Naums Mogers

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I am a PhD candidate in programming languages and deep learning at the University of Edinburgh. My project focuses on **optimizing compilation techniques** that benefit from functional intermediate representation (IR) with **deep neural networks** (DL) and **GPUs** as a case study. I also worked on this topic as a research intern at Microsoft Research Cambridge. My other interests include **software/hardware codesign** for DL: while interning at ARM Research Cambridge, I worked on a compiler that generates **FPGA** designs in the Spatial HLS language for LSTM networks.

EDUCATION

PhD in Compilers and Programming Languages, University of Edinburgh 2017—2022
Supervisor: Christophe Dubach. Co-supervisors: Michel Steuwer, Michael O'Boyle, Kenneth Heafield

> I am extending the Scala-based compiler Lift to achieve performance portability for DL across GPU architectures. The functional IR adds a universal level of abstraction between the applications and the hardware; the optimal implementation is found by exploring the design space created by rewrite rules.

Project title: "Optimising Compilation of Machine Learning Models for Heterogeneous Hardware"

MSc(R) in Computer Science, University of Edinburgh (sup.: Christophe Dubach) 2016—2017
Thesis title: "Optimisation of CNNs Using A Functional Data-Parallel Language"

MSc in Artificial Intelligence, University of Edinburgh (sup.: Christophe Dubach) 2015—2016
Thesis title: "Expressing Artificial Neural Networks In A Functional Data-Parallel Language For GPU Acceleration"

BEng in Computer Science (with a year in industry), University of York (sup.: Simon O'Keefe) 2011—2015
Thesis title: "Memory in Simulated Swarms"

RESEARCH VISITS AND INTERNSHIPS

Mila — **Quebec AI Institute** (Visiting Student), Montreal, Canada Sep'21 — Aug'22

McGill University (Graduate Research Trainee), Montreal, Canada Sep'21 — Aug'22

ARM Research (Research Intern), Cambridge, UK (hosts: Giacomo Gabrielli, Ali Zaidi) Sep'19 — Dec'19

> Worked on a software/hardware codesign project focused on extending the Scala-based Lift compiler to generate HDL designs in Spatial targeting LSTMs and FPGAs.

Microsoft Research (Research Intern), Cambridge, UK (host: Ryota Tomioka) Aug'18 — Oct'18

> Worked on optimizing compilation of ML workloads for the Microsoft Brainwave ML accelerator.

Huawei (Collaboration), University of Edinburgh Sep'17 — Aug'18

> Worked on accelerating VGG, ResNet and GoogleNet on Mali GPUs using automatic rewriting techniques.

York Centre for Complex Systems Analysis (YCCSA) (Research Intern), York, UK Jul'15 — Sep'15
Hosts: Martin Trefzer, Dimitris Lagos

PUBLICATIONS

Mapping Parallelism in a Functional IR through Constraint Satisfaction:
A Case Study on Convolution for Mobile GPUs
Naums Mogers, Lu Li, Valentin Radu, Christophe Dubach
Proceedings of the 31st ACM SIGPLAN International Conference on Compiler Construction (CC'22)

Automatic Generation of Specialized Direct Convolutions for Mobile GPUs
Naums Mogers, Valentin Radu, Lu Li, Jack Turner, Michael O'Boyle, Christophe Dubach
Proceedings of the 13th Annual Workshop on General Purpose Processing using Graphics Processing Unit 2020

Towards Mapping Lift to Deep Neural Network Accelerators
Naums Mogers, Aaron Smith, Dimitrios Vytiniotis, Michel Steuwer, Christophe Dubach, Ryota Tomioka
Workshop on Emerging Deep Learning Accelerators (EDLA) @ HiPEAC

Sensor Organism
Naums Mogers, Martin Trefzer, Dimitris Lagos
C. Paterson (Ed.), Proceedings of the Eighth York Doctoral Symposium on Computer Science & Electronics. (2015)

AWARDS

PhD scholarship, University of Edinburgh, EPSRC UK 2016–2020

1st Prize for the IBM and Swiss Re Hackathon Challenge, HackZurich hackathon 2016

Best Poster Award, National Student Research Conference, University of Edinburgh 2016

Best Poster Award, York Doctoral Symposium 2015

York Award, University of York 2015

Accepted to Google Compiler and Programming Language Summit, Google Munich 2019, 2017

Accepted to Facebook PhD London Tech Talk, Facebook London 2018

Accepted to Google Inside Look Program (31 selected out of thousands of applicants), Google London 2017

Public Engagement: Raspberry Pi Project Funding, University of York 2014

WORK EXPERIENCE

Thomson Reuters (News Annotator for NLP research), Remote, UK Sep'16 — Jun'17

Sophos (Engineering Intern), Abingdon, UK Jul'13 — Jul'14

> My responsibilities included antivirus engine development in C/C++/Python, manual and automated testing, code reviews, debugging, documentation maintenance and software release preparation. My team employed Agile Development practices including pair programming and daily planning meetings.

EDF Energy (IT and Digital Summer Intern), Brighton, UK Jul'12 — Sep'12

Stockholm Environment Institute York (Web Design Intern), York, UK Feb'12 — Aug'12

M2 Ltd (System Administrator / Software Developer), Riga, Latvia Jun'09 — Dec'14

TEACHING

Object-Oriented Programming, TA, University of Edinburgh	2017—2019
Algorithms, Data Structures and Learning, TA / Marker, University of Edinburgh	2016—2018
Introductory Applied Machine Learning, Marker, University of Edinburgh	2017—2018
Machine Learning; Algorithms; Microcontrollers, Tutor, ABFS School, Riga, Latvia	2016—2019
Software Testing, Tutor, University of Edinburgh	2017
Compiling Techniques, Demonstrator, University of Edinburgh	2016
Processing Formal and Natural Languages, Marker, University of Edinburgh	2016
Raspberry Pi / Raspbian / Windows 10 IoT, Tutor, Microsoft Student Partners	2016

PRESENTATIONS

Talk, International Conference on Compiler Construction (CC), remote	Apr'22
Talk, Systems, PL and Compilers Group at McGill University	Oct'21
Poster, Google Compiler and Programming Language Summit, Munich, Germany	Dec'19
Talk, "Renegotiating Accelerator Abstractions" workshop, ARM Research Summit, Austin, TX, USA	Sep'19
Talk, Workshop on Emerging Deep Learning Accelerators, HiPEAC, Valencia, Spain	Jan'19
Tutorial, International Symposium on Performance Analysis of Systems and Software (ISPASS), Belfast	Apr'18
Poster, Google Compiler and Programming Language Summit, Munich, Germany	Dec'17
Invited talk, Glasgow Systems Seminar, University of Glasgow, UK	Oct'17
Poster, The Scottish Informatics and Computer Science Alliance (SISCA), University of Dundee, UK	Jun'17

SKILLS

Prog. languages: Scala, Java, C, OpenCL, Python

Frameworks: Caffe, PyTorch, Tensorflow

Hardware: GPU (Mali, NVIDIA), FPGA, HiKey, Arduino

Languages: English, Russian, Latvian