



AI Institute for Advances in Optimization

The Monthly Opt-In Newsletter | July 2024



Pascal Van Hentenryck
AI4OPT Director

LETTER FROM THE DIRECTOR

As we approach our year-three annual review and site visit, I am pleased to share that AI4OPT continues its commitment to transformative research and educational programs that make a real difference. This month, I am thrilled to share some exciting news that underscores this commitment.

Clark Atlanta University and AI4OPT have been awarded a multi-million dollar grant to establish the first graduate degree curriculum in AI at a historically Black university. This is a significant step toward democratizing AI, opening opportunities for underrepresented communities, and complementing our ongoing initiatives like the AI4OPT faculty training program and the Seth Bonder Camp in Computational and Data Science for Engineering.

On the research front, we've received a new grant to apply AI and optimization to revolutionize digital agriculture, with the potential to transform food production. In addition to my role at AI4OPT, I am excited to share that I have been appointed to lead Tech AI, the Georgia Tech AI Hub. The goal of Tech AI is to promote everything AI at Georgia Tech and beyond, and the hub will create new opportunities for AI4OPT to scale up its initiatives and maximize its impact.

Of course, none of these achievements would be possible without the people at AI4OPT. This newsletter spotlights two of our members: faculty member Paul Grigas and student Andrew Rosemberg, who both share details about their research and ongoing projects.

Researcher Spotlight

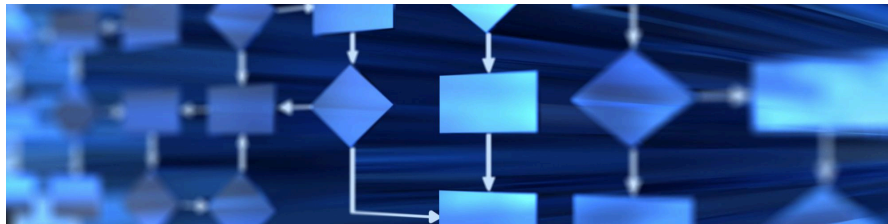


Paul Grigas



Paul Grigas is an assistant professor of industrial engineering and operations research at the University of California, Berkeley. Paul's research interests are broadly in optimization, machine learning, and data-driven decision-making, with a particular emphasis on contextual stochastic optimization and algorithms at the interface of machine learning and continuous optimization. His research has been funded by the National Science Foundation, including an NSF CRII Award. Paul was awarded first place in the 2020 INFORMS Junior Faculty Interest Group Paper Competition and the 2015 INFORMS Optimization Society Student Paper Prize. He received his B.S. in operations research and information engineering from Cornell University in 2011 and his Ph.D. in operations research from MIT in 2016.

Paul Grigas' Insights into SPO and ICEO in Online Decision-Making



Both of these papers, "[Smart Predict-then-Optimize](#)" (SPO) and "[Integrated Conditional Estimation-Optimization](#)" (ICEO), originated with the idea of rethinking how to do machine learning in the context of a decision-making problem, i.e., the subject of contextual optimization, decision-focused learning, and end-to-end learning. Most commonly, decision-making problems are modeled and solved in practice using the machinery of optimization, and these models involve some important but unknown parameters that can be predicted or estimated using machine learning. For example, in a vehicle routing scenario, optimal routes for package delivery are determined by solving a (possibly mixed integer) optimization model with estimated travel times along the roads of the network.

A central focus of my work has been about rethinking the basic building blocks of machine learning, such as loss functions, in ways that are aligned with the objectives of a downstream optimization model. In the SPO work, we have focused on linear cost functions and developed a tractable convex surrogate loss function approach called SPO+, while in the ICEO work, we have focused on nonlinear cost functions and taken a different approach that is more informed by the practical successes of neural network training. In both cases, it is imperative to develop learning methodologies that are computationally tractable, have theoretical guarantees on their success, and have experimental evidence to support their performance as compared to standard learning approaches.

More recently, along with several collaborators, I have been exploring extending the reach of the SPO and ICEO methodologies to more intricate learning and decision-making scenarios. For example, consider an online decision-making scenario where we make multiple routing decisions over time and each decision uses up some limited resources like driver/truck availability. Again, we need a model for predicting the travel times along the roads in the network, but now this model can be updated over time as we make more

routing decisions and collect more data. A key question is how can we train such a model efficiently and in a way that is aligned with the decision-making problem under limited resources that are consumed over time? As another example, I have also been examining active learning scenarios where data may be costly to acquire, and so we need to think strategically about how to collect data in light of the downstream optimization problem.

Recent Projects and Research through AI4OPT

In addition to the above, through AI4OPT and with AI4OPT student Wyame Benslimane, I have been exploring the topic of learning robust optimization proxies. Optimization proxies—the idea of approximating the solution of an optimization problem using a more computationally efficient process like a neural network—are a key component of some decision-focused learning methodologies, including ICEO. However, due to the mismatch between estimated parameters and the underlying "true" parameters, even a perfectly accurate optimization proxy may not be ideal to use inside a decision-focused learning training process. Instead, it is advantageous to learn a robust optimization proxy that accounts for this mismatch and has better guarantees, including guarantees on feasibility. We have been exploring different approaches for efficiently learning robust optimization proxies, and are excited by the potential for their application to decision-focused learning. Furthermore, optimization proxies and related topics have been of great interest and have seen successful applications by other researchers across multiple thrusts in AI4OPT, and we are excited to continue discussing and collaborating with them.

