WP4 – Machine Learning on FPGAs and Quantum Processors

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AI_INFN

Artificial Intelligence technologies for INFN research

Many ongoing activities within the INFN Community on developments **FPGAs** and ***Quantum Computing***.

These technologies may become **relevant to machine learning** in the near future: *we must connect those communities with ML practitioners.*

Enhancing the usability of these resources and the network of experts, by **provisioning resources in INFN Cloud**, documenting ***examples and applications*** and contributing to the ***hackathons*** is part of the effort.

Milestones (FPGAs)

❑ (Acquisition of FPGA resources, ASAP)

○ For experimenting with the provisioning of FPGAs we need the FPGAs to be available in the same OpenStack tenancy as the GPUs of ML_INFN.

❑ FPGA provisioned via JupyterHub on Kubernetes (06/25)

○ Xilinx provides the device-plugin for integrating FPGAs in Kubernetes, and we know how to provision extended resources with JupyterHub.

○ How to deal with GUIs? Is JupyterLab sufficient to the purpose?

❑ Compression pipeline on FPGA documented as a tutorial (12/25)

Milestones (Quantum Machine Learning)

❑ **Quantum Simulators** integrated to a conda env/docker image provisioned in the JupyterHub platform (12/24).

○ Precious work performed in the context of the <u>ECQ experiment available on baltig</u>.

○ Requires a review of which tools we need to include and to maintain as of today.

❑ Classical Machine Learning techniques for **optimizing quantum circuits** (*e.g.* NISQ) documented as tutorials (12/26).

❑ Operational interface between INFN Cloud and QC providers (12/26).

On the FPGA resource acquisition

Provided that FPGA resources will be made available in INFN Cloud, we should prefer diversity over quantity (budget is however limited, 7 k€).

Proposed setup:

❑ 1× Alveo V70
  ○ Cheap, specialized for AI tasks, but does not support custom VHDL/Verilog applications
  ○ Seems **not otherwise available** for tests **within INFN**.

❑ 1× U55C
  ○ The FPGA chosen by ICSC → develop provisioning models that can be **scaled to production resources**, later.