CURRICULUM VITAE

Lingchao Mao

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Research Interests

- Methodological developments in machine learning and deep learning:
  - Machine learning with limited supervision: Knowledge Informed Machine Learning, Self-supervised Learning, Weakly-supervised Learning
  - Multimodal learning with incomplete data
  - Data mining and subgroup identification
- Application domains: Healthcare Analytics, Medical Imaging, Biomedical Applications
  - Quantifying regional heterogeneity of brain cancer
  - Data-driven biomarker discovery of post-traumatic headache
  - Early prediction for Alzheimer's Disease
  - Automated segmentation and diagnosis from medical images

Education

- **Ph.D. Machine Learning** 2025
  Georgia Institute of Technology, Advisor: Dr. Jing Li
- **M.S. Computer Science** 2024
  Georgia Institute of Technology, GPA: 3.85/4.0
- **B.S. Statistics, B.S. Industrial and Systems Engineering** 2020
  North Carolina State University, GPA: 4.0/4.0, Dean's List all semesters

Selected Awards

- **Winner**, Data Analytics Competition, IISE DAIS, 2024.
- **Winner**, Mobile/Web App Competition, IISE DAIS, 2024.
- **Finalist**, Southeastern Regional Health Improvement Case Competition, Institute for Healthcare Improvement (IHI), 2024.
- **Best Student Paper Award**, IISE DAIS, 2022
- **Finalist for Best Student Paper Award**, INFORMS Conference of Service Science, 2021
- **Runners up for Best Poster Competition**, Quality and Productivity Research Conference, 2021
- **George F. Fellowship**, H. Milton Stewart School of Industrial & Systems Engineering, 2022
- **Williams S. Green Fellowship**, H. Milton Stewart School of Industrial & Systems Engineering, 2020
- **Stewart Fellowship**, H. Milton Stewart School of Industrial & Systems Engineering, 2020
- **NSF Travel Scholarship**, Quality and Productivity Research Conference, 2021

- **Caldwell Fellowship**, North Carolina State University , 2016-2020
- **Edward P. Fitts Sholar**, North Carolina State University, 2019
- **ISE Faculty Senior Award** (one student selected per department), NC State University, 2019
- **1st place**, DiamondHacks for Women in Computer Science at NC State University, 2019
- **1st place**, Deloitte StartUp Innovation Competition at NC State University, 2018
- **CiMs-Cellex Scholarship**, Cellex Foundation, Spain, 2013-2015

Publications

Journals

(P1) **Mao L**, Wang L, Hu L, Eschbacher J, Leon GD, Singleton K, Curtin W, Urcuyo A, Sereduk J, Tran L, Hawkins A, Swanson K, Li J. Weakly supervised transfer learning with application in precision medicine. *IEEE Transactions on Automation Science and Engineering.* doi:10.1109/TASE.2023.3323773

(P2) **Mao L**, Li J, Schwedt TJ, Berisha V, Nikjou D, Wu T, Dumkrieger GM, Ross KB, Chong CD. Questionnaire and structural imaging data accurately predict headache improvement in patients with acute post-traumatic headache attributed to mild traumatic brain injury. Cephalalgia. 2023 May; doi: 10.1177/03331024231172736. PMID: 37157808.

(P3) **Mao L**, Dumkrieger G, Ku D, Ross K, Berisha V, Wu T, Schwedt TJ, Li J, Chong CD. Developing multivariable models for predicting headache improvement in patients with acute post-traumatic headache attributed to mild traumatic brain injury: A preliminary study. *Headache: The Journal of Head and Face Pain 63(1).* doi:10.1111/head.14450

(P4) **Mao L**, Chu E, Gu J, Hu T, Weyner B, Su Y. A 4D theoretical framework for measuring topic-specific influence on Twitter: development and usability study on dietary sodium tweets *Journal of Medical Internet Research.* 2023. doi:10.2196/45897 http://dx.doi.org/10.2196/45897

Conference Papers

(C1) Ku D, Zheng Z, **Mao L**, Chen RQ, Su Y, Chen K, Weidman D, Wu T, Lure F, Lo S and Li J. A high-dimensional incomplete-modality transfer learning method for early prediction of Alzheimer's disease. *Alzheimer's & Dementia, 19, p.e078606.*. 2023, July. doi: 10.1002/alz.078606

