TIANCI SONG

📞 (651)-442-5315   ✉ song0309 at umn.edu   in LinkedIn   🎓 Google Scholar

🏠 6-225D Keller Hall, 200 Union Street SE, Minneapolis, MN, 55455

EDUCATION

Ph.D. in Computer Science at University of Minnesota   Sep, 2018 - May, 2025 (Expected)
  Advisor: Dr. Rui Kuang

M.E. in Computer Science & Technology at Jilin University   Sep, 2014 - Jun, 2017
  Advisor: Dr. Yanchun Liang and Dr. Wei Du

B.S. in Computer Science & Technology at Jilin University   Sep, 2010 - Jun, 2014

WORK EXPERIENCES

Research Assistant at Kuang Lab, *Minneapolis, MN*   Sep, 2018 - Present

- Propose linear and nonlinear tensor completion models guided by both spatial and functional relations to impute missing gene expression signals of in-situ capturing based 2D spatial transcriptomics data to facilitate the downstream analyses;

- Propose a deep clustering model to group genes based on their spatial expression patterns as well as known functional relations encoded in knowledge graph to reveal gene activities in the underlying morphological context for 2D spatial transcriptomics data;

- Propose a tensor decomposition model informed by spatial and functional relations to reconstruct 3D gene expression from tomography based 1D spatial transcriptomics data to study gene expression patterns in 3D space for embryonic development.

Research Intern at NEC Labs America, *Princeton, NJ*   July, 2024 - Oct, 2024

- Propose a graph neural network based model to learn compartment or cellular level features from digital pathology images associated with bulk gene expression to predict immunotherapy efficacy (*Worked with Dr. Jonathan Warrell and Dr. Eric Cosatto*).

Research Intern at NEC Labs America, *Princeton, NJ*   May, 2023 - Sep, 2023

- Propose a graph neural network-based model to predict spatial resolved transcriptomics data from histopathological images (*Worked with Dr. Jonathan Warrell*).

Research Assistant at Neuro Trauma Research Lab, *Minneapolis, MN*   Jun, 2020 - Dec, 2021

- Develop an ensemble classification model to identify the severity of brain injury based on both features from deep learning models on CT images and serum biomarker data (*Worked with Dr. Uzma Samadani*).

Research Intern at Infervision, *Beijing*   Mar, 2018 - Aug, 2018

- Develop capsule network based models for lung nodule detection based on 2D CT images and intracerebral hemorrhage volume measurement based on 3D CT images (*Worked with Dr. Rongguo Zhang*).

Research Assistant at Computational System Biology Lab, *Athens, GA*   Oct, 2015 - Jan, 2017

- Investigate cell-type specific contributions to breast cancer based on multi-omics data with dictionary learning (*Worked with Dr. Sha Cao*);

- Explore the competitive relationship between DNA methylation, nucleotide synthesis, and anti-oxidation in cancers with dynamic modeling on multi-omics data (*Worked with Dr. Sha Cao and Dr. Ying Xu*).

Research Assistant at Machine Learning Lab, *Changchun, Jilin*   Sep, 2013 - Jun, 2015

- Develop a computational model with multiple kernel learning to integrate multi-omics data to improve breast cancer grade classification (*Worked with Dr. Wei Du and Dr. Yanchun Liang*);
- Develop a computational model with the local principal curve to quantify the abnormalities of altered biological pathways or processes in pan-cancers based on their bulk gene expression and demonstrate its potential in clinical applications (*Worked with Dr. Wei Du and Dr. Yanchun Liang*).

RESEARCH INTEREST

- Design machine learning models for knowledge generalization and representation
- Develop computational models for single-cell and spatial transcriptomics data analysis
- Develop computational models for heterogeneous biomedical data integration

SELECTED PUBLICATION

1. **Tianci Song**, Quoc Nguyen, and Rui Kuang. *Reconstructing 3D Spatial Structures of RNA-Tomography Transcriptomes by Tensor Factorization.* **In submission**

2. **Tianci Song**, Eric Cosatto, Gaoyuan Wang, Martin Renqiang Min, Rui Kuang, Mark Gerstein, and Jonathan Warrell. *Predicting Spatially Resolved Gene Expression via Tissue Morphology using Graph Neural Networks with Adaptive Spatial Graphs.* **The 23rd European Conference on Computational Biology (ECCB 2024)** (2024) *(Accept rate: 12%)* [Paper] [Code]

