AKHILESH SONI

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Career Summary

Ph.D. candidate in operations research with expertise in mathematical modeling, optimization, and machine learning.

Education

University of Wisconsin-Madison **Madison, WI**

- Ph.D. in Industrial & Systems Engineering (Operations Research) *Aug 2023 (expected)*
  Thesis: "Discrete optimization methods for scheduling and matrix completion"
- M.S. in Computer Science, GPA: 3.82/4.0 *May 2022*
- M.S. in Industrial & Systems Engineering, GPA: 3.69/4.0 *Dec 2019*

Indian Institute of Technology (IIT) Dhanbad **Dhanbad, IN**

- B.Tech. in Mechanical Engineering (Hons), GPA: 9.32/10 *May 2017*
- Minor in Financial Management

Skills

- **Technical strengths:** Linear, discrete, stochastic & non-linear optimization ■ Combinatorial optimization ■ Simulation modeling ■ Time-series forecasting ■ Supervised & unsupervised learning
- **Languages:** Python ■ Java ■ Julia ■ AMPL ■ MATLAB
- **Tools:** Emacs ■ UNIX ■ Version Control ■ Gurobi ■ High-throughput computing ■ LaTeX ■ PyTorch ■ Scikit-learn ■ NumPy ■ Pandas ■ Matplotlib ■ Jupyter ■ AWS ■ SQL ■ Prophet ■ Arena ■ MS Office ■ PyCharm

Work Experience

University of Wisconsin-Madison

- *Research Assistant*, Collaboration with American Family Insurance *Sep 2020-Present*
  Integer programming-based methods for subspace clustering and matrix completion problems:
  - Built a unified mixed-integer programming framework (MISS-DSG) for the subspace clustering problem, integrating the use of Benders decomposition and column generation.
  - MISS-DSG outperforms state-of-the-art methods by 5-20% in low-affinity and high-missing data regimes.
  - Proposed novel integer-programming formulations for the low-rank binary matrix completion problem, and derived an explicit description for the convex hull of matrix element in the decomposition.
- *Research Assistant*, Collaboration with ExxonMobil Corporation *Sep 2018-May 2020*
  Mixed-integer linear programming for crew scheduling in shale oil field:
  - Developed a rolling horizon framework for crew scheduling based on mixed-integer programming, and derived a new family of valid inequalities to strengthen LP relaxation of the formulation.
  - Proposed approach resulted in 4-6% ($\approx$ \$ 10MM) improvement in net present value over greedy heuristic.
- *Teaching Assistant*, ISyE 323-Operations Research *Jan 2020-May 2020*
  - Conducted weekly discussion sections, created quizzes, and graded assignments and tests. Rating: 4.7/5

Amazon.com

- *Research Scientist Intern*, Graph representation learning for network design *June 2021-Aug 2021*
  - Developed an end-to-end framework consisting of a graph neural network and a multilayer perceptron to learn network topology and predict the probability of path selection by a network design model.
  - Achieved a reduction of 55% in solution time by using estimated probabilities to prune the path search space of the mixed-integer optimization model.
- *Research Scientist Intern*, Regional decomposition for network design *May 2020-Aug 2020*
  - Devised a regional decomposition technique for solving a large-scale middle-mile network design problem, leveraging local structure of the network with Lagrangian decomposition.
  - Achieved a reduction of 75% in solution time with the decomposition approach.

Schneider National

- *Supply Chain Engineering Intern*, Time series forecasting for truckload rates *June 2019-Aug 2019*
  - Developed a cost forecasting model to predict carrier freight rates in the spot market in the USA.
  - Achieved an improvement of 15% in accuracy over the existing model using an additive regression model.

Publications

- Soni, A., Linderoth, J., Luedtke, J., Pimentel-Alarcón, D. (2021) Integer programming approach to subspace clustering with missing data, *OPT2021: 13th Annual Workshop on Optimization for Machine Learning, NeurIPS*
- Soni, A., Linderoth, J., Luedtke, J., Rigterink,F. (2020) Mixed-integer linear programming for scheduling unconventional oil field development, *Optimization and Engineering*
- Soni, A., Atakans, S., Regional decomposition for network design using Lagrangian relaxation (*In-preparation*)
- Soni, A., Linderoth, J., Luedtke, J., Pimentel-Alarcón, D., Binary matrix completion (*In-preparation*)

Conference Presentation

Mixed Integer Programming Workshop

- Integer programming approach to high-rank matrix completion *May 2021*
- Mixed integer programming for unconventional oil field development. *May 2020*

INFORMS Annual Conference & INFORMS Optimization Society

- Integer programming approach to subspace clustering with missing data *Mar 2022*
- Integer programming approach to subspace clustering with missing data *Oct 2022*

NeurIPS, Optimization and Machine Learning Workshop

- Integer programming approach to subspace clustering with missing data *Dec 2021*

Academic Projects

- **Case study on facility planning:** Evaluated supply chain configurations for a fabric manufacturer using an ARIMA model for demand forecasting and (T,S) policy for inventory planning. Reduced working capital and lead time by 54% and 18%, respectively.
- **Temporal resource allocation for COVID-19:** Proposed a multi-stage stochastic program for the ventilator relocation problem and used stochastic dual dynamic programming algorithm to solve the model.
- **Soccer analytics:** Worked with Premier League soccer dataset of 20 seasons to predict outcome of a soccer match. Achieved 60% accuracy by training neural network on a subset of features selected by a random forest model.

Graduate Coursework

- *Industrial & Systems Engineering*: Intro to Optimization, Linear programming, Integer programming, Engineering models for supply chain, Stochastic modeling, Simulation modeling, Stochastic programming, ML in Action
- *Computer Science & Maths*: Algorithms, Nonlinear programming, Matrix methods in machine learning, Combinatorial optimization, Mathematical foundations of machine learning, Dynamic programming, Real analysis

Academic Achievements

- Spotlight presentation, Optimization and machine learning workshop, NeurIPS, 2021
- Travel grant for mixed-integer programming workshop, 2021
- Recipient of Vinod K & J. Gail Sahney Scholarship at UW-Madison, 2020
- Recipient of Mitacs Fellowship to intern at University of Windsor, Canada, 2016

Service

- Reviewer: Annals of Operations Research
- President of INFORMS UW-Madison Chapter, 2021-2022

References

- Prof. Jeff Linderoth, Dept. of Industrial & Systems Engineering, UW-Madison, linderoth@wisc.edu
- Prof. Jim Luedtke, Dept. of Industrial & Systems Engineering, UW-Madison, jim.luedtke@wisc.edu