects: Programmer-guided Effects for Open World Concurrent Programs," Technical Report 13-04, Computer Science, Iowa State University, October 2013.

9. Hridesh Rajan, Steven M. Kautz, Eric Lin, Sarah Kabala, Ganesha Upadhyaya, Yuheng Long, Rex Fernando, and Loránd Szakács, "Capsule-oriented Programming," Technical Report 13-01, Computer Science, Iowa State University, February 2013.

10. Yuheng Long, Tyler Sondag, and Hridesh Rajan, "A Type-and-Effect System for Shared Memory, Concurrent Implicit Invocation Systems," Technical Report 10-09a, Computer Science, Iowa State University, June 2011.

11. Mehdi Bagherzadeh, Robert Dyer, Yuheng Long and Hridesh Rajan, "Instance-level Quantified, Typed Events for Integrated System Design," Technical Report 08-15, Computer Science, Iowa State University, Aug. 2008.

12. Rakesh Setty, Robert Dyer, and Hridesh Rajan, "Weave Now or Weave Later: A Test-driven Development Perspective on Aspect-oriented Deployment Models," Technical Report 08-02, Computer Science, Iowa State University, Feb 2008.

13. Youssef Hanna and Hridesh Rajan, "Verifying Fault-Tolerance of Sensor Network Applications Using Auto-generated Fault Injection Mechanisms," Technical Report 07-11, Computer Science, Iowa State University, June 22, 2007.

14. Hridesh Rajan, "Type-Based Quantification of Aspect-Oriented Programs," Technical Report 06-32, Computer Science, Iowa State University, Sep 7, 2006.

15. Robert Dyer and Hridesh Rajan, "Modular Compilation Strategies for Aspect-Oriented Constructs," Technical Report 06-30, Computer Science, Iowa State University, July 16, 2006.

16. Hridesh Rajan, "Unifying Aspect- and Object-Oriented Program Design," Ph.D. Thesis, Department of Computer Science, University of Virginia, Aug 2005.

2.7 Software Systems

1. Hridesh Rajan, Tien N. Nguyen, Robert Dyer, and Hoan N. Nguyen (Since 2012): `Boa` - A web-based infrastructure for easing ultra-large scale mining of software repositories. Available at the URL `https://boa.cs.iastate.edu`.

2. Hridesh Rajan, Steven M. Kautz, Eric Lin, Sean L. Mooney, Yuheng Long, Ganesha Upadhyaya, Sarah Kabala, Bryan Shrader, Lorand Szakacs, and Rex Fernando. (Since 2009): `Panini` - A capsule-oriented programming language for easing concurrent programming and its compiler. Available at the URL `https://design.cs.iastate.edu/panini/`.

3. Hridesh Rajan, David Johnston, Dalton Mills and Trey Erenberger (Since 2015): `@PaniniJ` - An Annotation-based Framework for Capsule-oriented Programming in Java. Available at the URL `https://design.cs.iastate.edu/panini/`.

4. Hridesh Rajan, Steven M. Kautz, Wayne Rowcliffe and Sean Mooney (Since 2010): `Implicitly concurrent GOF patterns` - a framework for implicit concurrency via the use of GOF design patterns. Available at the URL `https://design.cs.iastate.edu/panini/`.

5. Hridesh Rajan (Since 2007): `Ptolemy` - A language design with quantified typed events and its compiler. Available at the URL `https://design.cs.iastate.edu/ptolemy`.

6. Youssef Hanna and Hridesh Rajan (Distributed from 2007-2011): `Slede` - A domain specific model checker for sensor network applications. Available at the URL `https://design.cs.iastate.edu/slede`.

7. Robert Dyer and Hridesh Rajan (Distributed from 2006-2012): `Nu` - A novel intermediate language model and corresponding virtual machine and compiler tool set. Available at the URL `https://design.cs.iastate.edu/nu`.

8. Hridesh Rajan and Kevin Sullivan (Distributed from 2003-2006): `Eos` - An aspect-oriented extension for C# pioneering novel concepts such as instance-level aspects and unified-aspect language model. Available at the URL `https://design.cs.iastate.edu/eos`.

