

Master thesis: Acceleration of Dataset Distillation using FPGAs

For multiple years now, FPGAs have been proposed as a promising approach for computational acceleration. The computation of big DNNs consume massive amounts of computational resources and energy, accelerating these workloads is a key hurdle in achieving further advancements in the field of AI. Another problem is the immense amount of data required for training Neural Networks. Data Distillation is a strategy to condense a large dataset to a smaller dataset, that can be used to train a CNN to a similar test performance. This requires a training of the dataset and a backpropagation through different iterations on the smaller dataset. We want to explore the possibilities of accelerating this process using FPGAs, as it is not well studied. Your task will be to implement the backwards propagation part of the data distillation algorithm and analyze the bottlenecks and opportunities of using FPGAs for Dataset distillation. More information about Dataset distillation can be found online: <https://arxiv.org/abs/2203.11932>.

Tasks:

- Analyze kernels required to implement backwards propagation in dataset distillation
- Explore existing FPGA implementations of these kernels
- Evaluate different approaches in memory organization and exploiting parallelism
- Implement the backwards propagation of Data Distillation on an FPGA using Vivado HLS and/or SystemVerilog
- Evaluate the results and compare them with other Software implementations
- Analyze Bottlenecks on FPGAs

Recommended knowledge and experience:

- Good knowledge of C/C++ is required
- Basic knowledge of Digital Design and Computer Architecture
- Experience in programming with VHDL/Verilog
- Experience in programming with Python
- Experience in deep learning

Benefits:

- Involve in the academic environment of chair of Computer Architecture and Parallel Systems
- Access to powerful Xilinx FPGAs

Application:

If you are interested in this topic, get in contact with Dirk Stober and Dai Liu (find the contact details below) through email.

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