(C2) **Mao L**, Vahdat K, Shashaani S, Swann J. Personalized predictions for unplanned urinary rract infection hospitalizations with hierarchical clustering. *AI and Analytics for Public Health: Proceedings of the 2020 INFORMS International Conference on Service Science (pp. 453-465)* (pp. 453-465). https://doi.org/10.1007/978-3-030-75166-1_34

Working Papers

(W1) **Mao L***, Wang H*, Li J. Knowledge-informed machine learning for cancer prognosis and predictions: a review. *(major revision at IEEE T-ASE).*

(W2) **Mao L**, Wang Q, Su Y, Lure F, Li J. Supervised multi-modal fission learning. *arXiv preprint arXiv:2409.20559 (2024).*.

(W3) **Mao L**, Li J, Schwedt T, Wu T, Ross K, Dumkrieger G, Smith D, Chong C. Identifying and Predicting Headache Trajectories Amongst Those with Acute Post-Traumatic Headache. *(major revision at Headache).*

(W4) Montoya A*, **Mao L***, Drewnowski A, Chen J, Shi E, Liang A, Weiner B, Su Y. Tracking influencers in policy field on social media: a global longitudinal study of dietary sodium reduction tweets, 2006-2022. *(major revision at Journal of Medical Internet Research).*

(W5) Kwak M, **Mao L**, Su Y, Chen K, Weidman D, Wu T, Lure F, Li J. A mutual knowledge distillation-empowered AI framework for early detection of Alzheimer's Disease using incomplete multi-modal images *(major revision at IEEE T-ASE)*.

(W6) Lewis E, **Mao L**, Wang L, Swanson L, Li J, Tran N, Leland Hu, Plaisier C. Revealing the biology behind MRI signatures in high grade glioma. medRxiv, 2023-12. doi: 10.1101/2023.12.08.23299733

(W7) Wang H*, **Mao L***, Zhang Z, Li J. A Holistic Weakly Supervised Framework for Liver Tumor Segmentation with Knowledge-Informed Label Smoothing. *(under review)*.

* co-first author

Conference Talks

(T1) Identifying and Predicting Headache Trajectories Amongst Those with Acute Post-Traumatic Headache. *American Headache Society 66th Annual Scientific Meeting*, June 13, 2024, San Diego, California (**selected oral presentation**)

(T2) Physical and emotional symptoms are associated with improvement of acute post-traumatic headache attributed to mild traumatic brain injury. *American Headache Society 66th Annual Scientific Meeting*, June 13, 2024, San Diego, California (poster)

(T3) A Holistic Weakly Supervised Approach for Liver Tumor Segmentation. *IISE Annual Conference*, May 19, 2024, Montreal, Canada (**DAIS Data Analytics competition winner**).

(T4) MMTrip: a Personalized Multi-modal Trip Planner. *IISE Annual Conference*, May 19, 2024, Montreal, Canada (**DAIS Mobile/Web Application competition winner**).

(T5) Multi-modal Fission Learning. *IISE Annual Conference*, May 19, 2024, Montreal, Canada.

(T6) Baseline Questionnaires and Longitudinal Headache Diary Data Predict Headache Improvement in Patients with Acute Post-Traumatic Headache Attributed to Mild Traumatic Brain Injury: Balancing Prediction Accuracy and Patient Burden. *5th Annual NIH HEAL Initiative Investigator Meeting*, February 8, 2024, Bethesda, Maryland (**selected oral presentation**)

(T7) Predicting Headache Improvement in Patients with Acute Post-traumatic Headache Attributed to Mild Traumatic Brain Injury Using Imaging, Clinical, and Speech Data: a Multi-Modality Machine-Learning Study. *American Headache Society Annual Scientific Meeting*, June 15, 2023, Austin, TX (**selected oral presentation**).

(T8) A Machine Learning Model Including Questionnaire and Structural Imaging Data Predicts Headache Improvement in Patients with Acute Post-traumatic Headache Attributed to Mild Traumatic Brain Injury. *American Academy of Neurology 2023 Annual Meeting*, April 25, 2023, Boston, MA (poster).

