# ZHICHAO HOU

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## EDUCATION

**Beijing Normal University, Beijing, China** *September 2016 - June 2020*
BS in Applied Mathematics GPA: 92.67/100
Liyun Class by the National Top-notch Talent Cultivation Plan

**Academy of Mathematics and Systems Science, Beijing, China** *September 2020-June 2023*
**& Institute for AI Industry Research, Tsinghua University, Beijing, China**
Joint Training MS in Applied Mathematics & Artificial Intelligence
Academic focus: Graph Neural Networks, Optimal Transport, Bioinfomatics

**Tufts University, Medford and Somerville, Massachusetts, United States** *June 2018-August 2018*
Exchange Student

## RESEARCH EXPERIENCE

—— Optimal Transport (Wasserstein Metric) ——

**Approximation Algorithms in Optimal Transport Wasserstein Distance** Adviser: Prof. Li Cui
*Computational Mathematics Laboratory, Beijing Normal University* *May 2018 - May 2019*

· Studied Sinkhorn algorithm based on entropy regularization theory
· Researched Gibbs-OT algorithm based on Boltzmann distribution
· Implemented Sinkhorn and Gibbs-OT algorithm in MINST dataset

**Wasserstein Distributionally Robust Optimization (WDRO)** Adviser: Prof. Lingyu Wu
*Operations Research Laboratory, Academy of Mathematics and Systems Science* *August 2019 - June 2020*

· Studied the theory of WDRO and deduced the analytical form of dual DRO
· Applied WDRO in ML problems (classification, regression, MLE, MMSE estimation)

**OT + X**

· SigC**W**GAN in Financial Sequential Data Generation (Intern in Beijing Ai-Quant Ltd)
· Inferring Relationships between scRNA-seq Data and Spatial Transcriptomics Data with **OT** Mapping

—— Machine Learning (GNNs, Intepretable ML ) ——

**Spatial-Temporal Attention Graph Neural Networks (STAGNN)** Advisor: Prof. Wenbing Huang
*Institute for AI Industry Research, Tsinghua University*
*Intelligent Transportation Department, Baidu* *March 2022 - Now*

· Leveraged Graph Learner to learn the graph structure from data instead of pre-defining it
· Constructed specific GNNs structure to capture the spatial dependencies in graphs
· Introduced attention mechanisms to model the temporal dynamics of the time series
· Implemented STAGNN on two time series prediction tasks:

- **Traffic** flow prediction: traffic flow-based adjacency matrix, multi-task learning
- **Protein** molecular dynamics: equivariant geometric GNNs

**PathExpSurv: Pathway Expansion and Factor Discovery** Advisers: Prof. Lingyu Wu & Zheng Xia
*Operations Research Laboratory, Academy of Mathematics and Systems Science*
*Computational Biology Laboratory, Oregon Health and Science University*

· Two-phase training scheme:
  - Pre-training phase: constructed a bio-informed NN based on KEGG Database and pre-trained it
  - Training phase: added penalty to the genes out of prior pathways and continued to train NN
· Pathways Expansion: expanded the prior pathways based on trained weights
· Downstream analysis of Expanded Pathways:
  - Compared the performance of expanded pathways with prior pathway and several baselines
  - Performed the single-gene survival analysis and the literature evidences searching to identify the key cancer disease drivers.
  - Performed enrichment analysis and recoverability testing to prove the model validity

**SCARP: scATAC-seq analysis via Network Refinement** Adviser: Prof. Lingyu Wu
*Operations Research Laboratory, Academy of Mathematics and Systems Science*

· Constructed the relation matrix based on the cell-peak accessible relationships and peak-peak co-accessibility.
· Aggregated information with the Network Refinement (NR) diffusion method.
· Leveraged SCARP to improve cell clustering performance and reveal new significant cell subpopulations.

## ADDITIONAL INFO AND AWARDS

Skilled in Python, Pytorch, Keras, Matlab, C, R, LaTex

Toefl : 99

First-class Scholarship of Beijing Normal University (3 consecutive years) *2017-2020*

First-class Prize of National Mathematical Modeling Contest *September 2018*

Third-class Prize of National Mathematics Competition *November 2018*

Honorable Mention of MCM *April 2019*