Kishor Jothimurugan

Levine 513, 3330 Walnut St, Philadelphia, PA – 19104 – USA
kishor@seas.upenn.edu • keyshor.github.io

Research Interests

My areas of interest lie at the intersection of **Formal Methods** and **Machine Learning**. In particular, I have worked on applying formal methods to improve reinforcement learning (RL), verification of neural networks (NN), and machine learning (ML) for program synthesis and analysis.

Education

University of Pennsylvania **Philadelphia, USA**
Ph.D. candidate in Computer and Information Science, Current GPA 4.0/4.0 *2017–2023*
Thesis Topic: Specification-Guided Reinforcement Learning
Committee: Osbert Bastani, Thomas A. Henzinger, Sampath Kannan, and George J. Pappas
Advised by Prof. Rajeev Alur

Chennai Mathematical Institute **Chennai, India**
B.Sc. (Honors) Mathematics and Computer Science, CGPA 9.77/10 *2014–2017*
Ranked among top 3 students

Publications

First (co)author in all publications; names are listed alphabetically in some papers
* equal contribution, † authors in alphabetical order

Refereed Conference Publications

[ICML 23] Robust Subtask Learning for Compositional Generalization
K. Jothimurugan, S. Hsu, O. Bastani and R. Alur
International Conference on Machine Learning, 2023
Acceptance rate: 27.9%

[CAV 23] Policy Synthesis and Reinforcement Learning for Discounted LTL
R. Alur, O. Bastani, *K. Jothimurugan*†, M. Perez, F. Somenzi and A. Trivedi
International Conference on Computer Aided Verification, 2023
Acceptance rate: 26%

[Festschrift 22] A Framework for Transforming Specifications in Reinforcement Learning
R. Alur, S. Bansal, O. Bastani and *K. Jothimurugan*†
Springer Festschrift in honor of Prof. Tom Henzinger (Invited), 2022

[CAV 22] Specification-Guided Learning of Nash Equilibria with High Social Welfare
K. Jothimurugan, S. Bansal, O. Bastani and R. Alur
International Conference on Computer Aided Verification, 2022
Acceptance rate: 24.4%

[NeurIPS 21] Compositional Reinforcement Learning from Logical Specifications
K. Jothimurugan, S. Bansal, O. Bastani and R. Alur
Advances in Neural Information Processing Systems, 2021
Acceptance rate: 25.7%

[EMSOFT 21] Compositional Learning and Verification of Neural Network Controllers
R. Ivanov*, *K. Jothimurugan**, S. Hsu, S. Vaidya, R. Alur and O. Bastani
International Conference on Embedded Software, 2021
Acceptance rate: 25.2%

[AISTATS 21] Abstract Value Iteration for Hierarchical Reinforcement Learning
K. Jothimurugan, O. Bastani and R. Alur
International Conference on Artificial Intelligence and Statistics, 2021
Acceptance rate: 29.8%

[LICS 20] Space-efficient Query Evaluation over Probabilistic Event Streams
R. Alur, Y. Chen, *K. Jothimurugan*† and S. Khanna
Symposium on Logic in Computer Science, 2020
Acceptance rate: 39.6%

[NeurIPS 19] A Composable Specification Language for Reinforcement Learning Tasks
K. Jothimurugan, R. Alur and O. Bastani
Advances in Neural Information Processing Systems, 2019
Acceptance rate: 21.1%

Preprints and Technical Reports

Learning Algorithms for Regenerative Stopping Problems with Logistics Applications
K. Jothimurugan, M. Andrews, J. Lee and L. Maggi
Nokia Bell Labs Intern Report

Tutorials

[AAAI 23] Specification-Guided Reinforcement Learning
Presenters: *K. Jothimurugan*, S. Bansal, R. Alur and O. Bastani
AAAI Conference on Artificial Intelligence, 2023
A comprehensive tutorial on RL algorithms for learning control policies from logical specifications