Continuing Interest in AI and Optimization

Since my time as an undergraduate student to today, I have been drawn to optimization due to its intriguing combination of mathematics and computation, as well as its broad applicability and modeling power. My interests in machine learning and artificial intelligence initially developed during my time as a Ph.D. student. Today, I view them also as core interests, and I think that they share the same characteristics as optimization that I described above. We are at a very exciting time in both AI and optimization. On the one hand, there is nearly a century of progress in these fields, and on the other hand, every day we see new developments that spur unanswered questions and exciting directions to explore. A remarkable thing is that concepts developed nearly a century ago—linear programming, stochastic gradient descent, and many others—are still highly relevant to today's AI and optimization systems. I view this as a testament to the fact that AI and optimization go far beyond hype and are fundamental subjects in the interest of society.

It is wonderful to be a part of a research institute concerning the fusion of optimization and AI, and this fusion has led to many challenges and questions, in contextual optimization and beyond, that fuel my excitement and passion as a researcher.



Click thumbnail to watch Grigas at CPAIOR 2022 provide an overview of his work on Smart Predict-then-Optimize (SPO) and its extensions to online decision-making.

Student Highlight



Andrew Rosenberg



Meet AI4OPT student researcher Andrew Rosenberg, a second-year Ph.D. student in the School of Industrial and Systems Engineering (ISyE) at Georgia Tech. He conducts his research under the guidance of AI4OPT Director Pascal Van Hentenryck. Rosenberg holds a Master of Science in Operations Research (MSOR). His research focuses on the intersection of machine learning, optimization, and their practical applications in energy systems and sustainability. Andrew is passionate about collaborating to solve complex problems and has partnered with academic institutions, industry leaders, and national laboratories. His previous projects have involved advancements in electricity markets, efforts in decarbonization, financial data analysis, and portfolio optimization.

Q&A

Q: Can you provide some background about your work in AI and/or optimization and how you got involved with AI4OPT?

A: Much of my work as a researcher in both Brazil and the UK revolved around improving computational efficiency and the solution quality of complex optimization problems under uncertainty, a central theme at AI4OPT. After closely following Dr. Pascal Van Hentenryck's work and meeting him at several conferences, I decided to join his team while pursuing a Ph.D. degree at Georgia Tech.

Q: Are there any new developments or projects you're working on?

A: I am spearheading cutting-edge research aimed at tackling complex multistage and bilevel optimization challenges in collaboration with Los Alamos National Laboratory. Additionally, I play a pivotal role in leading international partnerships with top-tier industry and academic entities to leverage the latest advancements from AI4OPT. These efforts are focused on addressing critical societal issues both in the United States and globally, with more information about these initiatives expected to be unveiled soon.

Q: What sparked your interest in artificial intelligence (AI) and optimization?

A: My journey into artificial intelligence and optimization was sparked by a longstanding fascination with the potential of automation to enhance human achievements. My academic path, beginning with a BSc in control engineering from PUC-RIO and continuing through a double degree program at École Centrale de Marseille, gradually shifted my focus towards the mathematical underpinnings of automation. This evolution culminated in my pursuit of a master's in operations research, where I deepened my understanding of AI and optimization as pivotal tools for automated decision-making. I believe that the synergy of AI and optimization enables the resolution of complex, previously unencountered challenges, propelling advancements across diverse domains.

Q: What is something unique about you, or something fun you do when you're not studying or doing research?

A: I have a passion for movies, TV shows, and books. In my free time, I enjoy skating, playing tennis, and sailing with my wife and friends.

News



[AI4OPT's Kevin Dalmeijer Presents at White House AI Conference](#)



[Industry and Academic Leaders Discuss the Future of AI](#)



[Pascal Van Hentenryck to Lead Georgia Tech's AI Hub](#)



[Yongsheng Chen Awarded \\$300K Grant for Sustainable Agriculture AI Research](#)



[AI4OPT Dir. Joins Experts at ARPA-E Summit Panel on AI and Clean Energy Transition](#)



[AI4OPT's EAB Meeting 2024 Recap](#)

For more news, click [here](#).

AI4OPT videos are available in the [Media Center](#).

Upcoming Event

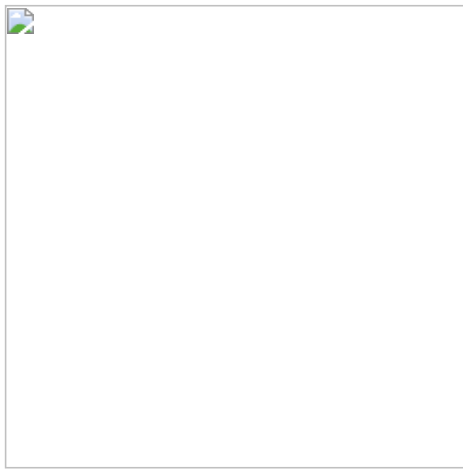


AI4OPT members will be attending the Forty-First International Conference on Machine Learning at the Messe Wien Exhibition Congress Center in Vienna, Austria, from Sunday, July 21st through Saturday, July 27th, 2024. Three papers have been accepted for presentation, including:

Taoan Huang, Aaron Ferber, Arman Zharmagambetov, Yuandong Tian, and Bistra Dilkina. Contrastive Predict-and-Search for Mixed Integer Linear Programs. International Conference on Machine Learning, page forthcoming, 2024

Outreach and Education

SETH BONDER CAMP 2024!