2.8 Invited Talks

1. *More Modular Deep Learning*, Bangladesh University of Engineering and Technology, Sept 2023, Dhaka, Bangladesh.

2. *More Modular Deep Learning*, University of Dhaka, Sept 2023, Dhaka, Bangladesh.

3. *More Modular Deep Learning*, University of Moratuwa, Sept 2023, Moratuwa, Sri Lanka.

4. *More Modular Deep Learning*, eBay, June 2023, Santa Clara, CA, USA.

5. *More Modular Deep Learning*, Symposium on Software Engineering for Machine Learning Applications, Polytechnique Montreal, October 2022, Montreal, QC, Canada.

6. *D4 (Dependable Data Driven Decision) Framework*, Department of Computer and Information Science, Indiana University-Purdue University, April 2021, Indianapolis, IN, USA.

7. *D4 (Dependable Data Driven Decision) Framework*, Keynote Speaker at the Fourth Paradigm Conference: From Data To Discovery, Artificial Intelligence in Scientific Research, January 28, 2020, Bhopal, India.

8. *A Benchmark for Understanding Data Science Software*, July 16, 2019, BenchWork Workshop at the 2019 European Conference on Object Oriented Programming, London, UK.

9. *Software as Data: Harnessing Big Data in Open Source for Data-driven Software Engineering*, June 14, 2019, USI Lugano, Lugano, Switzerland.

10. *Semantics Preserving Sampling*, May 13, 2019, Iowa SAS Conference, Des Moines, IA, USA.

11. *Software as Data: Harnessing Big Data in Open Source for Data-driven Software Engineering*, November 14, 2018, The University of Bristol, Bristol, UK.

12. *Accelerating Data-driven Software Engineering*, March 2018, The University of Illinois, Chicago, IL, USA.

13. *Tackling Lack of Software Specifications: A Sustained Sustainability and Productivity Crisis*, December 4, 2017, IBM Watson Research Center, Yorktown Heights, NY, USA.

14. *Tackling Lack of Software Specifications: A Sustained Sustainability and Productivity Crisis*, November 10, 2017, MIT CSAIL, Cambridge, MA, USA.

15. *Tackling Lack of Software Specifications: A Sustained Sustainability and Productivity Crisis*, September 28, 2017, Draper Laboratory, Cambridge, MA, USA.

16. *Static Modular Reasoning about Concurrent Software*, September 20, 2017, Harvard University, Cambridge, MA, USA.

17. *Data Quality & Shared Data*, the workshop on Data Quality in an Era of Big Data sponsored by the Midwest Big Data Hub and Indiana University, September 29, 2016, Bloomington, Indiana, USA.

18. Invited panelist, Spring 2016 Analytics Symposium, April 6, 2016, Des Moines, Iowa, USA.

19. *My Quest for Modular Reasoning: From Events to Big Data*, the 2016 International Workshop on Modularity Across the System Stack (MASS), March 14, 2016, Malaga, Spain.

20. *More Modular Reasoning about Concurrent Programs and its Implications*, March 7, 2016, Pennsylvania State University, State College, PA, USA.

21. *Opportunities and Challenges in Establishing a Shared Scientific Big Data Infrastructure*, Phenotypic Prediction: Image Acquisition and Analysis Workshop, Feb 24, 2016, Iowa State University, Ames, Iowa, USA.

22. *Lack of Software Specifications: A Sustained Sustainability and Productivity Crisis*, Computational Science and Engineering Software Sustainability and Productivity Challenges (CSESSP) Workshop, October 15, 2015, Rockville, MD, USA.

23. *Why Modularity Matters: Achieving Modular Reasoning about Concurrent Programs and its Implications*, AOAsia/Pacific 2014 Workshop co-located with FSE 2014, November 2014, Hong Kong, China.

