



Contribution ID: 25

Type: **not specified**

A Reconfigurable FPGA-Based ML Library for Kernel Methods

Wednesday 21 May 2025 12:20 (30 minutes)

Kernel methods are fundamental in machine learning. They excel in regression, classification, and dimensionality reduction. They model nonlinear relationships and are widely used in many fields such as in face recognition, wind forecasting, and molecular energy estimation. However, their reliance on a kernel matrix leads to quadratic complexity in computation and storage, which makes large-scale datasets challenging.

We propose an FPGA-accelerated library with high parallelism and efficient data movement. The library is accessed from Python via PYNQ with a plug-and-play solution without requiring hardware expertise. It currently supports Kernel Ridge Regression and Gaussian Processes. Five kernel functions are supported, with Partial Reconfiguration to switch between them. We achieve 30x speedup compared to Python libraries on a Kria SOM.

Future work includes extending support to other kernel methods, and heterogeneous FPGA architectures like AMD Versal, with more advanced kernels.

Talk's Q&A

During the talk

Will you be able to present in person?

Yes

Talk duration

20'+10'

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Session Classification: Algorithm Implementation

Track Classification: Algorithm implementation in HDL and HLS