

# Charupriya Sharma

## Machine Learning PhD Student



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## About Me

I am a PhD student in Machine Learning with a masters in optimization and top-tier publications (AAAI). I combine expertise in

1) **ML and Statistics:** Bayesian Methods, Causal Inference, Deep Learning,

2) **Optimization:** Linear, Integer, Combinatorial Optimization, Algorithm Design

3) **Implementation:** Python, R, Bash, C/C++, Java, ... to solve problems.

I am looking for opportunities to learn, challenge myself and have real-world impact.

## Education

**PhD in Computer Science** 2021

Artificial Intelligence  
University of Waterloo, Canada

**Masters of Mathematics** 2017

Combinatorics and Optimization  
University of Waterloo, Canada

**Bachelor of Technology** 2015

Computer Science and Engineering  
IIT-Delhi, India

## Skills

**Languages:** Python, R, Bash, C/C++, Java, OpenGL, MATLAB

**Machine Learning:** Tensorflow, PyTorch, Keras, XGBoost, Scikit-Learn

**Optimization:** CPLEX, Coin-OR, Boost

**Databases:** Gremlin, Terrier, Neo4j

**Other:** CUDA, Unix, D3.js, Verilog

## Course Work

**Machine Learning:** Deep Learning, Statistical Computing, Information Retrieval, Artificial Intelligence, Information Theory

**Optimization:** Combinatorial Optimization, Randomized Algorithms, Graph Theory

**Databases:** Information Retrieval

**Graphics:** GPU Computing, Splines

## Selected Research Projects

- 09.18–now **Structured Representations of Conditional Probability Distributions**  
Developed an algorithm (Python, Java) for learning Bayesian networks with Noisy-OR and logistic regression with performance guarantees for model averaging (90%+) and Bayesian inference ( $\sim 99\%$ ). We learn latent variables and can handle Gaussian and discrete data.
- 05.20–now **Simplex Optimization with Deep Reinforcement Learning**  
Developed a deep reinforcement learning algorithm (Python) for learning custom pivots for the simplex algorithm to speed up linear programming solvers.
- 01.20–now **Bayesian Model Averaging Toolkit**  
Developed a tool for querying, analysis and inference on an ensemble of Bayesian network with close to optimal score, learned with BIC, BDeu, Noisy-OR and logistic and spline regression for non-specialist use.
- 10.18–12.18 **Theorem Proving with Deep Reinforcement Learning**  
Developed a deep reinforcement learning algorithm (Python) for automatic theorem using Monte Carlo tree search and LSTM.
- 09.17–08.18 **Finding All Bayesian Network Structures within a Factor of Optimal**  
Designed an algorithm (C++) to find all high scoring Bayesian networks to address uncertainty in data using model averaging. Solved benchmarks 2X larger than state of the art.
- 03.18–04.18 **Multi-Dimensional Truncated Hierarchical B-Splines**  
Rendered surfaces using truncated-hierarchical B-splines (C++,R) to handle local refinement in B-spline multi-dimensional surfaces
- 09.15–08.17 **Technology Diffusion on Weighted Graphs**  
Designed polynomial time algorithms and polyhedral characterizations (CPLEX) for weighted cycles and spider graphs in the non-submodular seed minimization and influence maximization case.
- 03.15-04.15 **Voronoi Diagrams on the GPU**  
Adapted jump flooding algorithm (CUDA) for streaming to improve computation of generalized 3D Voronoi Diagrams on GPU. Achieved  $\sim 8X$  speedup for kernel time and memory transfer.

## Open Source

- 05.20–now **CyLP**  
Provided documentation for functions and error codes to interact with simplex solver methods in Coin-OR using Python.
- 10.19–12.19 **JavaBayes 8**  
Modified JavaBayes from Java 1.1 to Java 8. Provided scripts for fast Bayesian inference batch queries.
- 04.18–09.19 **GOBNILP**  
Relaxed pruning rules and provided methods to enumerate all high scoring Bayesian networks. Available in both Python and C++.

## Publications

A Score-and-Search Approach to Learning Bayesian Networks with Noisy-OR with Z. A. Liao, J. Cussens and P. van Beek.  
(*Proceedings of Probabilistic Graphical Models*, 2020)

Structural Properties of Bayesian Network within a Factor of Optimal. with Z. A. Liao, J. Cussens and P. van Beek. (*Under Review*)

Learning Bayesian Networks using Spline Regression with J. Cussens and P. van Beek. (*Under Review*)

Finding All Bayesian Network Structures within a Factor of Optimal. with Z. A. Liao, J. Cussens and P. van Beek.  
(*Proceedings of the AAAI Conference on Artificial Intelligence*. Vol. 33. 2019.)

Learning to search more efficiently from experience: A multi-heuristic approach. with S. Aine and M. Likhachev. (*Symposium on Combinatorial Search*, 2015.)