24. *Boa: A language and a BIGDATA repository for Democratizing Ultra-Large-Scale Software Repository Mining*, Jan 2014, University of Central Florida, Orlando, FL, USA.

25. *Mining Software Repository Made Easy - Boa Language and its Data Store*, Feb 2013, Microsoft Research, Redmond, WA, USA.

26. *Tisa: A Language Design and Modular Verification Technique for Temporal Policies in Web Services*, Sep 2009, University of Iowa, Iowa City, IA, USA.

27. Invited speaker on the panel session "On the application and impact of contemporary assessment techniques" at the ACoM workshop at the ACM Conference on Object-Oriented Programming Systems, Languages, and Applications (OOPSLA 2009).

28. *Ptolemy: Quantified, Typed Events for Improved Separation of Concerns*, Mar 2008, University of Maryland, College Park, MD, USA.

29. *Towards an Aspect-Oriented Invocation Mechanism*, May 2006 University of British Columbia, Software Practices Lab, Vancouver, BC, Canada.

30. *Preserving Separation of Concerns through Compilation*, Mar 2006 University of Minnesota, Software Engineering Center, Minneapolis, MN, USA.

31. *The Design and the implementation of the Eos Language*, Nov 2005, Microsoft Research, Redmond, WA, USA.

32. *Are Aspects Essential for Aspect-Oriented Programming?*, June 2005, Rutgers University, New Brunswick, NJ, USA.

33. *Eos: The Power of Simplicity*, March 2005, University of Chicago, Chicago, IL, USA.

3 Teaching, Curriculum Development, and Program Development

3.1 Curriculum and Program Development

- **MS in AI Program**: Along with Prof. Jin Tian, I led the development of the MS in AI program at ISU. This program is designed to provide students with a comprehensive understanding of artificial intelligence concepts, methodologies, and applications. It includes courses covering artificial intelligence, machine learning, natural language processing, and more. The program emphasizes both theoretical foundations and practical skills, preparing students for a wide range of careers in the rapidly growing field of AI.

- **BA in Computer Science Program**: Spearheaded by Professor Soma Chaudhuri, Professor Jack Lutz and me, ISU's BA in Computer Science program was approved by the Iowa Board of Regents and began in spring 2023. This program aims to lead to more diverse student enrollment by accommodating those who wish to major in computer science but desire a wider variety of courses. It offers a rigorous yet flexible curriculum with 32 computer science credits, allowing students to double major and enjoy more career choices. The BA program maintains a close relationship with the existing BS program, offering students an opportunity to study computer science as part of a broader liberal education. This effort aligns with the increasing demand for computing professionals and ISU's strong position to respond to commercial and academic needs for interdisciplinary computer scientists.

- **Data Science Program**: In collaboration with Associate Deans Dr. Arne Hallam and Dr. Sriram Sundararajan, I co-led the development of three *Data Science degrees* at ISU. I chaired two university-level committees. The first committee designed a Data Science B.S. degree, and the second committee designed Data Science Minor and Certificate programs. These service roles are further detailed in §4.2.

  - **Data Science B.S. degree:** A comprehensive undergraduate program in data science.
  - **Data Science minor:** Intended for undergraduate students of any discipline at Iowa State University, this minor aims to equip them with the skills needed for data science roles. It consists of nine credit hours of data science core courses and six credit hours in data science electives.
  - **Data Science certificate:** Designed for students who have completed a baccalaureate degree or are currently pursuing one at ISU, this certificate includes nine credit hours of data science core courses, nine credit hours of data science electives, and a three-credit data science capstone. The capstone provides hands-on experience, allowing students to apply data science concepts in a multi-disciplinary team setting.

  These courses within the data science programs are crafted to provide students with the background necessary for jobs that require substantial data science expertise, such as establishing and operating data analysis pipelines.

- I also led the creation of four new courses for the data science curriculum:

  - **DS 201: Introduction to Data Science** (with Dr. Adisak Sukul): A foundational course covering data science concepts, domain case studies, data analysis pipelines, computing concepts, hands-on experience, and ethical considerations.

