Harry Lu

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Education

University of Waterloo — Expected April 2029
Bachelor of Applied Science in Computer Engineering — *GPA - 3.8/4.0*

Technical Skills

Languages: C, C++, x86-64 Assembly, Python, Java, Verilog, TypeScript, SQL
Systems: Linux kernel modules, character drivers, mmap, POSIX shared memory, C11 atomics, lock-free structures
Embedded: STM32, ESP32, FreeRTOS, DMA, UART/SPI/I2C/SDIO, CAN, LittleFS, BLE/GATT/TCP/UDP
Developer Tools: Git, GDB, Make, Docker, Linux, STM32CubeIDE, STM32CubeProgrammer, VirtualBox

Experience

System Software Developer — May 2026 – August 2026
Gametime Technologies — *Markham, ON*
- Owned the software stack on STM32U585 for a commercial scoreboard, from architecture through board bring-up
- Designed the **concurrency model** for a **FreeRTOS system**: a bounded command queue and a single-writer state snapshot for **IPC**, DMA-ISR-to-task notification on the real-time audio path, and a fixed lock order on the shared I2C bus
- Built a real-time audio pipeline on a **lock-free SPSC ring** with a power-of-two buffer, task producer and SAI DMA-ISR consumer, and no locks on the per-sample path, feeding double-buffered DMA through a software mixer
- Closed a **PI rate servo** on the jitter buffer to absorb a 3000 ppm producer/consumer clock mismatch that otherwise drained it in under two minutes, slew-limited to 150 ppm/s so corrections stay inaudible; a 50-minute soak held the 200 ms target within ±6 ms with **0 underruns** across 1.05M frames
- Implemented dual-bank OTA with signed-image verification and a monotonic anti-rollback floor

Embedded Software Developer — September 2025 – Present
University of Waterloo Formula Electric — *Waterloo, ON*
- Deployed an Adaptive **Unscented Kalman Filter** in **C** for State-of-Charge estimation, replacing a basic lookup table and improving state estimation accuracy in the high-voltage subsystems by **70**%
- Wrote the voltage control driver for an STM32 Nucleo-F410Re, running under FreeRTOS over SPI and UART for peripheral communication

Head Lifeguard & Swim Instructor — October 2021 – August 2025
City of Toronto — *Toronto, ON*
- Led teams of 6-10 lifeguards to supervise aquatic environments with 250+ patrons continuously

Projects

sysipc - Kernel-Level Shared Memory IPC Mechanism | *C, Linux Kernel 6.8*
- Built a Linux kernel character driver implementing a **custom mmap handler** that allocates, splits, and refcounts physical pages into a userspace address space via alloc_pages / split_page / vm_insert_page
- Designed a **lock-free SPSC ring buffer** using C11 acquire/release atomics, verified with 10M-message strict-ordering tests and benchmarked at 24M msg/s and 252 ns round-trip p50, **14x** the throughput and **43x** lower latency than Unix sockets
- Added **poll/epoll** blocking via a kernel wait queue and a shared wait flag with adaptive spinning, cutting idle CPU from 100% to **0.3%** while eliminating **99.2%** of wakeup syscalls, and fixed a **StoreLoad race** that acquire/release does not cover

Minute Compiler - C subset compiler, x86-64 backend | *C, x86-64 Assembly*
- Wrote a C compiler in C emitting x86-64 AT&T assembly, with a lexer, **recursive-descent parser** with operator precedence, and a symbol-table pass assigning rbp-relative stack slots to locals
- Implemented the **System V AMD64 calling convention**, argument passing in rdi/rsi/rdx/rcx/r8/r9, per-function stack frames, 16-byte stack alignment at call sites, and self/mutual recursion, verified against gcc
- Built a differential test harness which runs 52 C programs through both the compiler and gcc and compares exit codes

Delirium Detector | *C++, PyTorch, ESP32, React, TypeScript, MongoDB*
- Wrote firmware for an ESP32 delirium detector that samples sensors at 100Hz, **preprocesses signals** in C++ within **4.5KB** of statically allocated buffers, and streams data frames over WiFi to the host
- Ported the trained LSTM to a Raspberry Pi, with end-to-end detection latency at <**2**s and >**85%** accuracy

Achievements

Team Canada, 2025 International Geography Olympiad | Selected for the Canadian national team