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Bastian Hagedorn

University Education

since 2016 **Ph.D. studies**, *University of Münster*, Münster, Germany.
Supervisor: Prof. Sergei Gorlatch
Main research interests: High-level programming abstractions for high-performance computing applications, Programming of modern multi- and many-core processors

2014 – 2016 **Master of Science in computer science**, *University of Münster*, Münster, Germany, *Final grade in computer science: excellent with distinction (90%).*
Thesis title: An Extension of a Functional Intermediate Language for Parallelizing Stencil Computations and its Optimizing GPU Implementation Using OpenCL.
In this thesis, I extended the Lift compiler to enable the generation of high-performance stencil code for GPUs from a high-level functional program *Grade for thesis: excellent*

2011 – 2014 **Bachelor of Science in computer science**, *University of Münster*, Münster, Germany, *Final grade in computer science: very good (81%).*
Thesis title: Implementation of a Multicast Module for the Floodlight SDN-Controller
In this thesis, I extended the Floodlight network controller with a module which enables a novel approach to multicast communication in software-defined networks. *Grade for thesis: excellent*

Research Visits

02/2018 – 04/2018 **Visiting researcher (2 months)**, *University of Glasgow*, Glasgow, UK.
Funded by HPC-Europa3
In collaboration with the Irish Centre for High-End Computing (ICHEC) and the University of Edinburgh, I implement high-performance code generation for emerging HPC applications like acoustics simulations and Ground Penetrating Radar (GPR) using Lift.

07/2017 – 09/2017 **Visiting researcher (2 months)**, *University of Edinburgh*, Edinburgh, UK.
Funded by HiPEAC
During this visit, I combined modern auto-tuning techniques with the current Lift code generator. I also evaluated Lift's functional compilation approach compared to state-of-the-art polyhedral compilation. A paper describing the results of this and our previous collaborations is nominated for the best paper award at the prestigious International Symposium on Code Generation and Optimization (CGO) [1]

02/2017 – 03/2017 **Visiting researcher (2 months)**, *University of Edinburgh*, Edinburgh, UK.
Funded by the EuroLab-4-HPC
During this visit, I extended the Lift compiler, developed at the University of Edinburgh, to enable automatic exploration of stencil-specific optimizations.

04/2016 – 05/2016 **Visiting researcher (2 months)**, *University of Edinburgh*, Edinburgh, UK.
Funded by the EuroLab-4-HPC
During this visit, I extended the Lift compiler to enable the generation of high-performance stencil code for GPUs.

09/2015 **Visiting researcher (3 weeks)**, *HUST University*, Wuhan, China.
Funded by the EC's 7th Framework Programme MONICA for accelerating the transfer and deployment of research knowledge between European countries and China. During this visit, I implemented an experimental setup for SDN-based multicast, and prepared a research paper on this topic [3]

Presentations

03/2018 Talk: *High Performance Stencil Code Generation with Lift*.
Scottish Programming Language Seminar (SPLS), University of Glasgow, UK

02/2018 Talk: *High Performance Stencil Code Generation with Lift*.
International Symposium on Code Generation and Optimization (CGO), Vienna, Austria

02/2018 Invited Talk: *High Performance Stencil Code Generation with Lift*.
Research Group on Compiler and Architecture Design, University of Edinburgh, UK

03/2017 Invited Talk: *Performance Portable Stencil Code Generation with Lift*.
Research Group on Compiler and Architecture Design, University of Edinburgh, UK

Publications

2018 [1] **B. Hagedorn**, L. Stoltzfus, M. Steuwer, S. Gorlatch, and C. Dubach. "High Performance Stencil Code Generation with Lift". In: *International Symposium on Code Generation and Optimization, CGO 2018 (accepted)*. 2018.

2017 [2] **B. Hagedorn**, M. Steuwer, and S. Gorlatch. "A Transformation-Based Approach for Developing High-Performance GPU Programs". In: *Perspectives of System Informatics - 12th International Andrei Ershov Informatics Conference, PSI 2017*. Lecture Notes in Computer Science. Springer, 2017.

2016 [3] T. Humernbrum, **B. Hagedorn**, and S. Gorlatch. "Towards Efficient Multicast Communication in Software-Defined Networks". In: *2016 IEEE 36th International Conference on Distributed Computing Systems Workshops (ICDCSW)*. June 2016, pp. 106–113. DOI: 10.1109/ICDCSW.2016.15.

2015 [4] M. Haidl, **B. Hagedorn**, and S. Gorlatch. "Programming GPUs with C++14 and Just-In-Time Compilation". In: *Parallel Computing: On the Road to Exascale, Proceedings of the International Conference on Parallel Computing, ParCo 2015, 1-4 September 2015, Edinburgh, Scotland, UK*. 2015, pp. 247–256.

[5] F. Stahl, A. Godde, **B. Hagedorn**, B. Köpcke, M. Rehberger, and G. Vossen. "High Quality Information Delivery: Demonstrating the Web in Your Pocket for Cineast Tourists". In: *Proceedings of the BTW 2015*. 2015, pp. 667–670.