- **DS 202: Data Acquisition and Exploratory Data Analysis** (with Dr. Heike Hofmann): This course focuses on data acquisition, data displays, numerical and visual summaries, pipelines for data analysis, data visualization, and reproducibility, and includes programming exercises.
- **DS 301: Applied Data Modeling and Predictive Analysis** (with Dr. Kris De Brabanter and Dr. Jin Tian): A course that explores predictive analysis elements, machine learning techniques, data modeling, assessment, communication of findings, and ethical considerations. Team projects are a vital component.
- **DS 401: Data Science Capstone**: A course where students work in individual and team settings to plan, design, and implement significant multi-disciplinary projects in data science, with oral and written reports expected.

3.2 Summer School Curriculum Development

- **Annual Midwest Big Data Summer School** (2016-2019, `https://tads.research.iastate.edu/midwest-big-data-summer-school`). This summer school, which I founded in 2016, is designed as a one-week, intensive curriculum aimed at early career researchers to introduce them to data science. The school includes full-day lectures on various topics, ranging from data acquisition, data preprocessing, and exploratory data analysis to descriptive data analysis, data analysis tools and techniques, visualization and communication, ethical issues in data science, reproducibility and repeatability, and understanding domain/context. The first summer school was attended by 144 participants from several universities within the Midwest, as well as a few outside of it, including but not limited to Iowa State University, Indiana University, University of Wisconsin, University of South Dakota, California State University East Bay, University of Maryland, and Oregon State University. We also had participants from various organizations such as American Express, Ames Lab, Danforth Plant Science Center, and others. In response to a post-event survey, 43.75% of participants reported being very satisfied, 43.75% were satisfied, 6.25% were neutral, 3.13% were dissatisfied, and 3.13% were very dissatisfied. Each successive edition was attended by a similarly diverse audience. The 2019 edition was attended by 175+ participants.

3.3 Research-based Training for Students and Postdocs

- Have contributed or am currently contributing to the research-based training of a diverse body of 29 graduate students, 4 postdocs, and over 45 undergraduate students from 2005 to the present.
  - **PhD Students and Postdocs:** Shibbir Ahmed, Fraol Batole, Ali Ghanbari (postdoc), Syem M Imtiaz, Ruchira Manke, Giang Nguyen, David Obrien, Astha Singh, and Deepak-George Thomas
  - **Postdoctoral Training Completed:** Dr. Breno Cruz (Samsung), Dr. Hoan A. Nguyen (Amazon), Dr. Zhen Yu (Guizhou Education University)
  - **Graduate Theses Completed:** M. Wardat (PhD Summer 2023, Oakland University), S. Biswas (PhD Spring 2022, MS Spring 2021, Carnegie Mellon University), R. Pan (PhD, Spring 2021, IBM TJ Watson Research Center), S. Khairunnesa (PhD Summer 2021, MS Fall 2017, Bradley University), H. Bagheri (PhD Spring 2021, John Deere), J. Islam (PhD Summer 2020, MS Fall 2019, Amazon), G. Upadhayaya (PhD Fall 2017, MS Spring 2015, Harmony.One R&D), M. Bagherzadeh (PhD Summer 2016, MS Fall 2011, Oakland

University), Y. Long (PhD Spring 2016, MS Spring 2010, Google), R. Dyer (Postdoc 2013-14, PhD Fall 2013, MS Fall 2008, University of Nebraska-Lincoln), T. Sondag (PhD Fall 2011, MS Fall 2009, Intel), J. Maddox (MS Summer 2018), R. Ramu (MS Fall 2017), N. Tiwari (MS Spring 2017), E. Lin (MS Spring 2015), H. Narayanappa (MS Spring 2010), Y. Hanna (MS Fall 2008), J. Jalan (MS Fall 2009), R. Setty (MS Spring 2008), and M. Hosamani (MS Fall 2007).

– **Undergraduate Students:** Junhyung Shim (Mentored 45+ undergraduate research assistants between 2005 to the present including First Year Honors program participants.)