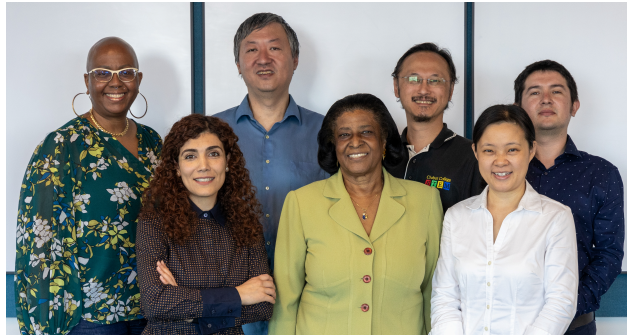


What an incredible summer for those involved in the Seth Bonder Camp! We're thrilled to announce that 47 campers have embarked on a transformative journey through Levels 1 and 2, paving the way for an exciting Level 3 experience. From mastering Snap! in Level 1 to diving into Python and data science in Level 2, our campers have shown remarkable enthusiasm and growth.

Now, we're gearing up for the pinnacle and newly installed: Level 3, scheduled for July 15-19, 2024. This advanced level in Computational and Data Science for Engineering promises even more thrilling challenges and opportunities.

AI4OPT FACULTY TRAINING PROGRAM

The Faculty Training Program Cohort 2024 - 2026 gained many experiences in their first month of the program. so far this summer, AI4OPT members met with the FTP participants for formal presentations, Q&A sessions and social outings.



Meet the Participants

AI Institute for Advances in Optimization

JOIN OUR TEAM!

JOB POSITION
SR. SYSTEMS/IT ARCHITECT MANAGER
(REMOTE)

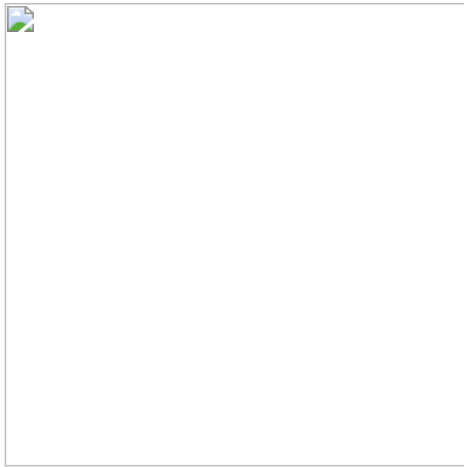
MORE INFORMATION
ai4opt.org/about/positions

JOB POSTING

Join the AI4OPT team to develop AI and optimization solutions for energy, supply chains, mobility, manufacturing, and chip industries. Lead projects from design to deployment, covering backend engineering, data analysis, documentation, maintenance, and testing. To learn more, click the post below.

Accomplishments and Announcements

WELCOME MICHAEL BUTROS TO AI4OPT!



We are excited to introduce **Michael Butros** as the newest member of our team, serving as the Director of Education at AI4OPT. Michael joins us following his tenure at Victor Valley College, where he led the Physics Department and promoted innovative teaching methods in physics and mathematics. During his time at VVC, Michael launched the use of technology and computation in education, employing techniques such as Mastery Grading, Peer Instruction, Inquiry-Based Learning, and Flipped Classrooms to enhance student learning outcomes.

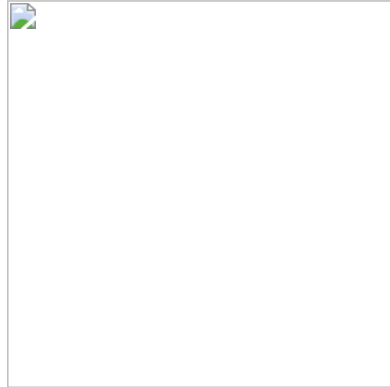
His experience and commitment to advancing education make him a valuable addition to AI4OPT. Please join us in welcoming Michael Butros to our institute!

AI4OPT MEMBER AWARD RECOGNITIONS



Daniel Molzahn

received the College of Engineering Outstanding Teacher Award (Early Career) at Georgia Tech, recognizing excellence in teaching among junior faculty.



Thomy Phan

was awarded an ACM Professional Membership for serving as a peer reviewer for GECCO 2024.



Juba Ziani



Guancheng Qiu

received the prestigious NSF CAREER Award, honoring junior faculty who excel in research, education, and organizational mission integration.

won the AI4OPT Best Poster Award for creating the top student-made poster during the 2024 AI4OPT retreat.

Publications

The latest AI4OPT publications are now available on [Google Scholar](#).

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