2014 [6] F. Stahl, A. Godde, **B. Hagedorn**, B. Köpcke, M. Rehberger, and G. Vossen. "Implementing the WiPo architecture". In: *E-Commerce and Web Technologies*. Springer, 2014, pp. 1–12.

Research Projects

since 04/2016 **Lift**, *A Novel Approach to Achieving Performance Portability on Accelerators*.
Ongoing research, *www.lift-project.org*
I am one of the main contributors focusing on implementing stencil computations in Lift. I extended the functional Lift IR and enabled the generation of efficient OpenCL kernels for stencil-based applications. The Lift project is a novel approach to generate high-performance OpenCL kernels from high-level functional programs.

04/2015 **PACXX**, *Programming Accelerators with C++*.
Ongoing research
I developed an LLVM analysis pass for the PACXX compiler and ported HPC applications to the PACXX programming model resulting in a publication [4]. PACXX is a unified HPC programming model for programming accelerators (GPUs etc.) using pure C++ by implementing a custom compiler (based on the LLVM framework) and a runtime system.

10/2013 - 09/2014 **OFERTIE EU Project**, *OpenFlow Experiment in Real-Time Internet Edutainment*.
I configured the SDN testbed at the University of Münster, conducted several SDN-based experiments and extended the monitoring interface of the Real-Time Framework (RTF) The OFERTIE project aims to use SDN approaches to improve delivery of Real-Time Online Interactive Applications (ROIA).

Attended Academic Events

2018 SPLS - *Scottish Programming Languages Seminar*, Glasgow, UK

2017 Compiler and Programming Language Summit (organized by Google), Munich, Germany

ACASES Summer School (organized by HiPEAC) - *Thirteenth International Summer School on Advanced Computer Architecture and Compilation for High-Performance and Embedded Systems*, Fiuggi, Italy

PUMPS Summer School - *Eighth edition of the Programming and Tuning Massively Parallel Systems summer school*, Barcelona, Spain

SPLS - *Scottish Programming Languages Seminar*, Edinburgh, UK

2016 HLPP conference - *9th International Symposium on High-Level Parallel Programming and Applications*, Münster, Germany

UKMAC - *UK Many-Core Developer Conference*, Edinburgh, UK

WadlerFest/LCFS30 - *30th Aniversery of the Laboratory for Foundations of Computer Science*, Edinburgh, UK

2015 PRACE Course - *Advanced Parallel Programming with MPI and OpenMP*, Jülich, Germany

PRACE Course - *Node-Level Performance Engineering*, Stuttgart, Germany

Reviewer

2018 CGO 2018 artifact evaluation commitee

2016 – 2018 I have been active as an external reviewer for the following conferences and journals: *Principles and Practice of Parallel Programming (PPoPP), the International Journal of Parallel Programming (IJPP)*, the *Journal of Supercomputing*, the journal *Concurrency and Computation: Practice and Experience*, the Journal of Applied Geophysics (APPGEO), the Parallel Computing Technologies (PaCT), the Parallel Computing Conference (ParCo), the UKRCON and the PSI.

Teaching

Summer 2018 Course design and Lecturer: *Introduction to programming with C and C++*

Summer 2018 Teaching assistant for the course: *Parallel Programming: Multi-Core and GPU*

Winter 2017 Teaching assistant for the course: *Operating systems*

Winter 2017 Teaching assistant for the course: *Introduction to programming with Java and Racket*

Summer 2017 Course design and Lecturer: *Introduction to programming with C and C++*

Summer 2017 Supervised a student project: *Automatic program optimization for modern many-core systems*

Winter 2016 Teaching assistant for the course: *Operating systems*

Winter 2015 Student assistant for the course: *Operating systems*

Summer 2015 Student assistant for the course: *Computer architectures*

Winter 2014 Student assistant for the course: *Operating systems*

Supervised Undergraduate and Master Students

since 02/2018 Johannes Lenfers (Master): *Implementing Compiler Auto-Tuning Strategies for Design Space Exploration of Lift Programs*

since 02/2018 Bastian Köpcke (Master): *Efficient GPU Code Generation for FFT Computations in Lift*

since 01/2018 Maurice Heine (Undergraduate): *Implementation of a Visualization Tool for Lift Programs*

since 01/2018 Martin Lücke (Master): *Efficient Implementation of Geometric Multigrid Operations in Lift*

Technical Skills

Programming Languages **Scala, C/C++, Java**.
Experiences: Stencil support for Lift compiler (Scala), Multicast Module for the Floodlight SDN Controller (Java), Measurement library for OpenCL (C++), Implementation of the WiPo architecture (Java), Monitoring interface extension of RTF (C++)

Parallel Programming **OpenCL, CUDA, OpenMP**.
Experiences: Performance portability evaluation of OpenCL Kernels on Intel Xeon (Phi) and NVIDIA Tesla. JIT compilation of a DSL using LLVM and CUDA Driver API

Compiler Tools **LLVM**.
Experiences: Analysis Pass for the PACXX Compiler, Compiler frontend for self-defined DSL for data parallel applications based on algorithmic skeletons