3.4 Teaching and Curriculum Improvement at Iowa State University

- ***Lang: A Family of Interpreters for Teaching Programming Languages.** Designed, implemented, and refined *Lang, a pedagogical tool for teaching programming languages. his tool addresses a severe pain point my students have faced over the last decade. Students trained in a recent object-heavy curriculum often struggle more with the tools than with functional programming concepts themselves. I have also worked on a textbook based on *Lang, which is currently in its second revision and appeared as follows.

  Hridesh Rajan, "An Experiential Introduction to Principles of Programming Languages," MIT Press, Cambridge, MA, ISBN: 9780262045452, pp. 304, May 2022.

- Taught the upper-level graduate course, *Com S 641 - Advanced Topics in Programming Languages*, where I executed two significant redesigns. The Spring 2016 redesign shifted the course focus towards the semantics of data-intensive languages and frameworks, while in Fall 2019, I restructured the course to emphasize support for fairness, accountability, and transparency in data-intensive languages and frameworks.

- Taught several editions of the graduate course, *Com S 541 - Programming Languages*, where I initiated several significant changes. In Fall 2011, I developed the course to utilize the automated proof assistant Coq for modeling formal semantics, based on software foundation notes by Pierce. I once again undertook a major course redesign in Fall 2015 to convert this course to a dual-listed course for both graduate and undergraduate students.

- Taught multiple editions of the undergraduate course, *Com S 342 - Principles of Programming Languages*. I've led several iterations and improvements. Initially, I taught the course in Fall 2007, Spring 2009, Spring 2010, and Spring 2011, during which I carried out a major course reorganization in Spring 2010 and Spring 2011 to add new modules. I continued teaching this course in Fall 2011 and Spring 2012, implementing another significant reorganization in Fall 2012. In Summer 2014, I developed alternative course material and a new textbook to teach programming language concepts. This new approach was first implemented in Fall 2014, resulting in a 20% increase in the success rate compared to Spring 2013. After revising the course based on feedback, I taught it again in Spring 2015, observing a sustained improvement in the success rate.

- Taught multiple editions of the undergraduate course *Com S 362 - Object-Oriented Analysis and Design*. The course underwent major reorganizations in Spring 2005, Fall 2006, and Fall 2007 to incorporate advanced topics in software design. In Fall 2016, I redesigned the course to engage students with large-scale software challenges using open-source projects. This included reverse-engineering the design of existing software projects and analyzing the effects of evolution on project design.

- I've also offered several editions of *Com S 610 HR - Graduate seminar*, focusing on various advanced topics. In Spring 2006, the course focused on aspect-oriented software development, while in Fall 2006, it centered on security properties of software systems. The focus then shifted to programming language design and implementation in Fall 2007 and program analysis in Spring 2008. I delivered a seminar on advanced topics in type systems in Fall 2009, and in Spring 2015, the course explored advanced topics in programming languages and software engineering.

