# Hanson Sun

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## Technical Skills

**Languages**: C, C++, Python, JavaScript, Java, HTML/CSS, R, C#, Bash, LaTeX, Julia
**Frameworks/Libraries**: QT/QML, AWS, PyTorch, Jupyter, Django, Node.js, Scikit-learn, NumPy, TensorFlow
**Tools**: Git, Docker, Linux, Valgrind, MPLAB, GDB, GPROF, WSL, CMake, Unity, Hugging Face, Arduino

## Experience

**Embedded Software Engineer** Jan. 2024 – Present
*NZ Technologies* *Vancouver, BC*

- Led redesign of touchless medical device: front-end (**QT/QML**), firmware (**C**), API middleware (**C++**).
- Designed a **configurable** and **stateful** data-representation/serialization system for **code-free** customization.
- Created a **cross-compiled** C++ build system with **Docker** and **CMake**, resulting in **10x** faster build times.
- Implemented **Kalman filters** and 3D **gesture detection algorithms**, increasing accuracy by **50%** to **400FPS**.
- Designed **multi-device IP** communication scheme combining **UDP** with **congestion control**, **automatic state management (ACK and handshake)**, and a **TCP-based FTP** with ∼**100%** file transfer accuracy.
- Engineered a **dual-buffered async event-driven networking system**, achieving **40%** performance gain.
- Adapted to existing hardware by using **I2C** for Teensy HID control and **SPI** for IMU and 3D capacitive sensors.

**Data Engineer Research Assistant** Nov. 2023 – Present
*Pacific Laboratory for Artificial Intelligence (PLAI)* *Vancouver, BC*

- Spearheaded a data-processing pipeline for **200TB** of Minecraft data with **image** and **audio processing**.
- Leveraged **Python** and the **Whisper ASR** model to produce time-stamped transcripts with **4x** real-time speed.
- Designed Dataloaders/Datasets in **PyTorch**, integrating **variational autoencoders** to improve model training.
- Integrated the data-processing pipeline with **AWS S3**, **DynamoDB**, using **AWS EC2**.

**Undergraduate Teaching Assistant** Aug 2023 – Dec 2023
*University of British Columbia* *Vancouver, BC*

- Instructed tutorial and lab sessions for ∼**100** students, fostering discussions and addressing questions.

## Projects

**MindVault** | *Python, SQL, HuggingFace, LangChain, SQLite, Numpy, Docker*

- **Dockerized** local database and RAG agent for personal notes for accelerated learning and studying.
- Implemented a custom **vector search database** with **trigram full text search** using **FAISS** and **sqlite**, running **10x** faster with a **50%** smaller storage footprint compared to **sqlite-vss**.
- Developed a **RAG** chain with **CoT prompting** and an **LLM-powered** retrieval system using **LangChain**.

**Managalator (nwHacks 2024)** | *React, JavaScript, Python, MongoDB, FastAPI, DeepL, cv2, pillow*

- ML-powered manga translation and localization **MVC** web application for small manga artists.
- Implemented a **React** front-end with a REST API **Python** back-end with **FastAPI** and **MongoDB**.
- Utilized a pre-trained **ML model** for image segmentation, the **DeepL** API for translation, and **cv2** for text infill.

**Particle Physics 2D (PPhys2D)** | *JavaScript, Webpack, Node.js, JsDoc*

- Designed a web-based **particle-physics** engine that supports constrained and fluid dynamics.
- Developed an **OOP**-based **API**, providing end-user abstraction and extensibility.
- Achieved >**60 fps** with **50,000**+ particles, and improved simulation stability using **spatial partitioning**, **numerical discretization**, and hybrid **impulse-position-based** algorithms.

**C++ Feed-forward Neural Network** | *C++, Valgrind, GDB, GPROF*

- Constructed a **multi-layer neural network** and a matrix library, benchmarked with MNIST classification.
- Utilized **thread-pools**, **vectorization**, and **cache efficient** data processing to improve performance by **30x**.
- Increased convergence with accuracy of **89%** by implementing **cross-entropy cost**, **hybrid hidden layers**, etc.

## Education

**University of British Columbia** Vancouver, BC
*2nd year, Bachelor of Science in Honours Computer Science, Minor in Data Science* *2022 – 2027*

- 95% Average, Science Scholar, Dean's List, Trek Excellence Scholarship, J Fred Muir Memorial Scholarship