

## EDUCATION

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**Ph.D. in Biomedical Engineering***Boston University, Boston, MA***09/2025 - 12/2030****B.S. in Computer Science***Georgia Institute of Technology, Atlanta, GA***01/2023 - 05/2025**

- GPA: 3.85/4.00
- Achievements: Highest Honor, President's Undergraduate Research Awards

**B.S. in Computer Science; Double Major in Mathematics***Rensselaer Polytechnic Institute, Troy, NY***09/2020 - 12/2022**

- GPA: 3.73/4.00
- Achievements: Dean's Honor List (every semester)
- Minor: Economics

## RESEARCH EXPERIENCE

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**Graduate Research Assistant***Boston University, Boston, MA***09/2025 - 12/2025***Biomedical Optical Technologies Lab, PI: Darren Roblyer, Ph.D.*

- Developed a transformer-based cuffless blood pressure (BP) estimation pipeline driven by speckle contrast optical spectroscopy (SCOS), with flexible inputs handling variable-length and missing data.
- Established a three-stage training pipeline consisting of unsupervised representation learning on BFi and PPG waveforms, supervised regression on BP waveforms, and subject-specific finetuning.
- Visualized representations after unsupervised pretraining on optical waveforms, showing that subject-level differences were captured across measurements and that BP-related patterns were encoded.

GitHub: [github.com/tianrui-qи/SCOS-BP](https://github.com/tianrui-qи/SCOS-BP)

**Undergraduate Research Assistant***Georgia Institute of Technology and Emory University, Atlanta, GA***04/2023 - 05/2025***Jia Laboratory for Systems Biophotonics, PI: Shu Jia, Ph.D.*

- Engineered a scalable 3D U-Net pipeline based entirely on simulated data for volumetric localization in single-molecule super-resolution microscopy, resolving sub-cellular structure down to 60 nm.
- Developed a patch-based prediction pipeline that flexibly adapts to various input volume sizes and achieves a 100x speedup over conventional deterministic localization methods.
- Integrated the redundant cross-correlation algorithm for drift correction with the deep learning-based prediction pipeline.

GitHub: [github.com/tianrui-qи/DSMLM](https://github.com/tianrui-qи/DSMLM)

**Undergraduate Research Assistant***Rensselaer Polytechnic Institute, Troy, NY***11/2021 - 12/2022***AI-based X-ray Imaging System Lab, PI: Ge Wang, Ph.D.*

- Derived backward propagation formulation for quadratic neural networks and compared forward and backward propagation between quadratic and conventional neural networks mathematically.
- Implemented forward propagation, backward propagation, and training process of quadratic and conventional neural networks explicitly using NumPy in Python.
- Demonstrated that single-layer quadratic neural networks rival conventional neural networks with hundreds of neurons in classifying simulated and real-world Gaussian mixture data.

GitHub: [github.com/tianrui-qи/QuadraticNeurons](https://github.com/tianrui-qи/QuadraticNeurons)

## PUBLICATIONS

†: contributed equally

### Volumetric Localization Microscopy with Deep Learning

2025

*Nature Communications*

*Keyi Han<sup>†</sup>, Xuanwen Hua<sup>†</sup>, Tianrui Qi<sup>†</sup>, Zijun Gao, Xiaopeng Wang, Shu Jia*

DOI: [doi.org/10.1038/s41467-025-65941-3](https://doi.org/10.1038/s41467-025-65941-3)

### Superiority of Quadratic Neural Networks for Classification of Gaussian Mixture Data

2022

*Visual Computing for Industry, Biomedicine, and Art*

*Tianrui Qi, Ge Wang*

DOI: [doi.org/10.1186/s42492-022-00118-z](https://doi.org/10.1186/s42492-022-00118-z)

## INDUSTRY EXPERIENCE

### Co-op

01/2024 - 08/2024

*Regeneron Genetics Center, Tarrytown, NY*

*Therapeutic Area Genetics, Manager: Jing He, Ph.D.*

- Utilized BERT-based large language models (LLMs) and unsupervised feature selection to obtain a vector representation in a bio-meaningful space for each whole exome sequencing (WXS) sample.
- Demonstrated that the representations capture sample-wise differences by predicting immune system indicators of The Cancer Genome Atlas Program (TCGA) skin cancer samples.
- Scaled up the pipeline to handle hundreds WXS samples with billion DNA sequences by optimizing parallel computing for high-performance computing (HPC) and enhancing file system efficiency through hashing.