4 International, National, and University Service Roles

4.1 International and National Service Roles

- **Conference leadership roles.**
  - General Chair, SPLASH (ACM SIGPLAN conference on Systems, Programming, Languages, and Applications: Software for Humanity) 2021. SPLASH 2021 included five co-hosted conferences, several sub-conferences such as OOPSLA (Object-oriented Programming, Systems, Languages, and Applications) and Onward!, and nine workshops. SPLASH 2021 was the first major hybrid conference organized by the Association for Computing Machinery (ACM).
  - General Chair, SPLASH 2020. SPLASH 2020 was the first virtual SPLASH and incorporated several innovations to improve accessibility and global inclusivity.
  - Founder and General Chair, the Midwest Big Data Summer School (MBDS 2016 - 2019).
  - Program Committee Co-chair, IEEE COMPSAC SETA Symposium (SETA 2016, 2017).
  - Organization Committee Member, ADSA Leadership Summit (2023).
  - Doctoral Symposium Chair, ESEC/FSE 2018.
  - Doctoral Symposium Chair, SPLASH 2012.
  - Student Volunteer Co-chair, Eighth International Conference on Aspect-Oriented Software Development (AOSD 2009).
- **Journal editorial board membership.** Advisory Board, Proceedings of the ACM on Programming Languages (2023 - Present); Associate Editor, IEEE Transactions on Software Engineering (2017 - 2022); Associate Editor, Software Engineering Notes (2015 - 2019); and Guest Editor, Journal of Systems and Software Special Issue on Software Engineering Technology and Applications (2016).
- **Workshop organization.** Founder and Co-organizer of Workshop on Virtual Machine and Intermediate Languages (VMIL 2007-2013, 2016); and Co-organizer Workshop on Foundations of Aspect-oriented Languages (FOAL 2013, 2015, 2016).
- **Steering committee member.** Steering Committee Member, SPLASH Conference (2019 - Present); Workshop on Virtual Machine and Intermediate Languages (VMIL 2017 - 2019); and Steering Committee Member, the Midwest Big Data Hub (2016-2018).
- **Conference program committee member.** The International Conference in Software Engineering (ICSE 2024); The Innovation in Software Engineering Conference (ISEC 2021, also in 2020); The Automated Software Engineering (ASE) Conference (2019, 2022, 2023); The ACM Conference on Object-Oriented Programming Systems, Languages, and Applications (OOPSLA 2009, 2013); the 13th International Conference on Modularity (Modularity

2014 - 2016); International Conference on Aspect-Oriented Software Development (AOSD 2009 - 2011, 2013); the 2010 Onward! Conference, the new ideas, new paradigms track at SPLASH/OOPSLA 2010; International Conference on Generative Programming: Concepts & Experiences (GPCE 2010, 2015); Blue Sky and Position Papers Track of the 14th International Conference on Modularity (Modularity 2015); Demonstration Track of the International Conference on Software Engineering (ICSE 2016); Posters subcomittee of the International Conference on Software Engineering (ICSE 2014); Research Demonstrations Track, the 32nd International Conference on Software Engineering (ICSE 2010); and International Conference on Next Generation Web Services Practices (NWeSP 2009).

- **Panel member for funding bodies.** US National Science Foundation (2007 - Present, 1 or 2 panels/year); Natural Sciences and Engineering Research Council of Canada (NSERC 2016); Discussant, Computational Science & Engineering Software Sustainability and Productivity Challenges (CSESSP Challenges): an inter-agency workshop sponsored by the Networking and Information Technology Research and Development (NITRD) / Software Design and Productivity (SDP) Coordinating Group (CG); SMART Defense Scholarship Evaluation Panel (2014); Fonds Wetenschappelijk Onderzoek - Vlaanderen, FWO Research foundation Flanders, Belgium (2013 - 2014); National Defense Science and Engineering Graduate (NDSEG) Fellowship evaluation panel (2008, 2009); and The Netherlands Organisation for Scientific Research (NWO) Research Grants Panel (2009).

- **Journal referee.** IEEE Transactions on Software Engineering (2005 - present); ACM Transactions on Software Engineering and Methodology (2006 - Present); LNCS Formal Aspects of Computing (2015); Empirical Software Engineering Journal (2010 - 2011); ACM Transactions on Programming Languages and Systems (TOPLAS) (2011); Wiley Software Practice and Experience Journal (2010, 2013); Science of Computer Programming (2011 - 2012); Elsevier Journal of Systems and Software (2010 - 2011); IEEE Transactions on Computers (2014); Journal on Software and System Modeling (2007); IEEE Software (2005, 2013, 2014); LNCS Transactions on Aspect-oriented Software Development (2009 - 2012); PeerJ Computer Science, an open access journal in computer science (2015); ACM Computing Surveys (2008); and IEEE Internet Computing (2007).

