

BEN MORCOS

full(er) stack developer

SOFTWARE

EMBEDDED

AI/ML

SYSTEM DESIGN

HARDWARE

CONTACT

Waterloo
Ontario, Canada

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LANGUAGES

English, French

PROGRAMMING

Python, C, C++
OpenCL, CUDA
VHDL, Verilog, HLS
JavaScript, TypeScript
L^AT_EX, shell, Tcl
VBA

TOOLS

GitHub, GitLab
TravisCI, Codecov
pytest, GTest
TensorFlow, TFMOT
NNI, Hyperopt
MongoDB, GraphQL
Conda, Docker
Vivado, Quartus
AutoCAD, SolidWorks
MATLAB, Simulink
kdenlive, inkscape

OPEN IP

zynq-axi-dna
c5soc-ocl-id
pre-commit-hooks-cpp
discord-downloader

CONTRIBUTOR

nengo
nengo-fpga

HOBBIES

Hiking & Canoeing
Climbing
Woodworking
Music
Cooking
Various sports
Philosophy

ABOUT ME

My academic and work experience has given me development skills at many levels of abstraction. I have worked on everything from gate-level hardware to embedded software to frontend clients, and everything in between. This breadth of knowledge led me to the label *full(er) stack developer* and I appreciate the perspective this affords me when designing systems and working across teams. I'm always looking to hone my skills and continue to learn new things. However, I am currently most interested in the middle of the full(er) stack from embedded to core application to backend.

WORK EXPERIENCE

- 2016–Now **Applied Brain Research** *Waterloo, ON*
Neuromorphic Software-Hardware Co-Developer
- Lead efforts to explore, optimize, and implement neural applications on various standard, embedded, and neuromorphic hardware platforms.
 - Establish a common high-level interface, via GUIs and APIs, for deploying neural networks across various hardware platforms.
 - Provide low-level libraries, interfaces, and protocols for modular embedded neural deployments.
 - Bring to market edge AI web platform.
 - Devise novel AI/ML solutions and benchmarking for dynamical tasks.
 - Leverage model pruning and quantization techniques.
 - Collaborate with leading scientists pushing the boundaries of computational neuroscience applications including autonomy, vision, speech, and more.
 - Single handedly develop run-time flexible FPGA implementation to efficiently run dynamic neural networks with a user-friendly Python interface.
 - Evaluate possible ASIC designs for sparse, event-driven dynamic neural networks.
 - Maintain clean code repositories with automated devops pipelines.
 - Manage and mentor co-op and Mitacs students.
 - Assist with yearly *Nengo Summer School* — a two week in-depth workshop for international scholars to learn and use Nengo.
- 2014–2015 **Teledyne DALSA** (co-op x2) *Waterloo, ON*
Mechanical Designer, Sustaining Engineer
- Designed and validated custom fixtures for testing and production.
 - Optimized and debugged software and hardware of vision sensors.
- 2014 **Toyota Motor Manufacturing Canada** (co-op) *Cambridge, ON*
Quality Control Engineer for Lexus Hybrid group
- Performed root cause analysis and coordinated trial solutions.
- 2013 **Intellijoint Surgical** formerly *Avenir Medical* (co-op) *Waterloo, ON*
Medical Device Designer
- Implemented and evaluated optical feature extraction algorithms.
- 2012–2013 **IKO Industries** (co-op x2) *Madoc, ON*
Mechanical Engineer, Electrical & Systems Engineer
- Improved throughput by 13% with analysis and recommendation.
 - Optimized sensors, PLC, and HMI.

EDUCATION

2017–2019 **MASc** — Computer Hardware Engineering

The University of Waterloo

Developed a neuromorphic hardware accelerator on FPGAs with a focus on run-time flexibility and accessibility. The hardware is conveniently connected to Python via the Nengo development framework and is run-time configurable to support a wide range of neural networks with a static hardware design.

2011–2016 **BASc** — Mechatronics Engineering, with distinction

The University of Waterloo

The Mechatronics program covers a broad base of mechanical, electrical, computer, and system design engineering while my elective courses leaned towards philosophy, machine intelligence, and neuroscience. My capstone design project was a small-scale portable hydro-electric generator built from scratch.

PUBLICATIONS

Peter Blouw, Gurshaant Malik, **Benjamin Morcos**, Aaron R. Voelker, and Chris Eliasmith (2021). *Hardware Aware Training for Efficient Keyword Spotting on General Purpose and Specialized Hardware*

TinyML Research Symposium

Benjamin Morcos. NengoFPGA: an FPGA Backend for the Nengo Neural Simulator. MASc thesis. University of Waterloo, 2019. URL: <http://hdl.handle.net/10012/14923>.

Benjamin Morcos, Terrence C Stewart, Chris Eliasmith, and Nachiket Kapre (2018). *Implementing NEF Neural Networks on Embedded FPGAs*

International Conference on Field-Programmable Technology (FPT), Naha, Okinawa, Japan

VOLUNTEER WORK

2017–Now **The Foodbank of Waterloo Region**

Kitchener, ON

Work at the distribution warehouse to sort food and keep track of local inventory. This is a fun, low mental effort, and social position that benefits the community — everybody wins!

2017 **Teaching Assistant**

Heterogeneous Architecture Summer School

Assisted with a one week workshop teaching students about computation using heterogeneous hardware platforms (FPGA, GPU, CPU).

2014–2015 **Federation Orientation Committee**

The University of Waterloo

One of four volunteers responsible for planning Engineering Orientation Week 2015 for ≈ 2000 incoming students:

- Interviewed, hired, and managed a team of ≈ 400 volunteers.
- Obtained sponsorship and created a formal budget for the year.
- Worked alongside numerous other entities within the University.
- Kept well documented records for continuous improvement.