Curriculum Vitae

Personal Data

Name:	Gu, Boyang
Date of Birth:	5th of January, 2001
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Google Scholar	scholar.google.com/citations?user=3IXxQiQAAAAJ

Education

Sep. 2023 - Sep. 2024	Computing (Artificial Intelligence and Machine Learning) (MSc 1YFT) at Imperial College London Diploma: Distinction (80.61)
Sep. 2019 - Jun 2023	Mathematics (MSci 4YFT) at Imperial College London Diploma: First Class Honours (81.87)
Sep. 2016 - Jun. 2019	Nanjing Foreign Language School (NFLS) Diploma: Senior High Diploma
Sep. 2013 - Jun. 2016	High School Affiliated to Nanjing Normal University Shuren Campus Diploma: Junior High Diploma

Publications

- Z. Cao, **B. Gu**, C. Zhang, P. Gimenes, J. Lu, J. Cheng, X. Gao, and Y. Zhao, *Scaling laws for mixed quantization*, 2025. arXiv: 2410.06722 [cs.CL]. URL: https://arxiv.org/abs/2410.06722.
- **B. Gu**, H. Zhou, B. M. Segal, J. Wu, Z. Cao, H. Zhong, L. Clifton, F. Liu, and D. A. Clifton, "Clinical-r1: Empowering large language models for faithful and comprehensive reasoning with clinical objective relative policy optimization," in *2rd AI for Medicine and Healthcare Bridge Program at AAAI26*, 2025. URL: https://openreview.net/forum?id=ZKVEILCb9I.
- F. Liu, H. Zhou, **B. Gu**, X. Zou, J. Huang, J. Wu, Y. Li, S. S. Chen, Y. Hua, P. Zhou, *et al.*, "Application of large language models in medicine," *Nature Reviews Bioengineering*, pp. 1–20, 2025.
- **B. Gu** and A. Borovykh, "On original and latent space connectivity in deep neural networks," *arXiv preprint arXiv:2311.06816*, 2023.
- H. Zhou*, **B. Gu***, and C. Jin, "Reinforcement learning approach for multi-agent flexible scheduling problems," in *Journal of Physics: Conference Series*, IOP Publishing, vol. 2580, 2023, p. 012 053.
- H. Zhou*, **B. Gu***, X. Zou*, Y. Li*, S. S. Chen, P. Zhou, J. Liu, Y. Hua, C. Mao, X. Wu, *et al.*, "A survey of large language models in medicine: Progress, application, and challenge," *arXiv preprint arXiv:2311.05112*, 2023.

Awards and Achievements

- Dean's list in Year 1 and 2 at Imperial College London, 2020 & 2021.

Project Experience

- **Domain-Specific Language with AI Copilot on Protein Design under Professor Wojciech Matusik (MIT CSAIL, Summer 2025)**

  We designed and implemented Protein DSL, a declarative domain-specific language that unifies fragmented protein design workflows into readable, reproducible pipelines. We modeled proteins as strongly typed, modular objects (Protein, Chain, ProteinPose, Domain) to enable reusable definitions of structures, regions, and annotations. We introduced build-in typed workflows (e.g., structure prediction, motif scaffolding, inverse folding, relaxation, docking) that transform proteins into what the designer wants with full validation and logging, enabling researchers to reconstruct protein design papers as executable scripts and systematically verify reported protein design results.

- **Scaling Laws for Mixed Quantization (2025)**

  We introduced a unified scaling law for post-training quantization (PTQ) of large language models (LLMs). The law predicts how quantization loss scales with model size N, quantization ratio Q_r, and block size Q_b, indicating that larger models can tolerate higher Q_r and that smaller block sizes yield diminishing returns at large scales. The paper can be seen at here.

- **Clinical-r1: Empowering large language models for faithful and comprehensive reasoning with clinical objective relative policy optimization (2025)**

  We trained and analyzed Med-R1-3B with Grouped Relative Policy Optimization (GRPO), which develops and refines cognitive reasoning behaviors and medical faithfulness by first learning multiple patterns in a "cold start" phase and then pruning unnecessary reasoning steps during reinforcement learning. The analysis reveals that GRPO acts like a critic, shortening response length by eliminating irrelevant or unproductive reasoning without severely reducing reasoning completeness. The paper can be found at here. The paper has been accepted by AAAI and can be seen at here.

- **Applying Large Language Models (LLMs) to Biomedical Hospital Course Summarization (Spring & Summer 2024)**

  We processed MIMIC-III to construct a dataset for hospital course summarization. We further applied Supervised Fine-tuning and Direct Preference Optimization to the constructed dataset. We also introduced a rewriting system that aims to reduce factual inconsistency and achieved SOTA results. The report is on here. The whole project can also be viewed at here

- **Survey of Large Language Models in the Biomedical Domain (Summer 2023)**

  We summarized the current progress of large language models' performance in biomedical natural language processing tasks. The survey discussed the performances, challenges, applications, and future works of biomedical LLMs. The paper is on here. The whole project can also be viewed at here

- **Using Minimum Energy Path to Study Neural Network Structures under Prof. Anastasia Borovykh (Summer 2023)**

  Understanding how the neural network views its own input space and how the latent spaces are structured has value for explainability and robustness. We studied whether inputs from the same class can be connected by a continuous path, in original or latent representation space. The paper is on here

- Machine Learning - Random Dynamic System Project about the Koopman theory
  under Prof. Jeroen Lamb and Dr. Kevin Webster (Spring 2023)

  In this project, I studied the Koopman theory, a theory about the Koopman operator. I discussed the Dynamic Mode Decomposition algorithm and its relation to the Koopman operator. I also studied some data-driven machine-learning models to find eigenpairs of the Koopman operator. The whole project can be viewed at here.

- Planning for Autonomous Robots Summer Program
  under Professor Nick Hawes (Summer 2022)

  In this project, we implement an environment and solve the Job Shop Scheduling Problem by the Q-learning algorithm. The paper is on here and has been accepted by the 3rd International Conference on Signal Processing and Machine Learning (CONF-SPML 2023). The whole project can also be viewed at here.

- Undergraduate Research Opportunities Programme about representation theory
  under Prof. Martin Liebeck (Summer 2021)

  In this programme, I studied Thompson's Conjecture in Representation Theory. I checked the conjecture to projective special linear groups and alternative groups. The whole project can be viewed at here.

Other Experiences

- Peer Tutor for Year 1 students at Imperial College London, 2022-2023.
- Summer Researcher at MIT Computer Science and Artificial Intelligence Laboratory (CSAIL), Summer 2025.