

Edwin Chacko

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EDUCATION

University of Toronto

Sep. 2022 – May 2027

BASc. in Engineering Science, Machine Intelligence Option.

Toronto, Canada

Relevant Coursework: Machine Learning, Data structures, Algorithms, Matrix Algebra and Optimization, Computational Linguistics, Natural Language Computing, Computer Architecture, Probability & Statistics

EXPERIENCE

Machine Learning Researcher

May 2024 – Present

McMaster University - ChemAI Lab

Hamilton, ON

- **Founded** and leading the Spectro project at McMaster University, exploring novel applications of AI in chemistry.
- Designed a multi-modal molecule prediction model, **Spectro**, achieving an **accuracy of 93%** (see projects).
- Collaborated with Dr. Kylie Luksa and other domain experts to inform model development and behaviour.
- Co-authored and submitted a paper to **AI4Mat-NeurIPS**, currently pending approval.

Calibrations Engineering Intern

May. 2023 – Sep. 2023

VACS Calibrations

Toronto, ON

- Calibrated electronic and mechanical equipment, following the **IEE and ISO17025** standards.
- Performed **statistical analysis**, including standard deviation, uncertainty propagation, and regression, to validate calibration accuracy and assess reliability.
- Developed insights from calibration data to improve process efficiency and enhance measurement precision.

PROJECTS

Spectro | TensorFlow, PyTorch, JS, Linux

May 2024 – Present

- Developed a multimodal molecule elucidation model (Spectro) using IR images and NMR text data.
- Preprocessed and augmented datasets, employing **data normalization and SMOTE** for class balancing.
- Fine-tuned a modified ResNet (j-IR-vis) for functional group prediction from IR images, with a **f1 score of 91%**.
- Designed and tuned the graph decoder (**RNN with LSTM**) to predict the molecule, achieving a **93% accuracy**.
- Implemented a **complete machine learning pipeline**, including data preprocessing, hyperparameter tuning, and model evaluation (cross-validation, AUC-ROC), with a focus on preventing overfitting.

Chess Engine | C++, CUDA, Docker, Postman, JavaScript

Jun. 2023 – Apr. 2024

- C++ chess engine (rated 1800) with hardware optimizations like BitBoards and compile-time optimizations.
- Implemented multithreaded Negamax search with alpha-beta pruning, **reducing search time by 50%**.
- Integrated Zobrist hashing, a transposition table, and quiescence search, to improve search accuracy and eliminate redundant calculations.
- Utilized custom **CUDA** kernels for move generation and evaluations, significantly accelerating parallelizable tasks to achieve around **35 million nodes per second** in performance test.

Chess NNUE (Efficiently Updatable Neural Network) | PyTorch, C++, SQL, HDF5

May 2024 – Present

- Developing chess static evaluation with NNUE in PyTorch, currently achieving **80% accuracy**.
- Augmented and preprocessed **83 million data points**, exploring utilizing a custom C dataloader.
- Bridging the **8 bit quantized** variant into my C++ chess engine with an accumulator step.

Remote ML Server | Linux (Ubuntu), Bash, Docker, Git

Jun. 2024

- Configured a retired GPU cryptocurrency mining rig into a remote ML server using Docker, optimizing compute power for my personal machine learning and programming projects.

TECHNICAL SKILLS

Languages: Python, C/C++, CUDA, SQL, JS, Assembly, Verilog, MATLAB, React, Django

Libraries: TensorFlow, PyTorch, scikit-learn, keras, NumPy, pandas, Matplotlib, Hugging Face Transformers

Developer Tools: Git, Docker, VS Code, Visual Studio, Linux (Ubuntu), Shell/Bash, HDF5

PUBLICATIONS

[1] (Pending) Chacko, Sondhi, et al. "A Multi-modal Approach for Molecule Elucidation Using IR and NMR Data." AI4Mat-NeurIPS 2024. December 2024.