Neha

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Final Year Ph.D. Candidate in Operations Management

Education

August 2021 - 2026 **PhD in Operations Management, Tepper School of Business, Carnegie Mellon University, Pittsburgh**, *Pennsylvania*.
- Minor in Operations Research, GPA: 3.77/4.0

August 2019-2021 **Masters in Operations Management, Tepper School of Business** , *GPA: 3.77/4.0*.

July 2011-2016 **Integrated Bachelors & Masters of Science, Mathematics & Computing, Indian Institute of Technology, Kharagpur (IIT Kharagpur), India**, *GPA: 8.7/10*.

PhD Research Projects

Spring 2023 - Fall 2025 **Optimizing School Bus Pickups with Third-Party Coordination and Delay Prediction**.
- Mentors: Prof. Peter Zhang, Prof. Holly Wiberg
- Frequent school bus delays (due to heavy traffic, harsh weather conditions, and driver shortage) and no-shows of school buses have posed societal and educational burdens.
- We propose a *data-driven optimization* approach to address the daily school bus routing problem in the presence of uncertain delays caused by adverse weather and traffic conditions within the school bus network.
- Developed *Machine Learning* models that produced reliable predictions from **highly imbalanced data** and embedded them in optimization pipelines for decision-making.

Summer 2020 - Spring 2021 **School Bus Sharing Across School Districts**.
- Mentors: Prof. Peter Zhang, Prof. Hai Wang, Prof. John Hooker
- Studied the tactical design of *school bus collaboration* among schools across school districts as a cooperative game where multiple levels of players (i.e., schools, school districts) with different objectives are involved.
- Derived closed-form analytical approximations for bus operating costs and student travel times, to evaluate cooperation in shared networks.
- Identified optimal collaboration conditions, demonstrating that cross-district routing reduces total system costs while maintaining student service levels (ride time constraints).

Summer 2021 - Present **Conditional Promotion Offers to Encourage Loyalty**.
- Mentors: Prof. Alan Montgomery, Prof. Fatma Kilinc-Karzan
- With growing popularity of loyalty programs and the resulting collection of vast amount of customer purchase data, there is a potential of designing customized offers to target specific customer groups and increase their spending (thereby loyalty) at the firm.
- Analyzed a conditional promotion that is earned only after a certain spending threshold is reached over multiple periods and studied conditions that improves the customer utility and firms revenue in presence of offer.
- Analyzed conditions in which the stated conditional promotional offer is more beneficial to a firm than a regular offer (exercised without any spending threshold).

Patents and Papers

- Optimizing School Bus Pickups with Third-Party Coordination and Delay Prediction. *In preparation for submission to Transportation Research Part C*.
- School Bus Sharing Across School Districts. *In preparation*.
- Conditional Promotion Offers to Encourage Loyalty. *In preparation*.
- **N. Singh**, T. Rambha: "Offline Optimization of Cab Supply for Ride-Sharing Applications using Hypergraph Matching." **Accepted for publication in World Conference on Transport Research (WCTR 2019)**.
- U.S. Patent, 20180003US01: "Method and system for dynamic trust model for personalized recommendation system in shared and non-shared economy," Filed November 2018.

Past Employment

July 2016 – April 2018 **Research Engineer**, *Algorithms and Optimization Group, Xerox Research Centre (XRCI), Bangalore, India*.
- Mentor: Dr. Koyel Mukherjee, Research Scientist at Adobe Research

May 2018 – June 2019 **Project Associate**, *Centre for infrastructure, Sustainable Transportation and Urban Planning (CiSTUP), Indian Institute of Science (IISc), Bangalore, India*.
- Mentor: Prof. Tarun Rambha, Associate Professor, IISc Bangalore

Technical Skills

Languages **Advanced:** Python, C++, Java, C. **Intermediate:** R, MATLAB.

Packages **Advanced:** Cplex, Gurobi, Gurobi-machinelearning, Pytorch, Pandas, Scikit-learn .

Relevant Coursework

Theory Discrete Mathematics, Design & Analysis of Algorithms*, Operations Research*, Graph Theory and Algorithms, Optimization Techniques in Finance, Linear & Modern Algebra, Real & Functional Analysis, Measure Theory & Integration, Non-Linear Programming, Regression and Time Series Model, Stochastic Processes, Markov Decision Processes, Statistical Inference, Intermediate Statistics, Bayesian Statistics, Discrete Choice Theory and Modeling Applications in Transportation, Linear Programming, Integer Programming, Dynamic Programming, Machine Learning, Probability and Mathematical Statistics (graduate level), Convex Optimization.

Academic Distinctions and Awards

- William Larimer Mellon Fellowship 2019-2024.
- Recipient of Mitacs GlobalInk Fellowship Grant 2015.
- INSPIRE scholarship and mentorship grants from Department of Science & Technology, Government of India for outstanding academic performance in 4 consecutive years (2012-2016).
- Consistently ranked among top three students throughout ten semesters in Math department.
- Offered a department change to Mathematics for outstanding performance at the end of freshman year, IIT Kharagpur (75 in the batch of 1300 students were offered this opportunity).

Internships and Research Experience (Before PhD)

April 2018 – August 2019 **Improved matching and routing algorithms for ride sharing**, IISc Bangalore, India.
- Mentor: Prof. Tarun Rambha
- Studied the problem of finding a robust lower bound to the number of vehicles needed to serve known short-term demand that can be used for regulatory policies.
- Employed a divide-and-conquer framework to construct a non-uniform hypergraph representing trips that can be shared and formulated a matching problem to solve for the optimal number of vehicles.
- Validated the proposed model against existing **Dial-a-ride problem algorithms** and achieved huge **reduction in computational time** on the New York City yellow taxicab dataset.

January 2018 – April 2018 **Dynamic trust model for ride recommendation in shared environment**, XRCI.
- Mentor: Saurabh Srivastava, Research Scientist, Google, India
- Built a **TrustCircle model** using ground truth data collected on user preferences for taking different rides.
- Designed ride recommendation as **contextual multi-arm bandit** and modified **LinUCB** algorithm to solve it.
- Trained the model to learn preferences via user feedback on previous recommended rides in an online fashion.
- Validated the model using **cumulative regret (CR)** and **frobenius Norm** of estimated theta vs actual.

October 2016 – March 2017 **XhareCost: Online strongly individual rational cost sharing scheme**, XRCI.
- Mentors: Prof. Ragavendranan Gopalakrishnan, Dr. Koyel Mukherjee, Raja Subramaniam Thangaraj (InMobi)
- Implemented the **fair pricing model** that included a disutility cost to account for inconveniences in ride sharing.
- Estimated optimal values for parameters like degree of disutility, etc., through simulations on different datasets.
- Added the validated pricing module within the **GoCity trip planning apps**.

July 2016 – October 2016 **CommuteShare: Offline scheduling & routing of cabs for employee commute**, XRCI.
- Mentors: Dr. Koyel Mukherjee, Raja Subramaniam Thangaraj
- Used employee travel information to design an ILP (integer linear program) with exhaustive constraints on detours, time windows etc. and added strongly individual rational constraints to find the **optimum supply** of cabs to serve the employees.
- Observed superior results on Denver City data when compared to the routing algorithm of Lyft rideshare.

August 2015 – March 2016 **Triad Prediction in social network**, *Master's Thesis*, IIT Kharagpur.
- Mentor: Prof. Bibhas Adhikari, Department of Mathematics
- Proposed a new **similarity measure** using information in network structure to predict the formation of triads.
- Validated the proposed measure on the Twitter dataset collected for a week and inferred logical conclusions.