Han "Bill" Huang

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EDUCATION

Rensselaer Polytechnic Institute (RPI), *Mathematics Ph.D.* May 2021 - May 2024 (Expected)
• Research interest: generative models, mean-field game theory/optimal transport.

Rensselaer Polytechnic Institute (RPI), *Applied Mathematics M.S.* **GPA:** 4.00 Aug 2019 - May 2021
• Courses: nonlinear optimization, stochastic processes, functional analysis, information theory.

Swarthmore College, *Mathematics and Computer Science B.A.* **GPA:** 3.78, **Major GPA:** 3.86 Aug 2015 - May 2019

SKILLS

Language: Python (proficient), C++, C# (proficient), SQL, R, CUDA.
Framework: PyTorch, Tensorflow (1 & 2), Keras, Sklearn, NumPy, Pandas, MATLAB, Mathematica.

EXPERIENCES

Research Intern [Git] [Git] [Website] | MICROSOFT May 2023 - Aug 2023
• Leveraged large language models (LLM) to generate interactive virtual worlds in real-time.
• Developed novel methods for world understanding, self-correction, and memory management.
• Presented extensive demos for 3D scene creation, accessibility, and remote assistance.
• Outperformed the standard GPT-4 by 4× in error rate and received positive feedbacks in the user study.
• Two manuscripts accepted to ACM CHI 2024 (Best Paper Honorable Mention) and NeurIPS ML4CD 2023 (Spotlight).

Credit Risk Specialist Intern | BANK OF MONTREAL June 2022 - Aug 2022
• Quantified the driving forces behind capital changes with game theoretic methods.
• Implemented 2k lines of Python code with detailed documentation in a team of 4.
• Provided insights to $300M+ of capital changes in vehicle and mortgage accounts.

Research Intern | IBM May 2020 - Aug 2020
• Developed a geometrically invariant autoencoder with a latent flow to perform drug discovery.
• Discovered molecules with 19.6% increase in penalized LogP via Bayesian optimization.
• Reduced baseline inference time by 55× with a novel decoding procedure.
• Achieved SOTA against 6 models across 9 MOSES molecular metrics on QM9 and ChEMBL.

RESEARCH

Neural Operator Learning for Mean-Field Game (MFG) Solution Maps | RPI Aug 2023 - Now
• Developed the pioneering framework for learning MFG solution maps via transformers.
• Proposed a physics-informed optimization scheme to enable scalable and unsupervised operator learning.
• Solved unseen MFG problems in ~ 0.07 second, which is five orders of magnitude faster than existing methods.
• Manuscript submitted to NeurIPS 2024.

Joint Inference of Unseen Obstacle and Optimal MFG Policy | RPI Aug 2022 - May 2023
• Proposed the first learning approach to solve inverse MFG problems with < 0.1 relative error.
• Recovered complex, multi-modal obstacles faithfully by solving a bilevel problem with the penalty method.
• Reduced generalization error for trajectory modeling on scarce data by up to 50×.

Bridging Generative Models and Game Theory [Git] | RPI June 2021 - May 2022
• Employed normalizing flows to solve MFG in $d = 100$ dimensions while traditional methods are intractable for $d > 3$.
• Established formal proofs on the proposed approach's universality.
• Outperformed the baseline by 61.5% in terminal matching with only $1/3$ of the training time.
• Introduced the L_2 transport cost to improve density modeling across 10 tabular and image datasets.

Mathematical Models for Brain Networks | Swarthmore College May 2017 - Aug 2018
• Applied differential equations and mean-field theory to model the cognitive decision-making process.
• Analyzed behaviors of excitatory and inhibatory neuronal populations with C++ and theoretical bounds.

PRESENTATIONS

• RPI FOCI GenAI Users Group, *The Large Language Model for Mixed Reality (LLMR)*, Troy, NY, Jan 31, 2024. [Link]
• NeurIPS 2023 Workshop on Machine Learning for Creativity and Design, *Real-time Animation Generation and Control on Rigged Models via Large Language Models*, New Orleans, LA, 16 Dec, 2023. [Link]
• MAA student poster session, Joint Mathematics Meetings 2019, *Network structure and input integration in competing firing rate models for decision-making*, Baltimore, MD, Jan 18, 2019.

PROJECTS

Helia Nov 2017 - May 2019
• Independently designed and implemented a D&D-themed video game with C# and Unity.
• Features a philosophically inspired story following Plato's cave allegory.
• Contains 8k lines of code for ten playable levels, enemy AI, sprite animations, events, UI, and dialogues.