(T9) Questionnaire and Structural Imaging Data Predict Headache Improvement in Patients with Acute Post-traumatic Headache Attributed to Mild Traumatic Brain Injury: A Machine-Learning Study. *Fourth Annual NIH HEAL Initiative Investigator Meeting*, February 21, 2023, Bethesda, Maryland (**selected oral presentation**)

(T10) Predicting Headache Persistence in Patients with Acute Post-traumatic Headache Attributed to Mild Traumatic Brain Injury: a Preliminary Study. *American Headache Society Annual Scientific Meeting*, June 9, 2022, Denver, CO (poster)

(T11) Weakly Supervised Transfer Learning with Application in Precision Medicine. *IISE Annual Conference*, May 21, 2022, Seattle, WA. (**DAIS Best student paper**)

(T12) Multivariate models for predicting headache improvement in patients with acute post-traumatic headache attributed to mild traumatic brain injury using baseline clinical data: a preliminary study. *Third Annual NIH HEAL Initiative Investigator Meeting*, April 11, 2022 (poster).

(T13) Weakly Supervised Transfer Learning with Application in Precision Medicine. *INFORMS Workshop on Data Mining and Decision Analytics*, October 23, 2021 (poster).

(T14) A Hybrid Regression-Ranking Model with Application in Personalized Radiomics. *Quality and Productivity research Conference*, 2021 July 27, virtual. (**Best student poster runner-up**)

(T15) Personalized Predictions for Unplanned Urinary Tract Infection Hospitalizations with Hierarchical Clustering. *INFORMS Conference of Service Science*, 2020 December 20, virtual. (**Best student paper finalist**)

Work Experience

- **Machine Learning Software Engineer Intern** Meta — May - Aug 2024
- **Graduate Research Assistant,** Georgia Institute of Technology — 2020 - present
- **Industrial Engineering Co-op,** Hafele America Co. — Aug - Dec 2018 and 2019
- **System Operations and Data Analysis Intern,** FORT Capital Resources — May - Aug 2019

Research Projects

- **Precision medicine of brain cancer**. This research aims to develop personalized machine learning models to predict regional tumor cell density from MRI. My contributions included developing a novel weakly-supervised transfer learning (WS-TL) model that leverages domain knowledge about the tumor, which addresses the small sample problem while quantifying intratumoral heterogeneity; and building a GUI for non-technical users to run pre-operative and post-operative model to assist cancer treatment.

  This research is in collaboration with Drs. Kristin Swanson and Leland Hu at Mayo Clinic.

- **Prognosis of persistent post-traumatic headache.** This research develops predictive machine learning algorithms for the prognosis of post-traumatic headache based on neuroimaging (MRI, fMRI, DTI), clinical questionnaires, and mobile-collected speech data. My contributions include: 1) identifying biomarkers for headache persistence, 2) developing prognostic models of headache persistence, and 3) identifying patient subgroups with distinct headache evolution trajectories.

  This research is in collaboration with Drs. Catherine D. Chong and Todd Schwedt at Mayo Clinic.

- **Early prediction of Alzheimer's Disease.** This research aims to do early prediction of AD conversion from multi-modal neuroimaging and genetics data (MRI, PET, SNP). My contribution include: 1) developing a novel Supervised Multi-modal Fission Learning (MMFL) model for predictive modeling under incomplete-modality data, and 2) developing a new mutual student-teacher multi-modal learning model with theoretical analysis of the knowledge distillation effectiveness.

  This research is in collaboration with the ASU-Banner Neurodegenerative Disease Research Center

- **Analyzing Influence of Public Health Organizations on Twitter.** This project aims to assess health organization's influence on social media to derive dissemination strategy recommendations. We designed a four-dimensional framework to analyze topic-specific influence on Twitter. We applied this framework to 1M+ tweets from health organizations and analyzed their influence about dietary sodium intake, one of the risk factors of cardiovascular diseases.

  I mentored a masters, an undergraduate, and three high school students in this project.

- **Prediction of Unplanned Hospitalization of Medicare Patients**. This project developed machine learning models to predict unplanned hospitalization of eight types of common diseases and four type of adverse events by analyzing over 15M Medicare claims and various public datasets. My methodological contributions included co-developing a multi-layered feature selection and dynamic personalized scoring algorithm to predict monthly hospitalization risk for individual patients.