- **Workshop program committee member.** 2021 Workshop on Testing for Deep Learning and Deep Learning for Testing (DeepTest 2021); 2016 Workshop on Data Quality in a Big Data Era; Workshop on Aliasing, Capabilities and Ownership (IWACO 2016); Workshop on Meta-Programming Techniques and Reflection (META 2016); Workshop on Programming based on Actors, Agents, and Decentralized Control (AGERE 2016); Workshop on Reactive and Event-based Languages and Systems (REBLS 2014, 2015, 2016); Workshop on Aspects, Components, and Patterns for Infrastructure Software (ACP4IS 2008, 2010); Workshop on Foundations of Aspect-Oriented Languages (FOAL 2006, 2008, 2010, 2011, 2012, 2014); Workshop on Virtual Machine and Intermediate Languages (VMIL 2007 - 2010); and Workshop on General Purpose Processing on Graphics Processing Units (GPGPU 2012).

- **Conference external reviewer.** International Conference on Object-Oriented Programming, Systems, Languages and Applications (OOPSLA 2006, 2008, 2010, 2012); International Conference on Generative Programming: Concepts & Experiences (GPCE 2013, 2014); Joint meeting of the European Software Engineering Conference and the ACM SIGSOFT Symposium on the Foundations of Software Engineering (ESEC/FSE 2007); 38th ACM SIGACT-SIGPLAN Symposium on Principles of Programming Languages (POPL 2011); 19th International Conference on Tools and Algorithms for the Construction and Analysis of Systems

(TACAS 2012); 20th European Symposium on Programming (ESOP 2011); International Symposium on Software Reliability Engineering (ISSRE 2010); The 18th International Symposium on High-Performance Computer Architecture (ISCA 2011); International Conference on Formal Methods (2006); and IEEE INFOCOM (2008).

4.2 Key University-level Service Roles at Iowa State University

- Chair, ISU Data Science Minor and Certificate Subcommittee. This university-level subcommittee of the ISU Data Science Academic Coordination Committee (chaired by Associate Deans Arne Hallam and Sriram Sundararajan) designed and developed two new degree programs at Iowa State University: a Data Science Minor and a Data Science Certificate. A key goal of these degree programs was to be broadly accessible across disciplinary boundaries. My responsibilities as a chair of this subcommittee were to:
  - help develop consensus among multiple stakeholders across campus on goals;
  - organize regular discussions and feedback sessions on the curriculum design;
  - write the majority of the program proposals and lead feedback on the documents;
  - lead development of four experimental courses and their course proposals: DS 201: Introduction to Data Science, DS 202: Data Acquisition and Exploratory Data Analysis, DS 301: Applied Data Modeling and Predictive Analysis, and DS 401: Data Science Capstone;
  - present both degree programs to university bodies that approve new degrees, e.g. the Department of Computer Science faculty, the ISU Data Science Curriculum Committee, the LAS College Curriculum Committee, the LAS Representative Assembly, the ISU Faculty Senate Curriculum Committee, the ISU Faculty Senate Academic Affairs Council, and the ISU Faculty Senate; and
  - help negotiate governance of these shared programs with college leaderships.
- Chair, ISU Data Science Major Subcommittee. This university-level subcommittee of the ISU Data Science Academic Coordination Committee designed a data science BS degree at Iowa State University as a collaboration between computer science, statistics and other departments. My responsibilities as the chair of this subcommittee were to:
  - help develop consensus on student outcomes among stakeholders across campus;
  - organize and coordinate meetings to develop student learning outcomes and map them to existing courses to identify gaps;
  - help develop consensus on the design of a core course on predictive analysis;
  - lead development of the program proposal by decomposing the overall proposal into components, encouraging committee members to work on these components, integrating separately developed components into an integral proposal;
  - develop revenue and expense projections for the new B.S. degree program;
  - deliver numerous presentations on the new B.S. degree program to relevant university committees that approve new degrees; and
  - help negotiate governance of this shared program with university leadership.
- Chair, Information Technology Committee, Iowa State University Faculty Senate (2015 - 2019). Developed agenda in consent with the college representatives and the Chief Information Officer's office, chaired meetings, reported key developments to the resource policies and

allocations council. During my tenure, ISU implemented significant IT changes, such as introducing new authentication services (Okta), an enterprise management system (Workday), and a workflow management system (ServiceNow) Also, served on the Ad Hoc WorkCyte Steering Committee that advised the CIO on Workday implementation.

