Aliakbar Izadkhah

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Education

Ph.D. in Chemical Engineering, Carnegie Mellon University, Pittsburgh, PA — September 2023
Research Area: Operations Research, Mixed-integer Linear Programming, Supply chain and Logistics
Coursework: Linear/Integer/Convex programming, Statistical Theory, Deep Learning
Award: Phillips and Huang Family Fellowship in Energy

M.Sc. in Mechanical Engineering, University of California Davis, Davis, CA — July 2018

B.Sc. in Chemical Engineering, Sharif University of Technology, Tehran, Iran — May 2016

Work Experience

Research Intern, Microsoft, Redmond, WA — May 2022 - Aug. 2022

- **Container Placement in Large-scale Distributed System**:
  Developed a low-latency scalable resource allocation strategy for Microsoft internal cloud computing system (COSMOS) with more than 300k serves.
  Through Reinforcement Learning approach, the allocation strategy captured specific characteristics of the system such as hardware heterogeneity demonstrated a significant increase of cloud system's throughput (Python, OpenAI gym, JAX, Haiku, COAX, SCOPE).

Research Experience

Ph.D. Researcher, Center for Advanced Process Decision-making, Pittsburgh, PA — Jan. 2019 - present

- **Exact Optimization Solver Package for Periodic Routing**:
  - Designed and implemented an exact customized Branch-Price-and-Cut (BPC) solver to tackle challenging variants of Periodic Vehicle Routing Problem (PVRP)
  - Introduced novel PVRP variants in context of BPC such as multi-day trips and workload balancing, all with significant theoretical implication and practical relevant to the supply chain and logistics sector (C++, CPLEX, Gurobi).
- **Flexible Days of Service in Last-Mile Distribution**:
  - Created a decision support framework for evaluating last-mile devilry policy for Linde PLC, the world's largest industrial gas company (C++, CPLEX).
  - Developed a forecasting scheme based on historic data on order placement and an exact routing optimization solver (branch-and-cut).
  - Proposed a flexible service day policy which leads to significant savings in the last-mile delivery operations
- **Vendor-managed Inventory Scheduling Optimization**:
  - Implemented an efficient delivery schedule search algorithm with a derivative-free optimization (DFO) solver and parallelized implementation, reducing computational cost by a factor of 10 (C++, Python, NOMAD4)

Project Experience

- **Movie Recommendation Platform** (MLOps)
  - Deployed a low-latency industrial-grade ML-based recommendation system for a movie streaming service serving 1 million customers and 27k movies with automatic updates and features such as A/B testing and data drift detector (Apache kafka, Python, Scikit-learn, Azure ML, Jenkins)
- **"Needle" Deep Learning Framework** (Deep Learning Systems)
  - Built a PyTorch-like deep learning framework, called Needle, from ground up, with CPU/GPU backend support containing standard functionalities such as automatic differentiation, optimizers, data loaders, loss functions, and and modular layers
  - Implemented a Neural ODE as an implicit layer within Needle and demonstrated its superior performance in learning physical systems (Python, Numpy, C++, CUDA)

– **Model Compression** (ML with Large Datasets)
  – Implemented multiple model compression techniques from scratch such as magnitude-based pruning for faster inference and reduced memory usage (Python, Tensorflow)

Technical Skills

Programming	Python, C/C++, SQL
Library/Framework	CPLEX, Gurobi, CBC, GAMS, NOMAD, Numpy, pandas, scikit learn, PySpark, TensorFlow, JAX, OpenAI gym, COAX, Azure, CUDA, Git

Coursework Highlight

Computer Science & Machine Learning: Data Structure & Algorithms, Introduction to ML, ML with Large Datasets, Deep Learning Systems, Machine Learning Production, Intermediate & Advanced Statistical theory
Operations Research: Linear/Integer/Quantum Integer/Convex programming, Convex Analysis

Selected Publications

Izadkhah, Aliakbar, Anirudh Subramanyam, et al. (2022). "Quantifying the impact of delivery day flexibility on last-mile delivery costs". In: *Digital Chemical Engineering*.

Izadkhah, Aliakbar, Yiwen Zhu, et al. (2022). "Cloud container assignment with Reinforcement learning". In preparation.

Izadkhah, Aliakbar, Akang Wang, et al. (2023a). "Incorporating knapsack cuts for Load balancing in periodic vehicle routing with service choice". Forthcoming.

– (2023b). "Periodic vehicle routing with multi-day Routes". Forthcoming.

Selected Presentations

"A Branch-Price-and-Cut Approach for Designing Optimal Periodic Schedules to Visit Vendor-Managed Customers" (2020). In: *INFORMS*.

"A Unified Branch-Price-and-Cut Framework for Various Classes of Periodic Vehicle Routing Problems" (2020). In: *INFORMS*.

"Effect of Flexible Delivery Windows during Multi-Period Vehicle Routing" (2021). In: *Transporation Research & Logistics*.

"Periodic Vehicle Routing with Trips Spanning Multiple Days" (2022). In: *INFORMS*.

"Workload Balancing in Periodic Distribution Scheduling and Routing Optimization" (2023). In: *INFORMS*.