Open Source Tools

DIRL — Github link
Compositional RL algorithm for learning from temporal specifications

HIGH-NASH — Github link (CAV Artifact Evaluation Badge: Functional)
Multi-agent RL algorithm for learning Nash equilibria with high social welfare

SARL — Github link
Hierarchical RL algorithm leveraging user provided state abstractions

SPECTRL — Github link
Generating shaped rewards from temporal specifications

Teaching Experience

Guest Lecturer

Computer-Aided Verification, CIS 673 (Class of ~ 20) *Fall 2021*
Graduate Course, University of Pennsylvania
Topic: Techniques for Verifying Robustness of Neural Networks

Teaching Assistant

Principles of Embedded Systems, CIS 540 (Class of ~ 20) *Spring 2019*
Graduate Course, University of Pennsylvania

Automata, Computability and Complexity, CIS 262 (Class of ~ 150) *Fall 2018*
Undergraduate Course, University of Pennsylvania

Discrete Mathematics (Class of ~ 30) *Spring 2017*
Undergraduate Course, Chennai Mathematical Institute

Design and Analysis of Algorithms *Fall 2016*
Online Course offered by Indian Institute of Technology, Madras

Mentoring and Outreach

Graduate Student Mentoring 2020–2022
Steve Hsu, Masters Student, University of Pennsylvania
Topic: Compositional reinforcement learning for multi-task generalization
Co-authored two papers

Penn CIS Mentorship Program 2022
Participated as a mentor
Department-wide effort to connect early career PhD students with senior PhD students
Attracted participation from 34 first-year students

Awards

CTL Teaching Certificate *Spring 2022*
Awarded by Center for Teaching and Learning, University of Pennsylvania

CMI Undergraduate Scholarship *2014–2017*
Awarded by CMI to undergraduate students for excellence in academics

Research Presentations

Invited Talks

University of Illinois Urbana-Champaign *Spring 2023*
Title: Specification-Guided Reinforcement Learning

University of Virginia *Spring 2023*
Title: Specification-Guided Reinforcement Learning

NYU Formal Methods Group *Fall 2022*
Title: Specification-Guided Reinforcement Learning

Microsoft PROSE Group *Fall 2022*
Title: Specification-Guided Reinforcement Learning

Thomas Henzinger's Group, IST Austria *Fall 2021*
Title: Reinforcement Learning from Logical Specifications

Simons Institute, UC Berkeley *Spring 2021*
Workshop on Games and Equilibria in System Design and Analysis
Title: Abstract Value Iteration for Hierarchical Reinforcement Learning

Presentations and Posters (from publications)

Conferences: NeurIPS 2019 and 2021, LICS 2020, AISTATS 2021, EMSOFT 2021, CAV 2022.

Workshops: DeepRL @ NeurIPS 2020 and 2022, SafeRL @ NeurIPS 2021, SYNT @ CAV 2022.

Internships

Amazon Web Services Summer 2022
Applied Science Intern, AI Labs
Incorporating program semantics in transformer-based code generation models
Mentors: Nathan Fulton, Siddhartha Jain and Baishakhi Ray (Columbia University)

Nokia Bell Labs Summer 2020
Research Intern, Data and AI Lab
An application of deep RL to regenerative stopping problems
Mentors: Matthew Andrews, Jeongran Lee and Lorenzo Maggi

Amazon Web Services Summer 2019
Software Development Engineering Intern, Automated Reasoning Group
Using machine learning to improve usability of taint analysis
Mentors: Andrew Gacek and Lee Pike

ENS Paris-Saclay Summer 2017
Research Intern, Formal Methods Group
Models for distributed reactive synthesis
Mentor: Dietmar Berwanger

Review Service

Conferences: NeurIPS 2022, AAAI 2023, AISTATS 2023, ESOP 2023, L4DC 2023, ICML 2023, CAV 2023, NeurIPS 2023.

Journals: IEEE TCAD.