

Education

Imperial College London

Oct 2020 – Present

- Electronic and Information Engineering
 - Year 1 – 1st Class Honours
 - Digital Arithmetic & Computer Architecture, Programming
 - Year 2 – 1st Class Honours
 - Instruction Architectures & Compilers, Information Processing, Software Systems, Discrete Maths,
 - Year 3 – 1st Class Honours
 - Advanced Computer Architecture, Operations Research, Embedded Systems, Machine-Learning, Computer-Vision, Digital Systems Design
 - Year 4
 - Math for Machine Learning, Large Dimensional Data Processing, Probability and Stochastic Processes, Deep-Learning, Advanced Deep-Learning Systems
 - Awards – Dean's List Year 3 (Top 10% of year)

Dharan High School

Sept 2018 – Jun 2020

- IB diploma programme
- SAT and SAT subject tests

Technical Experiences

- FPGA Engineering Placement at Quantum Motion Apr 2023 – Oct 2023
 - Designed and integrated bespoke signal generator into QICK stack for High-Speed Qubit Feedback on an **FPGA** in **System Verilog**, using **Vivado**.
 - Built a high-level, user-friendly software library to interface with and take advantage of optimised **FPGA** hardware with **PYNQ** and QICK **Python** libraries.
 - Programmed an RP2040 to communicate using TCP/IP over ethernet connections in **C** using the light-weight IP library.
 - Ported functions into **C** to be used on the RP2040, building an extensive codebase.
- Analogue and Digital IC Validation Intern at Quantum Motion Jul 2022 – Oct 2022
 - Automated custom data pre-processing and analysis in **Python**.
 - Analysed properties of silicon across a range of chips, at room and cryogenic Temperatures (2K), to create model predicting transistor threshold-voltage.
 - Designed a low noise, wide-range (1na-10ma), wideband (100MHz) current sensor schematic and PCB.
 - Validated operation of Ring Oscillator hardware on silicon chips.

Publications & Research Experience

- OptiMult - Multiplier Optimization via E-Graph Rewriting – Primary Author
 - Created tool in **Rust** to compile common hardware arithmetic expressions into an optimized representation for both area and latency.
 - Demonstrated up to a **46% latency reduction** in squarer circuits and **9% latency reduction** in general **multiplication** against industry standard logic synthesis tools.
 - This paper has been presented at ASILOMAR 2023 - Preprint available: <http://arxiv.org/abs/2312.06004>
- Accelerating Interpretable Deep Neural Networks for medical Imaging using FPGAs – Final Year Project

Technical Projects

- Cosine Accelerator on FPGA in SystemVerilog Jan 2023 – Mar 2023
 - **Reduced the output latency of vector function by 77%** by implementing custom cosine block on an **FPGA** using CORDIC in **SystemVerilog** with **Quartus**.
 - Designed customized hardware Floating-Point Arithmetic blocks for further speed-ups.
 - Optimised function further via low-level programming in **C**.
- MRI Diagnosis Model using Computer Vision in PyTorch Feb 2023 – Mar 2023
 - Implemented a **U-Net CNN** architecture to perform image classification and segmentation on brain scans.

- Digital Synthesiser in Embedded C Jan 2023 – Mar 2023
 - Programmed an STM32 microcontroller using **Multi-Threading in Embedded C**.
 - Developed advanced functionality while maintaining thread safety, without affecting latency of sound output.
 - Enabled automatic detection and integration of additional devices to expand the synthesiser's functionality.
- GymBro Embedded Raspberry PI Device Jan 2023 – Mar 2023
 - Built a network hosting an **AWS** server, a **Raspberry Pi** Client, and **MySQL Database**.
 - Expanded functionality for multiple concurrent users, using **Express.js**, **Node.js** and **MySQL**.
 - Ensured security by adding user authentication.
- House Price Regression Model in PyTorch Nov 2022 – Dec 2022
 - Designed a **regression model** using a **neural network**.
 - Performed data pre-processing, **K-fold hyperparameter validation**, early stopping, **batched gradient descent** and various other ML optimisation techniques.
 - Implemented a custom NN training and inference mini library with batched gradient descent, arbitrary layers and custom activation functions.
- Maximised Energy Efficiency of a SuperScalar CPU Nov 2022
 - Varied microarchitectural parameters such as **Branch Predictors**, **Memory Hierarchy**, and **Instruction Parallelism**, investigating their impact on energy usage.
- Webapp for Mars Rover May 2022 – Jul 2022
 - Developed backend for webserver using **AWS**, **Node.js** and **Express.js** for communication between the webapp and embedded system on Mars Rover.
 - Designed front-end with **HTML/CSS/JavaScript**.
 - Utilised **MySQL** on an **AWS** instance as a database for the WebApp, to maintain live rover position and data.
- C to MIPS Assembly compiler in C++ Feb 2022 – Mar 2022
 - Built Object Oriented Compiler from base including Lexer and Parser in **C++**.
 - Compiles complex expressions in C such as **pointer arithmetic**, **arrays** and **advanced function calls**.
- Automatic Scheduler in C++ Jul 2022 – Oct 2022
 - Created software to allocate projects within a set schedule to improve time management in **C++**.
- Video game with FPGA hand-held controller Feb 2022 – Mar 2022
 - Instantiated NIOS-II soft-core CPU onto **FPGA** using **Quartus**.
 - Programmed **FPGA** accelerometer functionality and low-level local processing and networking in **C** using **Quartus** and **Eclipse**.
 - Developed client-side communication with server and user along with advanced signal processing for motion detection in **Python**.
- MIPS 32-bit CPU in Verilog Nov 2021 – Dec 2021
 - MIPS 32-bit CPU written in **Icarus Verilog** to process standard assembly instructions.
 - Wrote **testbenches** to systematically test edge cases for each instruction.
- Boolean Algebra Solver in C++ May 2021
 - Programmed tool that could reduce and solve Boolean algebra expressions using **trees** in **C++**

Leadership and Team Experiences

-
- | | |
|--|----------------------|
| • Vice-President of Electrical Engineering Society | Oct 2022 – Jun 2023 |
| • Undergraduate Teaching Assistant – Mathematics | Oct 2022 – Jan 2023 |
| • Year 2 Academic Representative | Oct 2021 – Jun 2022 |
| • Fundraising Officer at Habitat for Humanity | Aug 2019 – Jun 2020 |
| • President of Robotics Club | Aug 2018 – Jun 2019 |
| • Founder of School Tutoring Club | Sept 2016 – Jul 2018 |

Skills Strengths and Achievements

-
- Programming Languages: C/C++, Python, Rust, JavaScript (NodeJS), SQL, SystemVerilog
 - Technologies: AWS, Git, FPGAs, Microcontrollers, TCP/IP, PyTorch, Vivado, Quartus, Eclipse, LTSpice, QICK
 - Proficient in (written and spoken) English, French, and Arabic
 - Completed Math and Further pure maths iGCSE, 2 years early