- Senator-at-large, Faculty Senate, Iowa State University (2014 - 2019).
- Member, Resource Policies and Allocations (RPA) Council, Iowa State University Faculty Senate (2015 - 2019).
- Member, Technology Enterprise Advisory Committee (TEAC) (2015 - 2019). As a member of TEAC, I contributed my unique computing background to address enterprise technology issues, serving as a campus advocate. Additionally, my service extended to the Workday Advisory Committee, where we ensured the alignment of technology with business needs, identified the impacts of organizational change, and provided insights on information technology designs, decisions, and policies for continuous improvements.
- Member, Faculty Review Board, Iowa State University (2016 - 2019).

4.3 Key Service Roles in College of Liberal Arts and Sciences

- College of Liberal Arts and Sciences (LAS) representative assembly executive committee member (2012 - 2015).
- College of Liberal Arts and Sciences (LAS) representative assembly representative from Computer Science (2011 - 2017).
- LAS ad hoc committee for preparing a report on faculty salaries (Winter 2011 - Spring 2012). Along with Alison Morris (now deceased) and Paul Griffiths, I helped prepare a report on faculty salaries in the college. We produced a comparative analysis with faculty in other colleges and peer universities. Our findings and recommendations were compelling enough to be presented to the Provost. This eventually led to initiatives aimed at addressing notable salary inequalities in LAS, particularly within the Humanities and Social Sciences.
- Member of FIRES: a faculty working group seeking to increase the number of under-represented groups in all areas, Spring 2009.
- Interdisciplinary Advisory Council for the Center for Excellence in the Arts and Humanities, Fall 2005 - Summer 2006.

4.4 Key Service Roles in Department of Computer Science

- Chair, Graduate Admissions and Recruitment Committee from Jan 2014 to June 2019.
  - Increased graduate student body from 104 to 185 during my leadership
  - Established and rekindled pipelines from several underrepresented countries, e.g. Kenya, Eritrea, Nigeria.
  - Established and rekindled pipelines from top institutions in Asia e.g. IITs, Tsinghua, Nanjing.
  - Helped increase the number of GEM fellows at Iowa State University. According to ISU graduate college, there hasn't been a GEM fellow at ISU in over a decade. My efforts led to the recruitment of two GEM fellows at ISU and in the department.

  - Helped recruit first George Washington Carver (GWC) Scholar in the department.
  - Led development of the department highlights for graduate recruitment.
  - Led development of the department brochure for graduate recruitment.
  - Increased the number of African and African-American graduate students from zero to four by Fall 2015, slowly but steadily increasing the participation of underrepresented groups in computing.
  - Managed the entire graduate admission process during Summer and Fall 2014 without graduate staff support.
  - Implemented several strategies aimed at increasing both the quality and quantity of incoming graduate students.
  - Collaborated with Director of Graduate Education (DOGE) to write grant applications for fellowships for incoming students. Also, directed graduate program coordinator to prepare grant applications, e.g. the RECRUIT grant to establish contacts with Historically Black Colleges and Universities (HBCUs) (awarded 2015, $2000).
  - Revamped graduate admission web-pages and e-mail query response process.
  - Helped admissions committee interview several potential candidates for admission to the CS PhD program.

- Faculty Peer Mentor for several junior faculty in Computer Science, such as Dr. Wei Le, Dr. Ali Jannesari, Dr. Borzoo Bonakdarpour. Received the 2016-17 Exemplary Mentor of Junior Faculty award recognizing my commitment to the success of the faculty.

- Member of the Software Engineering (SE) faculty from the program's inception until 2019. Service to the inter-departmental program included serving on the curriculum committee and the faculty search committee.

- Multi-year service on key departmental committees such as the Undergraduate Committee, the Graduate Committee, the Graduate Admissions Committee, the Faculty Search Committee, the Recruitment and Retention Committee.