

My Research and I

...and maybe you as well

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Me, me, me

- **2009 - Engineering Doctorate in System Level Integration**
- **2009 – 2014: Mostly teaching and academic admin in Pakistan**
- **2014 – 2020: Post-doc at Glasgow**
- **2020 onwards: Lecturer at Glasgow**
 - 2023-24: Secondment in the industry
- **Member of:**
 - **Systems Research Section (GLASS)**
 - Low-Carbon and Sustainable Computing Theme
 - **Education & Practice Research Section (EAP)**
 - Skills and Competencies Research Group

Two Broad Areas of Research

1. Computing **Systems** (Systems Research Section)

- **Heterogeneous** Computing
 - Scientific Computing, High-performance Computing
- **Optimization** of Computing Systems
 - Focus on: Low-carbon and Sustainable Computing
 - Also: Performance, Energy, Resources

2. Computing **Education** (Education & Practice Research Section)

- Competency-based Education, Work-based Learning
- Computing Education in Low- and Middle-Income Countries (LMICs)

Cross-cutting theme: **Sustainability, Responsibility** and **Equity** in
Computing **Education** and **Practice**

UN Sustainable Development Goals (UNSDGs)



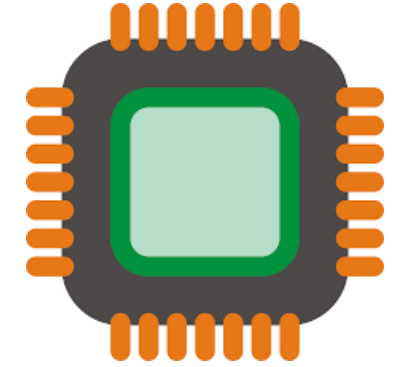


Computing Systems

Computer Systems – Heterogeneous Computing

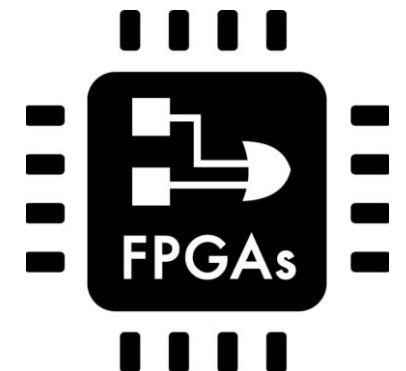
What?

- Use heterogeneous devices for **various workloads** (e.g. scientific workloads, AI workloads)
- Make it **easier** to program and more **efficient**

