Tianrui Qi

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EDUCATION

Ph.D. in Biomedical Engineering   **09/2025 - 12/2030**
Boston University, Boston, MA

B.S. in Computer Science   **01/2023 - 05/2025**
Georgia Institute of Technology, Atlanta, GA
- GPA: 3.85/4.00
- Achievements: Highest Honor, President's Undergraduate Research Awards

B.S. in Computer Science; Double Major in Mathematics   **09/2020 - 12/2022**
Rensselaer Polytechnic Institute, Troy, NY
- GPA: 3.73/4.00
- Achievements: Dean's Honor List (every semester)
- Minor: Economics

PUBLICATIONS   †: contributed equally

Volumetric Localization Microscopy with Deep Learning   **2025**
Nature Communications
Keyi Han[†], Xuanwen Hua[†], Tianrui Qi[†], Zijun Gao, Xiaopeng Wang, Shu Jia
DOI: 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

RESEARCH EXPERIENCE

Undergraduate Research Assistant   **04/2023 - 05/2025**
Georgia Institute of Technology and Emory University, Atlanta, GA
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-qi/DSMLM

Undergraduate Research Assistant   **11/2021 - 12/2022**
Rensselaer Polytechnic Institute, Troy, NY
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-qi/QuadraticNeurons

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 obtrain 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-qi/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-qi/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-qi/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-qi/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-qi/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-qi/MIPS-ISA

Skills

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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