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# Yuchen Cong

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## Education

**Juntendo University** — Tokyo, Japan
*M.S. in Health Data Science* — Apr. 2025 – Mar. 2027 (Expected)
- Supervisors: Prof. Ryutaro Himeno and Prof. Zhe Sun
- GPA: 3.74/4.00; Research Focus: Tensor Networks and Variational Inference

**Qilu University of Technology** — Shandong, China
*B.E. in Computer Science and Technology* — Aug. 2019 – Jun. 2023
- GPA: 4.13/5.00

## Research Interests

Tensor Networks, Variational Inference, Probabilistic Modeling, Tensor Network Architecture Search.

## Professional Experiences

**RIKEN Center for Advanced Intelligence Project (AIP)** — Tokyo, Japan
*Research Assistant, Tensor Learning Team* — Nov. 2024 – Present
- Supervisor: Dr. Chao Li
- Research Topics: Tensor network architecture search; tensor-network methods for probabilistic modeling

## Publications

[1] **Yuchen Cong**; Zerui Tao; Chao Li; Zhe Sun; Qibin Zhao. *QuanVI: Score-based Variational Inference via Quantum Maximally Mixed States*. *Advances in Neural Information Processing Systems (NeurIPS)*, 2026. [Paper]

[2] Chao Li; Zerui Tao; **Yuchen Cong**; Jian Xu; Qibin Zhao. *On the Approximation Complexity of Matrix Product Operator Born Machines*. arXiv preprint arXiv:2605.11471, 2026. [Paper]

[3] Yicong He; Chao Li; **Yuchen Cong**; Tomonori Shirakawa; Seiji Yunoki; Qibin Zhao. *Joint Structure Search for Tensor Network Operators Inspired by Symmetry Breaking*. [Paper]

## Presentations

**QuanVI: Score-based Variational Inference via Quantum Maximally Mixed States** — 2026
**Yuchen Cong**; Zerui Tao; Chao Li; Zhe Sun; Qibin Zhao
*The 29th Information-Based Induction Sciences Workshop (IBIS 2026)*. Poster Presentation.

**Score-based Variational Inference via Quantum Maximally Mixed States** — 2026
**Yuchen Cong**, Zhe Sun, Chao Li
*The Annual Conference of the Japanese Society for Artificial Intelligence (JSAI)*. Oral Presentation.

**Tensor Network and its Structure Search Problem** — 2025
Chao Li, **Yuchen Cong**
*Mechanism of Brain and Mind Winter Workshop*. Poster Presentation.

## Services

- **Professional Reviewing:**
  - Conference Reviewer: ICML Workshop
  - Journal Reviewer: Quantum Machine Intelligence

## Research Experience

**QuanVI: Score-based Variational Inference via Quantum Maximally Mixed States**
RIKEN Center for Advanced Intelligence Project (AIP) — Tokyo, Japan
Research Assistant, Supervisor: Dr. Chao Li — Aug. 2025 – Present

- Proposed QuanVI [Paper], a quantum-inspired framework for score-based variational inference that extends pure-state representations to mixed-state density operators, enabling a more expressive variational family and a basis-independent representation of degenerate low-energy subspaces.
- Developed efficient matrix product operator (MPO)-based implementations that avoid explicit global eigendecomposition and exponential parameter growth. Demonstrated scalability to 100 dimensions and competitive approximation quality on non-Gaussian distributions and Bayesian inference tasks.

- Contributed to the theoretical study of MPO Born machines [Paper], which characterizes approximation complexity and establishes polynomial-bond approximation guarantees for structured target distributions under suitable assumptions.

**Joint Structure Search for Tensor Network Operators Inspired by Symmetry Breaking**
RIKEN Center for Advanced Intelligence Project (AIP) Tokyo, Japan
Research Assistant, Supervisor: Dr. Chao Li Nov. 2024 – Present

- Designed and implemented the quantum circuit optimization framework for evaluating joint tensor network structure search (TN-SS) [Paper], incorporating symmetry-breaking strategies for operator-specific architecture optimization.
- Conducted numerical experiments, managed experimental workflows, and organized experimental results to evaluate the effectiveness of joint TN-SS on quantum circuit optimization tasks.

## Awards

- **National Scholarship** (2023)
- **First Prize**, 15th China University Computer Design Competition (2022)
- **National Inspirational Scholarship** (2020)
- **Third Prize**, 11th Lanqiaobei National Software Competition (C/C++) (2020)

## Skills & Languages

**Programming:** Python (PyTorch, NumPy), C++, Linux.
**High-Performance Computing:** SLURM, SGE, PJM workload managers; Singularity/Apptainer container workflows; large-scale HPC experiment deployment and batch workflow management.
**Languages:** Chinese (Native); English (Professional Working Proficiency; TOEIC: 880/990; IELTS 7.0).