LARA Tutorial

Plans for LARA in the context of the ANTAREX Project

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ANTAREX 10^{18}

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Outline

- Runtime adaptivity dimensions
- ANTAREX and LARA
- An example of ANTAREX + LARA
- Ongoing work
- Conclusions

Runtime Adaptivity Dimensions

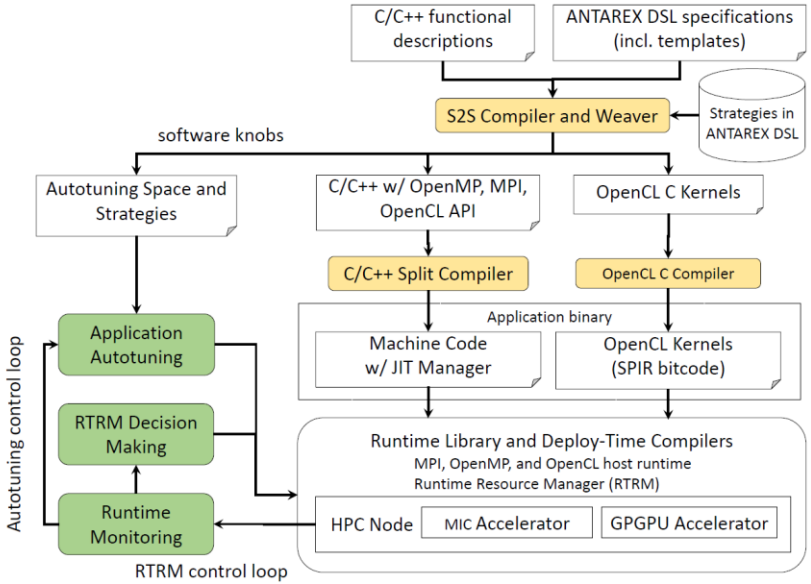
- From algorithm parameters to compiler and mapping optimizations
- Forms of adaptability include:
  - modifications to application parameters (attributes),
  - selection among different algorithms for solving the same problem,
  - different compiler optimizations for the same algorithm,
  - runtime strategies for partitioning and for mapping computations targeting hardware accelerators,
  - management of system resources

Extending LARA with native support for runtime adaptivity strategies

ANTAREX and LARA

AutoTuning and Adaptivity appRoach for Energy efficient eXascale HPC systems, FET-HPC, H2020 Project

- LARA as a vehicle to specify strategies for saving energy, increasing performance, etc.
- How?
  - Specifying strategies to optimize/specialize the code
  - Specifying strategies to refactor the code for autotuning and to control the autotuner



Example of a strategy supported by the ANTAREX Tool Flow:

- Create **multiple versions** of function "A"
- Insert calls to timers for **measuring the execution time** of the function
- **Substitute the call to the original function** with the possibility to execute one of the versions based on a parameter
- Instantiate an autotuner and **insert calls to the autotuner** and communication of execution time
- Use the **parameter output by the autotuner to select** between the versions of the function at runtime
- Apply to each version a **different optimization strategy**

Autotune every 1 sec

Silvano et al., ACM CF'2016

Ongoing Work

- Clang based source to source compiler controlled by LARA
- Code refactoring techniques to
  - increase performance, energy efficiency
  - support/help dynamic adaptivity schemes
  - expose autotuning opportunities (e.g., exposing parameters in some code transformations)
- Adding weaving support for offloading strategies (include code refactoring)
- Extending weaver with analysis for reporting information to be used by parallelization strategies (mainly OpenMP directives)
- Code refactoring and support for MPI
- Seamless integration of autotuning

Conclusions

- The LARA approach allows
  - To decouple functional and non-functional concerns
  - To express and capture transformation schemes and strategies
- Tool flows can be controlled and guided through aspects and strategies powered by LARA
- LARA leverages modularity, best practices and user expertise
- Experiments highlight developer's productivity and the usefulness of LARA
- Ongoing and Further Work will further enhance the usefulness of the LARA technology

Thank you! Questions?

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