3. Charles Broadbent, **Tianci Song**, and Rui Kuang. *Deciphering High-order Structures in Spatial Transcriptomes with Graph-guided Tucker Decomposition.* **The 32nd International Conference on Intelligent Systems for Molecular Biology (ISMB 2024)** (2024) *(Accept rate: 16%, Outstanding Student Paper)* [Paper] [Code]

4. **Tianci Song**, Charles Broadbent, and Rui Kuang. *GNTD: Reconstructing Spatial Transcriptomes with Graph-guided Neural Tensor Decomposition Informed by Spatial and Functional Relations.* **Nature communication** (2023) [Paper] [Code]

5. **Tianci Song**, Kathleen K Markham, Zhuliu Li, Kristen E Muller, Kathleen Greenham, and Rui Kuang. *Detecting Spatially Co-expressed Gene Clusters with Functional Coherence by Graph-regularized Convolutional Neural Network.* **Bioinformatics** (2022) [Paper] [Code]

6. Zhuliu Li, **Tianci Song**, Jeongsik Yong, and Rui Kuang. *Imputation of Spatially-resolved Transcriptomes by Graph-regularized Tensor Completion.* **PLoS computational biology** (2021) [Paper] [Code]

7. Raphael Petegrosso, **Tianci Song**, and Rui Kuang. *Hierarchical Canonical Correlation Analysis Reveals Phenotype, Genotype, and Geoclimate Associations in Plants.* **Plant Phenomics** (2021) [Paper] [Code]

8. Mingxin Tao, **Tianci Song**, Wei Du, Siyu Han, Chunman Zuo, Ying Li, Yan Wang, and Zekun Yang. *Classifying Breast Cancer Subtypes using Multiple Kernel Learning based on Omics Data.* **Genes** (2019) [Paper]

9. **Tianci Song**, Sha Cao, Tao Sheng, Sen Liang, Wei Du, and Yanchun Liang. *A Novel Unsupervised Algorithm for Biological Process-based Analysis on Cancer.* **Scientific Reports** (2017) [Paper]

10. **Tianci Song**, Yanchun Liang, Zhongbo Cao, Wei Du, and Ying Li. *Computational Analysis of Specific microRNA Biomarkers for Noninvasive Early Cancer Detection.* **BioMed Research International** (2017) [Paper]

11. **Tianci Song**, Yan Wang, Wei Du, Sha Cao, Yuan Tian, and Yanchun Liang. *The Method for Breast Cancer Grade Prediction and Pathway Analysis based on Improved Multiple Kernel Learning.* **Journal of Bioinformatics and Computational Biology** (2017) [Paper]

SKILLS

Expertise: Tensor Modeling, Representation Learning, Graph Neural Network, Deep Learning, Statistical Learning, Bioinformatics, Computational Biology.
Programming: Python, R, C/C++, Matlab, Perl, and Shell with practical experiences.
Tool: Pytorch, Tensorflow, Unix/Linux, Git, and LaTeX.
Language: Mandarin (native), English (fluent)

AWARDS AND HONORS

- John T. Riedl Memorial Graduate Teaching Assistant Award 2023, University of Minnesota
- College Science and Engineering Graduate Fellowship 2018 and 2019, University of Minnesota
- National Excellent Student Scholarship 2012 and 2013, Jilin University

TEACHING

- Machine Learning Fundamentals, University of Minnesota (Teaching Assistant, Fall 2019, Spring 2020, Spring 2023)
- Functional Genomics, Systems Biology, and Bioinformatics, University of Minnesota (Teaching Assistant, Spring 2021)
- Computational Biology, Jilin University (Guest Lecturer, Spring 2015)
- Introduction to Bioinformatics, Harbin Medical University (Guest Lecturer, Fall 2014)

ACADEMIC SERVICES

- **Journal Reviewer**: Nature Communication, Scientific Reports, BMC Genomics, BMC Cancer, Biomarker Research, and Computational and Structural Biotechnology Journal
- **Conference Reviewer**: the ACM Conference on Bioinformatics, Computational Biology, and Health Informatics (ACM BCB) 2020, 2021, 2022, 2023, and 2024