  Team selected top 25 out of 300+ teams into Stage I of the $1M CMS AI Health Outcomes Challenge.

Tools

- **MedAssist-Liver: an AI-powered Tool for Automated Liver Tumor Analysis** (link). This web application supports automated liver tumor segmentation from CT scans using deep learning, and automated diagnosis report generation using large language models (LLM).
- **Mendel AI, a LLM Assistant for Bioinformatics Data Analysis and Visualization.** (link) This chatbot assistant performs automated analysis of single cell RNA-seq data generating analysis plan, python code, and figures given users' biological question.

  This project is lead by Dr. Assaf Magen, former Assistant Professor at Precision Immunology Institute.
- **Sodium Reduction Policies in the U.S.** (link). This project compiled sodium reduction policies and laws in the U.S. from 1965 to 2022. This interactive dashboard allows users to analyze and visualize the distribution of policies by category, geographical region, and relationship with local sociodemographics.

  This project is lead by Dr. Yanfang Su, Assistant Professor at University of Washington.
- **MMTrip, a Personalized Multi-modal Routing Planner.** (demo) This trip planning app provides door-to-door routes optimizing through all multimodal combinations of flights, public transit, driving, biking, and walking. Trips can be personalized via user-defined preferences/constraints. Accurate cost projections powered by real-time APIs and machine learning predictions.

  This project is winner of the 2024 IISE DAIS Mobile/Web App Competition.

Grant Writing Experience

Helped Ph.D. advisor in preparation of the following grant applications. My involvement included literature review and participating in component section writing.

- NIH-NCI, "The Coordinating and Data Management Center for PDAC Stromal Reprogramming Research," unfunded, 2022 – 2027, $1,856,218 (GT share)
- NSF, "Collaborative Research: CPS: Medium: The Internet of Greens: A AI simulation platform to maximize crop productivity, resource use efficiency and sustainability in indoor farming," unfunded, 2023 – 2016, $800,000
- NIH-NIA, "STTR Phase IIB: Multi-Modality Image Data Fusion and Machine Learning Approaches for Personalized Diagnostics and Prognostics of MCI due to AD," unfunded, 2023 – 2016, $2,500,000

Teaching

- H. Milton Stewart Ph.D. Student Teaching Fellow
- Tutor, ISYE4031 Regression and Forecasting, the Center for Academics, Success, and Equity at Georgia Institute of University
- Teaching Assistant, ISE110 Computer-Based Modeling for Engineers, North Carolina State University
- Tutor, PY205 & PY208 Physics for Engineers I & II, the University Tutorial Center at North Carolina State University ((College Reading & Learning Association Level II))

Service and Leadership

- Reviewer
  - IEEE Transactions on Automation Science and Engineering (IEEE-TASE)
  - INFORMS Journal on Computing
  - International Conference on Learning Representations (ICLR)

  - BMC Medical Informatics and Decision Making
  - Journal of Electrical and Electronic Engineering

- Executive Board Member
  - Editor, INFORMS ORMS Tomorrow Magazine, 2024 - present
  - Advisory Committee, Caldwell Fellows at NC State University, 2023 - present
  - President, INFORMS Chapter at Georgia Tech, 2024 - present
    Chapter won the INFORMS QSR Chapter Activities Funding Award
  - Treasurer, INFORMS Chapter at Georgia Tech, 2023 - 2024
    Chapter won the INFORMS chapter Summa Cum Laude Award of the year
  - Project Manager, Society of Asian Scientists and Engineers (SASE) Chapter at NC State University, 2019 - 2020
  - Student HR Lead, Project Management Lite Internship program at the Office of Information Technology at NC State University, 2019 - 2020
  - Treasurer, IT Club at NC State University, 2018-2020

- Volunteering
  - Business Analyst, Consult Your Community (CYC) Chapter at NC State University, 2019
  - Geographic Information System Analyst, Habitat for Humanity, 2018
  - Guatemala Water Systems Team, Engineers Without Borders, 2018
  - Thailand Permaculture Project, GIVE Volunteers, 2018

- Professional Memberships
  - Member, Institute of Industrial and Systems Engineers (IISE)
  - Member, Institute for Operations Research and the Management Sciences (INFORMS)
  - Member, International Headache Society (IHS)