

JUNYANG CAI

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<https://github.com/caidog1129>

EDUCATION

University of Southern California

Ph.D. in Computer Science

Los Angeles, CA

Aug 2023 - Present

- Advisor: Bistra Dilkina
- Research interest: Machine Learning + Optimization, AI for Science

Bucknell University

B.S. in Computer Science & Engineering; B.A. in Mathematics

Lewisburg, PA

Aug 2019 - May 2023

- Overall GPA: 3.98 / 4.0
- Summa Cum Laude
- Member of Phi Beta Kappa, Omega Rho, Pi Mu Epsilon Honor Society

PUBLICATIONS

1. **Junyang Cai**, Taoan Huang, Bistra Dilkina. Learning Backdoors for Mixed Integer Programs with Contrastive Learning. Under Submission.
2. Jiatai Tong, **Junyang Cai**, Thiago Serra. Optimization Over Trained Neural Networks: Taking a Relaxing Walk. Under Submission.
3. **Junyang Cai***, Nguyen Nguyen*, Nishant Shrestha, Aidan Good, Ruisen Tu, Xin Yu, Thiago Serra. Getting away with more network pruning: From sparsity to geometry and linear regions. *International Conference on Integration of Constraint Programming, Artificial Intelligence, and Operations Research (CPAIOR) 2023*.
4. **Junyang Cai**, Christopher M. Haggerty, Joshua V. Stough. Co-UNet-GAN: a Co-Learning Domain Adaptation Model on Echocardiography Segmentation. *Proceedings Volume 12464, Medical Imaging 2023: Image Processing; 124641B*.

* equal contribution

ONGOING RESEARCH PROJECT

Finding Pseudo-Backdoors for MIP with Contrastive Learning

Aug 2023 - Present

Supervised by Professor Bistra Dilkina, University of Southern California

- Propose a machine learning approach for quickly solving Mixed Integer Programs (MIPs) by learning to prioritize sets of branching variables at the root node which result in faster solution times.
- Use Monte-Carlo Tree Search to find backdoors and Contrastive Learning to select backdoors, then compare the performance with the baseline methods.

RESEARCH EXPERIENCE

Modeling Carceral Algorithms for Pennsylvania Prison System

Mar 2022 - May 2023

Supervised by Professor Nathan Ryan, Bucknell University

- Implemented sequence alignment algorithm with non-uniform time and distance intervals and applied the algorithm to analysis similarity between prisoners.
- Performed network analysis and made predictions of parole decisions based on movement information and personal data of prisoners.

Pruning Neural Networks Based on Linear Regions

Jan 2022 - May 2023

Supervised by Professor Thiago Serra, Bucknell University

- Analyzed ways of pruning neural networks to increase their accuracy.
- Studied faster ways to approximate the linear regions in the neural networks and construct the upper bounds formula of linear regions for pruned networks.
- Performed neural network pruning based on the sparsity arrangement that leads to the highest upper bound and achieved better accuracy in both fully connected and convolutional neural networks.

Domain Adaptation on Echocardiography Segmentation

Sept 2021 - Feb 2023

Supervised by Professor Joshua Stough, Bucknell University

- Used Convolutional Neural Networks to automatically segment echocardiography images, which can provide useful information and guide doctors to detect heart diseases.
- Trained the segmentation network and an image translation generative adversarial network (GAN) together to generalize performance across domains given supervised data only in the source domain.
- Obtained mean absolute error of 9.67% on our model outperforms a previously published model.

Named Entities Recognition of Epitaphs in the Song Dynasty

Sept 2021 - May 2022

Supervised by Professor Song Chen, Bucknell University

- Developed methods based on computer platforms to reduce the substantive work of human annotators when dealing with historical documents.
- Applied regular expression to extract kinship relationships from epitaphs. Developed algorithms and implemented node disambiguation using born place and death year information.
- Built a two-mode network to analyze the different families and their relationships in Song Dynasty.

PRESENTATIONS

Oct 2023 (Oral) Getting away with more network pruning: From sparsity to geometry and linear regions. *INFORMS 2023*

Feb 2023 (Oral) Co-Unet-GAN: a Co-Learning Domain Adaptation Model on Echocardiography Segmentation. *SPIE Medical Imaging 2023: Image Processing*

AWARDS AND FELLOWSHIPS

2023 INFORMS 2023 Undergraduate Operations Research Prize Finalist

2023 Viterbi School of Engineering/Graduate School Fellowship

2023 The Bucknell Prize in Computer Science and Engineering

2022 Ciffolillo Healthcare Technology Inventors Program

SKILLS

Languages: Python, C, Java, C++, Matlab, LATEX

Software: Gurobi, PyTorch, Scikit-learn, Matplotlib