



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

itee^{PhD}
information technology
electrical engineering



Vincenzo Maisto

Innovative Computing Architectures for Green Computing

Tutor: Alessandro Cilaro

Cycle: XXXVII

Year: First

Presentation organization

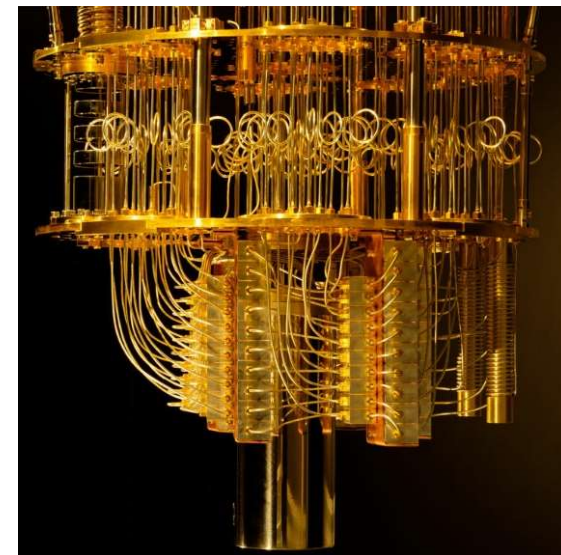
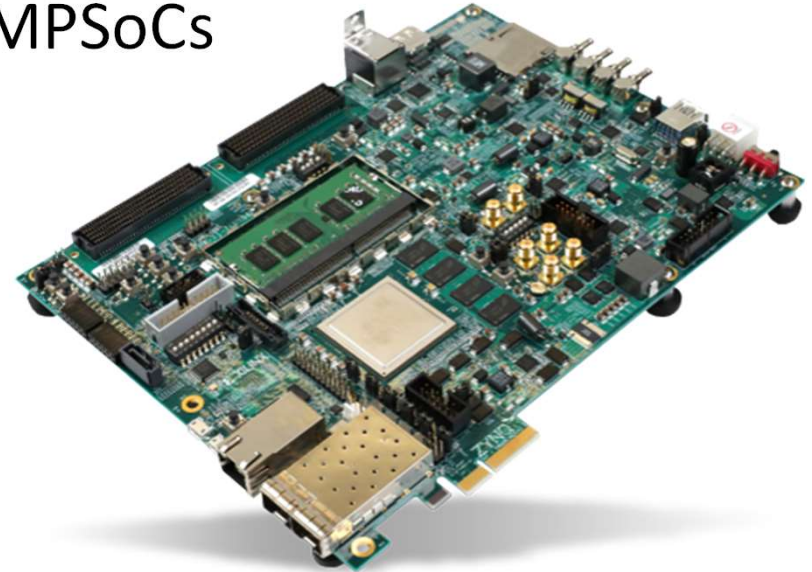
- CONTENT
 - Cover
 - Your background
 - Graduation MS, DIETI group, cooperations
 - Type of fellowship (University, company-funded, etc.)
 - Your research field
 - Specific (1 minute)
 - Summary of study activities
 - Courses attended, schools, seminars, etc.
 - Your research activity (3 minutes)
 - idea, methodology, developments, expected results, validation
 - Your products
 - List papers, tools, awards (if any), etc.
 - Tutorship
 - list courses of tutorship activities authorized by ITEE Board)
 - Next year

My background

- MSc degree: Computer Engineering at UNINA
- Research group/laboratory: SECLAB
- PhD start date: 1st January 2022
- Scholarship type: MUR PON
- Partner company under DM 1061: A3cube Inc.

Research field of interest

- **High Performance Computing Architectures**
- Hardware/Software Co-design on MPSoCs
 - FPGAs
 - Edge-class
 - Server-class
- Cutting-edge technologies
 - Quantum Computers
 - ...



Summary of study activities

- Ad hoc PhD courses / schools:
 - Virtualization Technologies and their applications, ITEE, UNINA;
 - Big Data Analytics and Architectures, ITEE, UNINA;
 - Academic Entrepreneurship, DII, UNINA.
- Courses borrowed from MSc curricula:
 - Introduction to Quantum Circuits, DIETI, UNINA;
 - Quantum Information, DIETI, UNINA.
- Conferences / events attended:
 - DATE 2022;
 - National Workshop for Technology Transfer and Higher Education 2022;
 - QUATIC 2022.