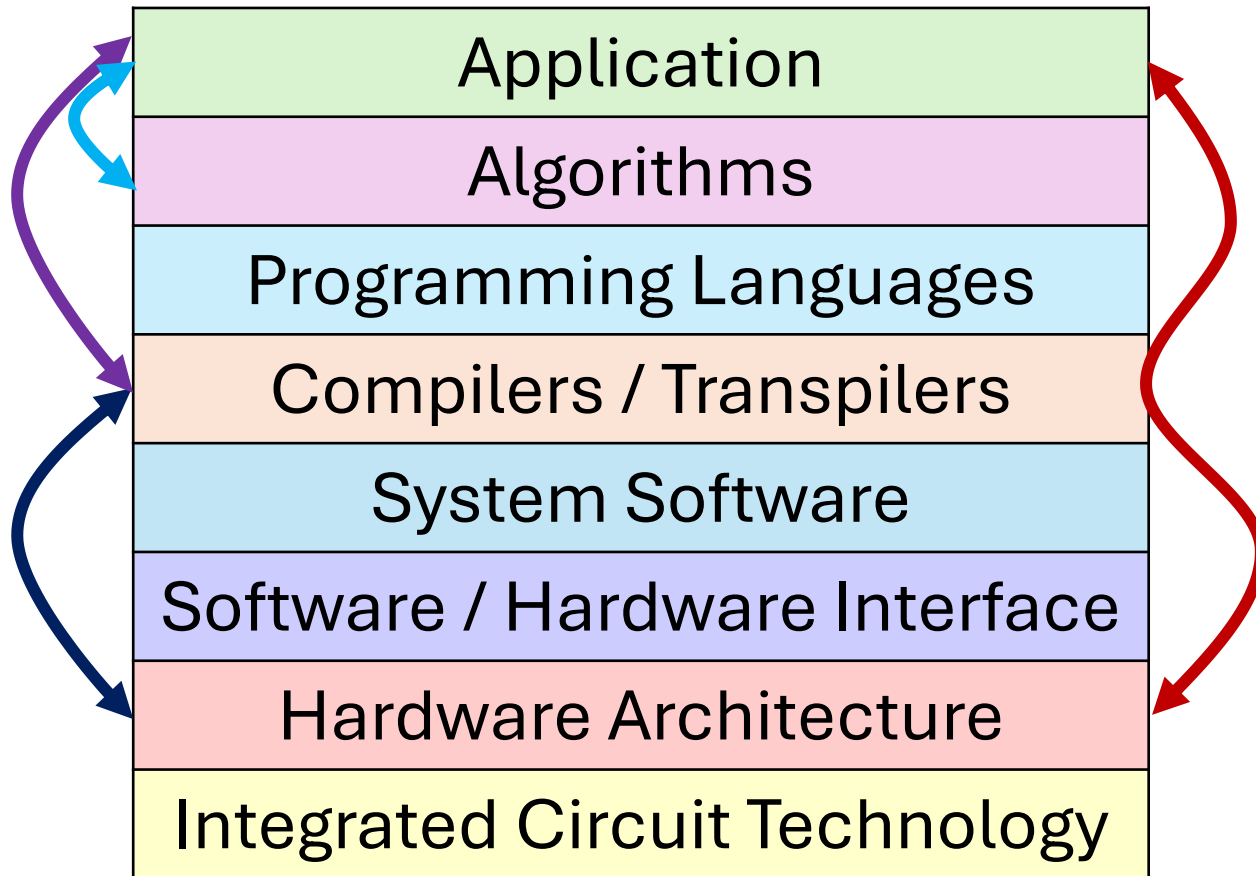


How?

- Making smarter tools and compilers for **Heterogeneous Computing**
 - Finding patterns in code
 - Predicting performance
 - Source-source translations
 - Back-end code generation
 - Front-end APIs and DSLs (standard, custom)
 - In-house, on the cloud
 - Embedded/edge devices
- Static **and** dynamic tuning



Computer Systems – *Cross-Layer* Optimization



- Integrating optimization across layers presents opportunities (and challenges!)
- Optimization can be for:
 - Performance (Latency, Throughput)
 - Resources (compute, memory)
 - Energy
 - Carbon footprint
 - Functionality
 - Programmability / Portability

Some PhD Projects


Completed or On-going

- Compiler / Hardware Co-design for Irregular Code Patterns
- 3D Medical Imaging for Resource-Constrained Environments
- RISC-V¹ extensions for energy-efficient DNN Models
- Efficient Deep Learning on the Edge

Proposed

- Dynamic, Heterogeneity-Aware Energy Optimization of Scientific / AI workloads
- Optimizing High Throughput Computing for Physics Experiments using Accelerators
- Energy-Efficient Database Management Systems
- Accessible Computing for Modelling Climate Change and Mitigation for LMICs

