

Jackson Woodruff

Informatics Forum

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PhD Student in Compiling for Hardware Accelerators at the University of Edinburgh.

Education

University of Edinburgh, 2019–(Ongoing). PhD in Informatics.

University of Cambridge, 2018–2019. MEng with Distinction in Computer Science.

University of Cambridge, 2015–2018. BA in Computer Science (2nd overall in year). MA cantab (2023).

Experience

MIT

June 2023 – Ongoing

Visiting postdoc working on scheduling languages for hardware accelerators.

Meta AI Research

Summer 2022

Research scientist exploring applications of reinforcement learning to CGRA compilers, and CGRA co-design.

Arm

Summer 2017, Summer 2018

GCC and LLVM compiler work. Mid-end tree optimizations and performance analysis. Instruction scheduling for Cortex-A55 and Cortex-M7.

Research Aims

Hardware accelerators promise to achieve new levels of performance in a post-Denard era. However, compilation techniques lag behind the development of hardware accelerators leading to poor uptake rates, poor performance and limiting impact.

My work enables programmers to keep writing programs in the same way they always have, but enabling them to take advantage of newly available hardware: freeing both the programmer from a steep learning curve, and the hardware architects from the constraints of existing programming languages.

Languages, Frameworks and Tools

Languages: Bash, C/C++, Java, Latex, Python, Scala, OCaml, P4

Frameworks: GCC, LLVM, Torch

Tools: Program Synthesis, Reinforcement Learning, Equality Saturation

Awards

Best Paper Award, GPCE 2023

Best Paper Award, GPCE 2020

Xilinx Open Hardware Prize, 2020

Distinguished Talk Award, Churchill College Computer Science Talks Series, 2017 & 2018

Magdalene College Prize for Computer Science, 2016, 2018, 2019
Magdalene College Academic Scholarship, 2016–2017, 2018–2019, 2019–2020
Top 50 A-Level Computer Science Student in the UK, 2015
Old Warwickian Association Prize for Information and Communication Technology, 2015
Ward Scholarship, 2015–2018

Publications

Jackson Woodruff, Sam Ainsworth, Michael F.P. O’Boyle, Secco: Codesign for Resource Sharing in Regular Expression Accelerators, ASP-DAC 2024.

Jackson Woodruff, David Schall, Christopher Woodruff, When Does Saving Power Save the Planet? HotCarbon 2023

Jackson Woodruff, Chris Cummins, Designing CGRAs with Deep Reinforcement Learning. DoSSA, 2023

Jackson Woodruff, Jordi Armengol-Estap , Sam Ainsworth, Michael F.P. O’Boyle, Bind the Gap: Compiling Real Software to FFT Hardware Accelerators, Programming Languages Design and Implementation, 2022

Jackson Woodruff, Michael F.P. O’Boyle, New Regular Expressions on Old Accelerators, Design Automation Conference 2021

Jackson Woodruff, Andrew W. Moore, Noa Zilberman, Measuring Burstiness in Data Center Applications, Buffers Workshop 2019.

Jackson Woodruff, Murali Ramanujam, Noa Zilberman, P4DNS: In-Network DNS, ANCS 2019. Represented at Innovation in Clouds, Internet and Networks (ICIN) 2020 and IETF Meeting 107 as invited paper. Winner of Xilinx Open Hardware Award.

Other Publications

Jose Wesles de Sourza Magalh es, Jackson Woodruff, Elizabeth Polgreen, Michael F.P. O’Boyle. C2TACO: Lifting Tensor Code to TACO, GPCE 2024. Best Paper Award.

Jordi Armengol-Estape, Jackson Woodruff, Michael F.P. O’Boyle. Slade: Effective real-world de-compilation with a small language model, CGO 2024.

Pablo Martinez, Jackson Woodruff, Jordi Armengol-Estap , Michael F.P. O’Boyle, Matching linear algebra and tensor code to specialized hardware accelerators. CC 2023

Jordi Armengol-Estap , Jackson Woodruff, Alexander Brauckmann, Jose Wesley de Souza Magalh es, Michael F.P. O’Boyle, ExeBench: an ML-scale dataset of executable C functions, MAPS 2022

Noa Zilberman, Andrew Moore, Billy Coleman, Jackson Woodruff, Yuta Tokusashi, Pietro Bressana, Murali Ramanujam, Salvator Galea, NGG: A Network Perspective on Application’s Performance, TMA, 2021.

Bruce Collie, Phillip Ginsbach, Jackson Woodruff, Ajitha Rajan, Michael F.P. O’Boyle, M3: Semantic API Migrations. International Conference on Automated Software Engineering, 2020.

Bruce Collie, Jackson Woodruff, Michael F.P. O’Boyle, Modeling black-box components with probabilistic synthesis. International Conference on Generative Programming: Concepts and Experiences,

2020. Best Paper Award.

Murali Ramanujam, Jackson Woodruff, Andrew W Moore and Noa Zilberman, “Reproducible Cloud Measurements”, poster, Google Networking Research Summit, March 2019.

Dissertations

Jackson Woodruff, Acceleration for the many, not the few, PhD Thesis, University of Edinburgh 2024 (To Appear).

Jackson Woodruff, Analyzing data center applications using high precision packet traces, Master’s Dissertation, University of Cambridge, 2019.

Work Under Submission

Jackson Woodruff, Thomas Koehler, Alexander Brauckmann, Sam Ainsworth, Chris Cummins, Michael F.P. O’Boyle, Rewriting History: Repurposing Domain-Specific Accelerators with Rewrite Exploration. (Under Submission, 2023)

Talks

“Lifting Tensor Code”, MIT, 2023 (invited talk, Karima Ma)

“The Rebound Effect in Computer Science”, Meta AI Research, 2023 (invited talk, Carole Jean-Wu)

“Rewriting in Modern Compilers”, HiPEAC ACASES Summer School, Michael F.P. O’Boyle, 2023

“Using Program Synthesis to Compile for Hardware Accelerators”, University of Illinois at Urbana-Champaign, 2022 (invited talk, Mendith Charis)

“Compiling for Heterogeneous Hardware Accelerators”, University of California at Los Angeles, 2021 (invited talk, Tony Nowatzki)

“Compiler Support for Hardware Accelerators”, Arm Virtual Conference, 2021 (invited talk, Arm)

Teaching

Supervising (2020–2022):

- Principles of Communication (Advanced Computer Networks)
- Comparative Architectures (Advanced Computer Architecture)
- Compiler Construction (Introductory Compilers)

Students:

- Ben Andrew, Cambridge BA Dissertation: Delay-Tolerant Link-State Routing (2022)