

AARON FERBER

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aaron-ferber.github.io

PhD Student – Artificial Intelligence, Deep Learning, and Discrete Optimization for Social Impact

EDUCATION

PhD - Computer Science Engineering
University of Southern California

Graduation: September 2023

PhD - Computer Science Engineering
Georgia Institute of Technology, Presidential Fellow

Transferred: Dec 2017

Bachelors of Science – Dual degree in Computer Science / Operations Research and Information Engineering
Cornell University, Dean's List for Excellence in Scholarship

Graduation: May 2017

EXPERIENCE

PhD Student – University of Southern California

Aug 2017 - Present

Finance, Wildlife Trafficking, Virtual Reality, Recommendation Engines

Mentors: Bistra Dilkina, Milind Tambe, Yisong Yue, Meredith Gore, Burcu Keskin, Bryan Wilder

- Developed differentiable discrete optimization layers for training machine learning + optimization pipelines end-to-end.
- Deployed to settings in wildlife conservation, finance, virtual reality device design, and recommendation systems
 - 32% higher avg returns: Portfolio Optimization
 - 182x more recommendations per second: Meta Advertisement Recommendation
 - New nanoscale VR parts designed with AI + Photonics: Metaverse
 - 13% higher wildlife trafficking detection rates
- Improved optimization solver speed by identifying core problem structure using deep learning
- Social good projects:
 - ML modeling of neighborhood crime impact on childhood stress
 - Supply chain interdiction for wildlife trafficking with a focus on Pangolin trade
 - Embedded shortest path solver in deep neural network to predict wildlife trafficking routes
 - Built tools to interdict illegal fishing / transshipment activities

Research Intern – Meta AI (FAIR) headquarters in Menlo Park, CA

May 2022 – Jan 2023

Virtual Reality, Recommendation Engines

Mentors: Yuandong Tian, Benoit Steiner

- Developed SurCo, a framework for nonlinear combinatorial optimization using differentiable optimization
- SurCo outperforms Meta's existing methods in recommendation systems by and inverse photonic design

Research Intern – NEC Labs in Princeton, NJ

May 2021–Aug 2021

Video Object Tracking

Mentor: Alexandru Niculescu-Mizil

- Designed a novel algorithm to train deep learning models with downstream reasoning modules end-to-end, focused on

Data Scientist, Research Assistant – Cornell University

Jan 2014 - May 2017

Citibike Bikeshare Logistics

Mentors: David B. Shmoys, Shane G. Henderson, David P. Williamson

- Optimized Citi Bike bikeshare system to increase daily trip capacity from 20,000 to >60,000 trips
- Designed demand prediction system to increase bike traffic prediction accuracy by 62%
- Constructed mathematical models to expand system by 130 stations and demonstrate provable need for 2,000 more bikes
- Reduced runtime of daily system-wide optimization from 24hr to 10min with linear algebra and parallelization
- Developed and improved web tools for Citi Bike staff with Google App Engine using Python, HTML, JavaScript, D3, and SVG

Machine Learning Engineer – Microsoft Azure headquarters in Bellevue, WA

May - Aug 2016 & 2017

Service Account Monitoring, Anomalous Logins, Automatic Pentesting

Mentors: Malcolm Davis, Ram Shankar Siva Kumar

- Designed and tested deep learning model to flag suspicious Azure service accounts, external logins, and privilege escalation
- Demonstrated a 46% increase in real threat detection for external Azure endpoints
- Developed deep generative attack bot which automates penetration testing and external cybersecurity evaluation

RESEARCH PUBLICATIONS

- **Ferber, A.**, Huang, T., Zha, D., Schubert, M., Steiner, B., and Dilkina, B., & Tian, Y., SurCo: Learning Linear Surrogates for Combinatorial Nonlinear Optimization Problems. *ICML 2023*
- Huang, T., **Ferber, A.**, Tian, Y., Dilkina, B., & Steiner, B. (2023). Searching Large Neighborhoods for Integer Linear Programs with Contrastive Learning. *ICML 2023*