¹*an open-source, extensible CPU architecture*



Computing Education



Computing Education

Focus Areas

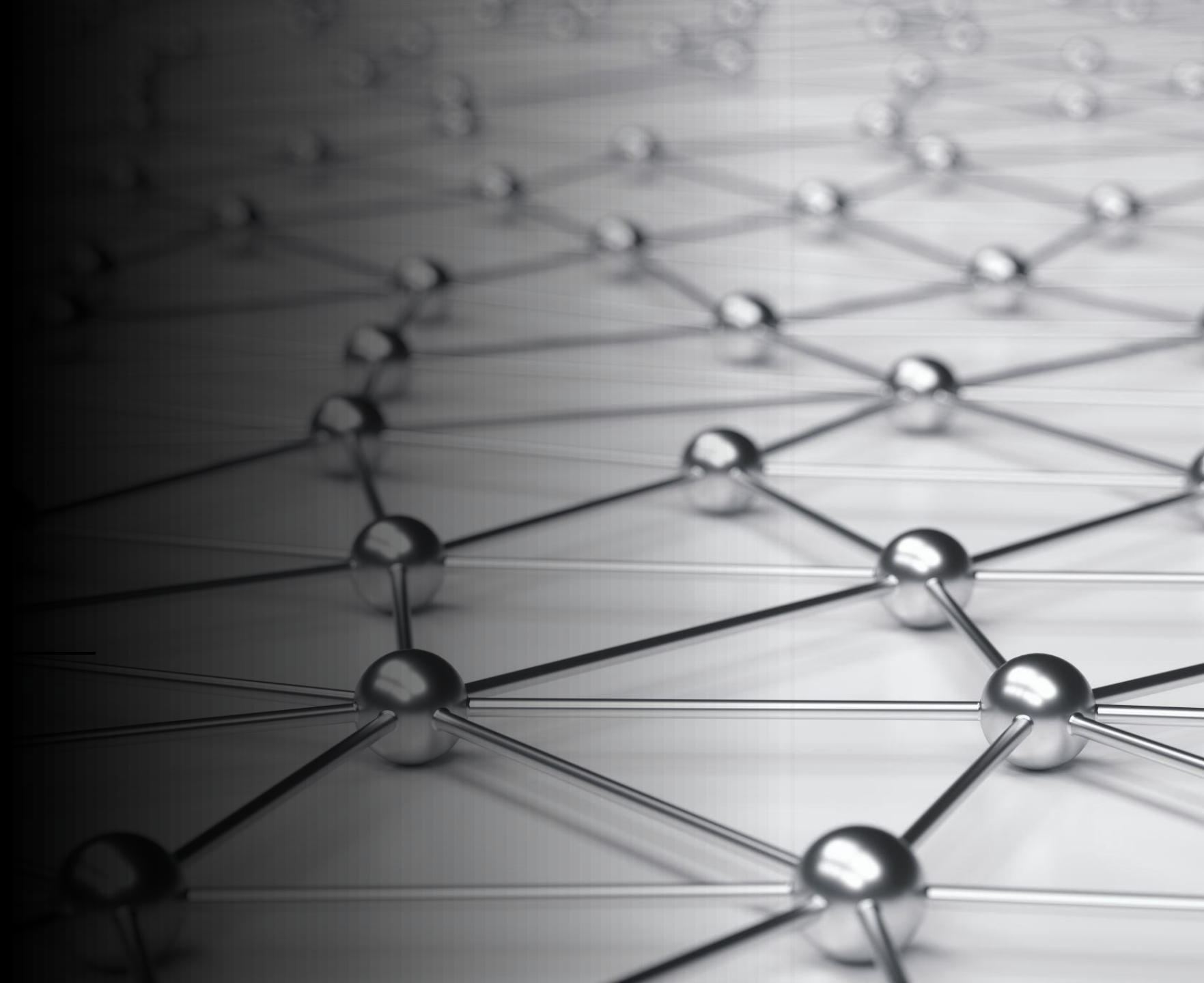
- Competency-Based Education, Mastery Learning
 - Responsible use of AI
- Addressing Disparities in Computing Educational Attainment
 - Focus on Low- and Middle-Income Countries

Phd Projects

- On-going
 - Test-driven Approaches for Comprehending Code in Novice Learners
 - LLMs as Virtual Lab Assistants
- Proposed
 - Evaluating Responsible AI Use for Enabling Mastery Learning
 - AI for addressing disparities in Computing Education



Network



Colleagues I co-supervise PhD Students with

- Prof Wim Vanderbauwhede
- Dr Nikela Papadopoulou
- Dr Lauritz Thamsen
- Dr Jose Cano Reyes
- Dr Maria Kallia
- Dr Mireilla Bikanga Ada
- Dr Fani Deligianni
- Dr Hasan Abbas (Engineering)

Thank you!

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