Alberto Moriconi

# An automatic methodology for the synthesis of approximate circuits

Tutor: Prof. Nicola Mazzocca

Cycle: XXXVII Year: 2022

# My background

- MSc degree: Computer Engineering
- Research group/laboratory: Seclab / Embedded systems laboratory
- PhD start date: 1/11/2021
- Scholarship type: Not funded

# Research field of interest

- Amount of data to be processed is increasing, power consumption concerns are becoming increasingly critical.
- Approximate computing is a possible approach: we “gently” relax, in a controlled way, correctness requirements of specific applications (especially iterative or strictly tied to human perceptual limitations).
- In this way we can obtain area, time or power consumption advantages.

# Summary of study activities

- Attended specific seminars on machine learning and deep learning applications
- Attended an ad-hoc course on virtualization technologies
- Attended and gave a technical presentation at:
  - AxC 21 workshop  on approximate computing
  - IWES 2022 workshop on embedded systems

# Research activity: Overview

- Problem (of your own research activity)

  *Devise an automatic and general methodology for the synthesis of approximate circuits.*

- Objective

  *Provide an open-source implementation of a methodology that improves the current state-of-the-art for approximate combinatorial circuits synthesis.*

- Methodology

  *Our methodology, based on the application of multi-objective combinatorial optimization to optimally selected cuts of combinatorial circuits, has been applied to well-known circuital benchmarks (i.e. real circuits used to test conventional synthesis suites), and the results has been compared to other approximation approaches.*

# Products

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|---|---|
| [P1] | Barbareschi, M., Barone, S., Mazzocca, N., & Moriconi, A. (2022). A Catalog-based AIG-Rewriting Approach to the Design of Approximate Components. IEEE Transactions on Emerging Topics in Computing. (Journal paper, published, early access) |
| [P2] | Barbareschi, M., Barone, S., Mazzocca, N., & Moriconi, A. (2022). Design Space Exploration Tools. In Approximate Computing Techniques (pp. 215-259). Springer, Cham. (Book chapter, published) |
| [P3] | Barbareschi, M., Barone, S., Mazzocca, N., & Moriconi, A. Towards Catalog-based AIG-Rewriting<br>Approximate Technique Based FPGA Synthesis.. (Journal paper, submitted) |
| [P4] | Barbareschi, M., Barone, S., Casola, V., Montone, P., & Moriconi, A. A Memory Protection Strategy for Resource Constrained Devices in Safety Critical Applications. The 6th International Conference on System Reliability and Safety. (Conference paper, accepted) |
| [P5] | PyAls (https://github.com/SalvatoreBarone/pyALS). Open source implementation of the methodology presented in the articles. |

# Next year

- *Extend our methodology to sequential circuits, ensuring relevant time-dependant properties are not violated.*
- *Find alternatives to currently used heuristics (AMOSA) that can reduce synthesis running time.*
- *Integrate our methodology in system-level approximation suites such as IIDEAA.*
- *Applications of the methodology (especially to accelerators in real-time systems).*