Approximate Computing (AxC) is a novel energy-efficient design paradigm that takes advantage of inherent error tolerance in a broad set of applications, such as image processing, computer vision, and machine learning. By reducing the required computations' accuracy in a deliberated but controlled manner, energy savings can be achieved.

Over the last decade, different AxC techniques have been proposed at almost all computing layers. Many of these techniques are focused on the design of approximate hardware. However, numerous accurate processor-based systems cannot afford hardware modifications or the deployment of custom approximate accelerators, mainly based on off-the-shelf components or well-established IPs. For such systems, AxC can be exploited, for instance, by executing inaccurate versions of error-tolerant applications.

Some approximate software techniques have been reported in the literature. Unfortunately, independently. For instance, loop perforation proposes to modify loops to execute fewer iterations than the original and then compensate for the effect of the skipped loops in the result. Another technique proposes to explore the code and perform replacement of variables, either for constant values (V2C) or for other variables (V2V).

In this thesis, we will propose a design space exploration methodology to synergistically apply different approximate software techniques to error-tolerant applications to reduce the original execution time while meeting a defined quality level for a given application-driven quality metric.

Tasks:

- Implementation of dynamic and static analysis for error-tolerant sections of applications.
- Implementation of compiler optimization passes to apply different approximate techniques.
- Search of the design space during compilation time in an automated manner.
- Demonstration using existing benchmarks.

Required knowledge:

- C++ programming.
- Compiler background (no prior experience is required).

Skills acquired with this thesis:

- Compiler development and integration for design space exploration.
- Work on a state-of-the-art research topic.
- Technical writing.

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