Tianrui Qi

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Education

B.S. in Computer Science **01/2023 - 05/2025**
Georgia Institute of Technology, Atlanta, GA
- GPA: 3.83/4.00
- Achievements: 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

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.

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.

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.

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.

Publications

Keyi Han†, Xuanwen Hua†, **Tianrui Qi**†, Zijun Gao, Xiaopeng Wang, Shu Jia. "Volumetric Reconstruction and Localization Networks for 3D Single-molecule Localization Microscopy." *Manuscript under review at Nature Communications.* **2025**

Tianrui Qi, Ge Wang. "Superiority of quadratic over conventional neural networks for classification of gaussian mixture data." *Visual Computing for Industry, Biomedicine, and Art.* **2022**

† *denotes co-first authors*

Course Projects

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.

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.

Skills

Programming: Python (PyTorch, NumPy, pandas), MATLAB, Java, C, C++, R, Swift (ARKit), Bash, MIPS.
Development Tools: Git, Conda, VS Code, RStudio, JetBrains Suite, Android Studio, Xcode.
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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