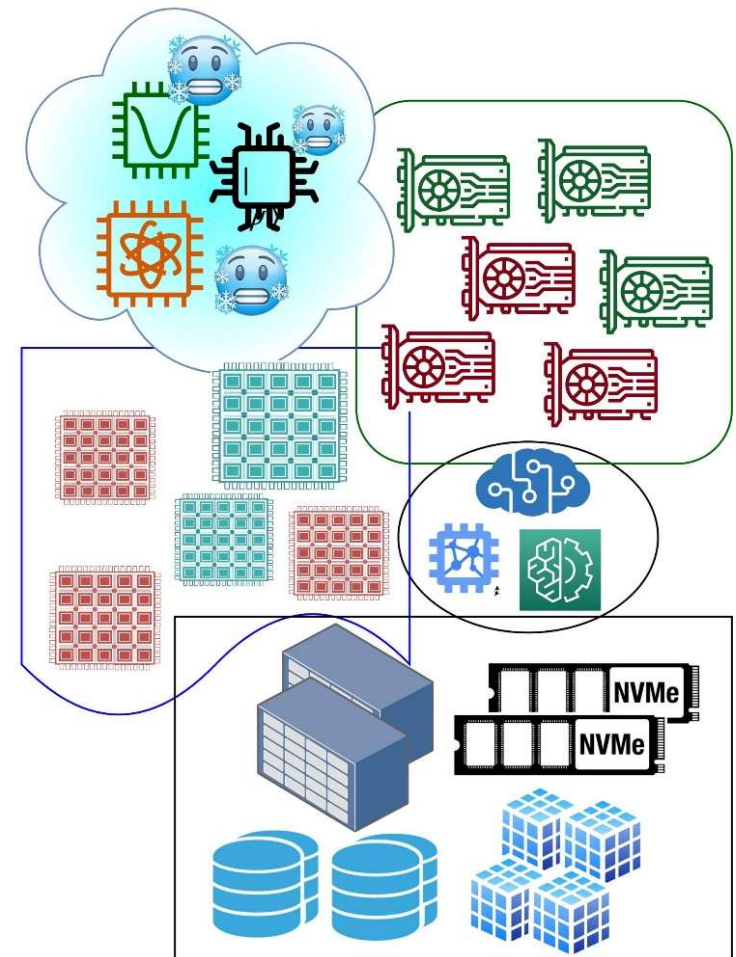
Research activity: Overview

Problem:

1. **Acceleration** of industrial and scientific computing workloads
2. **Energy consumption** of both:
 - Large-scale Big Data processing in HPC platform
 - Ubiquitous edge computing
3. **Technologically heterogeneous** computing architectures
 - FPGAs
 - MPSoCs
 - AI co-processors
 - Distributed storage and computing
 - Quantum computers
 - GPUs
 - ...

Objective:

- **Innovative computing architectures**
- Novel integration methodologies
- Use of cutting-edge technologies
- **Energy efficiency by design**



Research activity: Overview

Methodology:

1. **State-of-the-art** of the acceleration methodologies and cutting-edge technologies
 - AI co-processors
 - High Level Synthesis
 - Dynamic Partial Reconfiguration
 - Distributed computing
 - High Bandwidth Memories
 - ...
2. **Evaluation and analysis** of modern hardware computing platforms and software stacks
 - Xilinx ZCU102, Intel Arria10, Intel Agilex, Xilinx Alveo, *Quantum Computers**,...
 - Vitis-AI, Intel OPAE, OpenCL, ...
3. **Hardware/software co-design** of innovative architectures

**Hardware system
and interfaces**



**Software drivers
and libraries**

Products

[P1]	<p><i>V. Maisto and A. Cilaro (2022).</i> <i>"A Pluggable Vector Unit for RISC-V Vector Extension",</i> <i>doi: 10.23919/DATE54114.2022.9774501</i> <i>[published]</i></p>
[P2]	<p><i>Cilaro, A., Maisto, V., Mazzocca, N., Rocco di Torrepadula, F. (2022).</i> <i>"A Proposal for FPGA-Accelerated Deep Learning Ensembles in MPSoC Platforms Applied to Malware Detection".</i> <i>doi: https://doi.org/10.1007/978-3-031-14179-9_16</i> <i>[published].</i></p>
[P3]	<p><i>Cilaro, A., Maisto, V., Mazzocca, N., Rocco di Torrepadula, F. .</i> <i>"An approach to the systematic characterization of multitask accelerated AI inference in edge MPSoCs"</i> <i>[Submitted on October 31st, 2022, to ACM TECS (Transactions on Embedded Computing Systems)]</i></p>

Plans for Next Year

- First year:
 - Transversal study of all technologies
 - Experimental focus on **edge-class platforms and AI workloads**
- Next year:
 - 1st part: experimental focus on **server-class platforms and datacenter workloads**
 - 2nd part: **abroad collaboration** on innovative computing paradigms and architectures
 - 3rd part: begin the synthesis of a **structured proposal** for the new era of heterogeneous computing platform

Thank you for the attention!