Student assignment

Type: Graduation assignment
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Topic: Energy-efficient and reconfigurable memory subsystem for the Blocks CGRA.

Background:
Data movement and address calculations account for a significant fraction of the total energy consumption in the Blocks CGRA. This is partially due to the dedicated address generator for every local memory in the Load-Store Units (LSUs). Therefore, we would like to investigate possible optimizations in the current CGRA memory subsystem.

To address the varying application requirements, we could make the memory subsystem more reconfigurable in terms of size (with banking), vector width (sharing address generation with multiple local memories) or the use of other memory structures (2D memories, scatter-gather memories, line-buffers or FIFOs, either dedicated or emulated).

Task description:
In this MSc thesis project you are tasked to investigate, implement and evaluate potential hardware optimizations to support energy-efficient data movement on the state-of-the-art Blocks Coarse-Grained Reconfigurable Array (CGRA). These optimizations will be evaluated on a (pre-defined) set of benchmarks.

The expected outcomes of this MSc thesis are:

1. An extensive literature study on existing approaches for reconfigurable memory subsystems and the application-specific optimizations that are required to maximize energy-efficiency,
2. An evaluation of the most promising approaches using an analytical model or synthesized RTL-level implementation in a modern ASIC technology,
3. An application-level evaluation of the most promising approach implemented on the Blocks CGRA while (partially) running a (pre-defined) set of benchmarks.
4. A detailed report and/or potential paper.

COVID disclaimer:
This project can be fully carried out remotely. The second half of the project requires a stable connection to a TU/e server (over the VPN) to access the ASIC tooling for simulation and/or logic synthesis.
Recommended courses and experience

- Embedded Computer Architecture (ECA).
- Some experience with the Linux command line and RTL coding and some scripting language like Python is a plus.

Interesting references