- **Ferber, A.**, Griffin, E., Dilkina, B., Keskin, B., & Gore, M. Predicting Wildlife Trafficking Routes with Differentiable Shortest Paths. *CPAIOR 2023*
- Gore, M., Hilend, R., Prell, J.O., Griffin, E., Macdonald, J.R., Keskin, B.B., **Ferber, A.** and Dilkina, B., 2023. A data directory to facilitate investigations on worldwide wildlife trafficking. *Big Earth Data 2023*
- Huang, T., **Ferber, A.**, Tian, Y., Dilkina, B., & Steiner, B. Local Branching Relaxation Heuristics for Integer Linear Programs. *CPAIOR 2023*
- Gore, M., Griffin, E.C., Dilkina, B., **Ferber, A.**, Griffis, S., Keskin, B.B., & MacDonald, J., Advancing Interdisciplinary Science for Disrupting Wildlife Trafficking Networks. *PNAS 2022*
- **RRBM Honor Roll:** Keskin, B.B., Griffin, E.C., Prell, J.O., Dilkina, B., **Ferber, A.**, MacDonald, J., Hilend, R., Griffis, S. & Gore, M., Quantitative Investigation of Wildlife Trafficking Supply Chains: A Review. *Omega 2022*
- **Ferber, A.**, Song, J., Dilkina, B., & Yue, Y. (2022, June). Learning Pseudo-Backdoors for Mixed Integer Programs. *CPAIOR 2022*
- Gupta, U., **Ferber, A.**, Dilkina, B. & Ver Steeg, G. Controllable Guarantees for Fair Outcomes via Contrastive Information Estimation AAAI 2021
- **Ferber, A.**, Wilder, B., Dilkina, B., & Tambe, M. MIPaal: *Mixed Integer Program as a Layer*. AAAI 2020
- Paul, A., Freund, D., **Ferber, A.**, Shmoys, D. B., & Williamson, D. P. Budgeted Prize-Collecting Traveling Salesman and Minimum Spanning Tree Problems. *Mathematics of Operations Research 2019*
- Chung, H., **Ferber, A.**, Freund, D., Greenwald, J., Henderson, S. G., Jiang, N., Noone, T., O'Mahony, E., Paul, A., Shmoys, D. B., Wiberg, H., & Williamson, D., P., Optimizing Citibike. *CompSust DC 2017*

ORGANIZATION EXPERIENCE

Project Manager: QuantSC 2022 FTX market making competition team of 4 lead

Session Chair: INFORMS 2020 Fairness in Optimization and Machine Learning: ~100 virtual attendees

Workshop Organizer: NeurIPS 2020 Learning Meets Combinatorial Algorithms (LMCA): ~120 virtual attendees

Co-Organizer: Computational Sustainability Doctoral Consortium (2018, 2019): (46, 63) in-person attendees

TEACHING EXPERIENCE

- **Artificial Intelligence for Social Good @USC** Teaching Assistant, Lecturer: Spring 2019, Fall 2019
- **Engineering Applications of Operations Research @Cornell** Teaching Assistant: Spring 2015, Spring 2016
- **Introduction to Analysis of Algorithms @Cornell** Teaching Assistant: Spring 2016
- **Introduction to Computing Using Python @Cornell** Tutor: Fall 2013, Spring 2014, Fall 2014
- **Object-Oriented Programming and Data Structures @Cornell** Tutor: Spring 2014, Fall 2014, Fall 2015

SERVICE / INDEPENDENT PROJECTS

- Mathematical optimization specialist & programmer for [FinRL](#), a reinforcement learning for finance library
- Technical advisor to Hygeia Medical, a reproductive and public health NGO in Madagascar <https://hygeiamedical.org/>
- Quality improvement for Electronic Health Record for a Neurology practice in New Jersey
- Data Scientist for Omdena COVID challenge measuring domestic violence & unemployment: [blog post](#)
- Algorithm designer / data scientist for COVID testing site placement tool <https://cais.usc.edu/projects/testing-site-allocation>
- Volunteer LXAI (LatinX in AI)

SKILLS

Expertise: Deep Learning, Computer Vision, Natural Language Processing, Operations Research, Optimization, Simulation

Programming and Markup Languages: Python, C++, C, Java, Objective-C, Javascript (React), Matlab, OCaml, Julia

Machine Learning & Data Analysis: Tensorflow (Python + C), PyTorch, JAX, Scikit-Learn, Pandas, GeoPandas, Numpy (Python + C), Weights and Biases, AWS, Azure, GCP, Portfolio Optimization, Geocoding, PostGIS, Parallelization, Hyperparameter Optimization, FinRL, Alpaca, Qlib, Facebook LLaMA, Stable Diffusion, Pytorch Geometric, DGL

Operations Research Expertise: Linear / Nonlinear / Discrete / Semidefinite Programming, Financial Optimization, Simulation

Languages: English (Native), Spanish (Fluent), French (C2 Level)

ADVANCED COURSES

Cornell:

- CS 6784 (PhD Level): Advanced Topics in Machine Learning
- CS 6820 (PhD Level): Analysis of Algorithms
- CS 6700 (PhD Level): Advanced Artificial Intelligence
- CS 6840 (PhD Level): Algorithmic Game theory
- CS 6850 (PhD Level): The Structure of Information Networks
- ORIE 5370 (Masters in Finance Level): Optimization Modeling in Finance
- ORIE 5582 (Masters in Finance Level): Monte Carlo Methods in Financial Engineering

Georgia Tech:

- ISyE 8871 (PhD Level): Multi-objective Optimization
- ISyE 6661 (PhD Level): Linear Optimization