GitHub: [github.com/tianrui-qj/SIP-DB2](https://github.com/tianrui-qj/SIP-DB2)

## TEACHING EXPERIENCE

### Undergraduate Teaching Assistant

09/2022 - 12/2022

*Rensselaer Polytechnic Institute, Troy, NY*

*CSCI 2200 Foundations of Computer Science, Instructor: David Goldschmidt, Ph.D.*

- Led weekly recitation sessions to help students understand course material.
- Assisted students' understanding of weekly lab exercises and graded assignments and exams.

## COURSE PROJECTS

### WanderSync: A Collaborative Travel Management System

09/2024 - 12/2024

*Georgia Institute of Technology, Atlanta, GA*

*CS 2340 Objects and Design, Instructor: Nimisha Roy, Ph.D.*

- Designed and implemented a travel management app following the MVVM architectural pattern, using Firebase Realtime Database to manage user accounts, destinations, accommodations, and dining reservations.
- Enabled real-time collaboration features, allowing users to seamlessly share and synchronize travel plans, including itineraries and notes, across group members.

GitHub: [github.com/tianrui-qj/WanderSync](https://github.com/tianrui-qj/WanderSync)

### Datapath and Control for a Turing Complete ISA with Interrupt Handling

09/2023 - 12/2023

*Georgia Institute of Technology, Atlanta, GA*

*CS 2200 Systems and Networking, Instructor: Daniel Forsyth*

- Designed a single-bus datapath and an efficient four-ROM microcontroller for a Turing complete instruction set architecture (ISA), supporting arithmetic, logical, memory access, and control flow instructions.
- Handled basic and input device interrupts by additional hardware including new instructions, interrupt registers, signals, and I/O bus, along with software supports such as interrupt vector tables.

GitHub: [github.com/tianrui-qj/LC2222a-ISA](https://github.com/tianrui-qj/LC2222a-ISA)

## **Alternating Direction Method of Multipliers for Support Vector Machine**

**01/2022 - 05/2022**

*Rensselaer Polytechnic Institute, Troy, NY*

*MATP 4820 Computational Optimization, Instructor: Yangyang Xu, Ph.D.*

- Formulated the primal and augmented dual optimization problems for support vector machine (SVM) objective and developed alternating direction method of multipliers (ADMM) solver.
- Implemented the ADMM solver in MATLAB and reported the primal and dual feasibility violations at each outer iteration for the testing datasets.

GitHub: [github.com/tianrui-qj/ADMM-for-SVM](https://github.com/tianrui-qj/ADMM-for-SVM)

## **Windows of Susceptibility Analysis for Brain Diseases**

**01/2022 - 05/2022**

*Rensselaer Polytechnic Institute, Troy, NY*

*MATP 4400 Data Mathematics, Instructor: Kristin Bennett, Ph.D.*

- Performed the windows of susceptibility analysis based on mouse data from a similar brain-in-a-dish model for mice using R with k-means clustering and principal component analysis (PCA).
- Analyzed the same sets of microcephaly-associated genes and Zika-associated genes and detected similar windows of susceptibility for Microcephaly and Zika-induced microcephaly in mice as in humans.

GitHub: [github.com/tianrui-qj/WOS-Analysis](https://github.com/tianrui-qj/WOS-Analysis)

## **Full Gate-Level Circuit in C for a Reduced MIPS ISA**

**09/2021 - 12/2021**

*Rensselaer Polytechnic Institute, Troy, NY*

*CSCI 2500 Computer Organization, Instructor: Konstantin Kuzmin, Ph.D.*

- Designed a datapath for a reduced MIPS instruction set architectures (ISA) that support I-type instructions including `lw`, `sw`, `beq`, `addi`, R-type including `and`, `or`, `add`, `sub`, `slt`, `jr`, and J-type including `j`, `jal`.
- Implemented the datapath through a full gate-level circuit in C, including components of the processor like memory, control, arithmetic logic unit (ALU), decoder, adder, multiplexor, etc.

GitHub: [github.com/tianrui-qj/MIPS-ISA](https://github.com/tianrui-qj/MIPS-ISA)

## **SKILLS**

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**Programming:** Python (PyTorch, NumPy, pandas), MATLAB, Java, C, C++, R, Bash, MIPS.

**Development Tools:** Git, Conda, VS Code, RStudio, JetBrains Suite, Android Studio.

**Computing Platforms:** Linux (Ubuntu), AWS (EC2, S3), HPC (Slurm).

**Software:** LaTeX, ImageJ, Adobe Illustrator.

**Laboratory:** optics and laser alignment, fluorescence imaging, fluorescence labeling, cell culture maintenance.

**Communication:** English (Professional), Mandarin (Native).

## **REFERENCES**

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### **David Goldschmidt, Ph.D.**

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### **Xuanwen Hua, Ph.D.**

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### **Ge Wang, Ph.D.**

Clark-Crossan Chair Professor and Director of the Biomedical Imaging Center

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