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Funding and Contact

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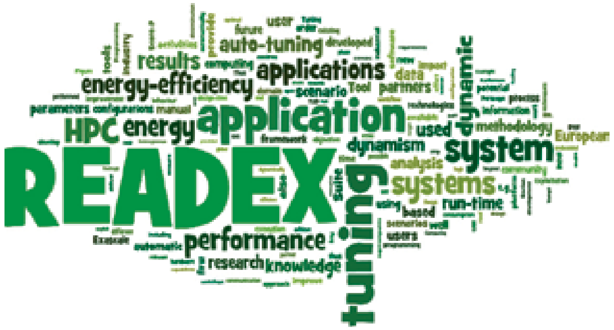

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READEX

Runtime Exploitation of Application Dynamism for Energy-efficient eXascale computing

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Runtime Exploitation of Application Dynamism for Energy-efficient eXascale computing

European Commission | Horizon 2020 European Union funding for Research & Innovation

Overview

The importance of energy efficiency is constantly increasing in High Performance Computing. While systems can be adapted to exploit the dynamic behaviour of HPC applications for energy-efficiency, manual tuning of platform parameters is a tedious task, often neglected by application developers. The READEX project develops a tools-aided methodology for dynamic auto-tuning that combines technologies from two ends of the computing spectrum: the System Scenario Methodology from the embedded systems domain and the Periscope Tuning Framework (PTF) coming from the field of HPC performance tuning.

System Scenario Methodology

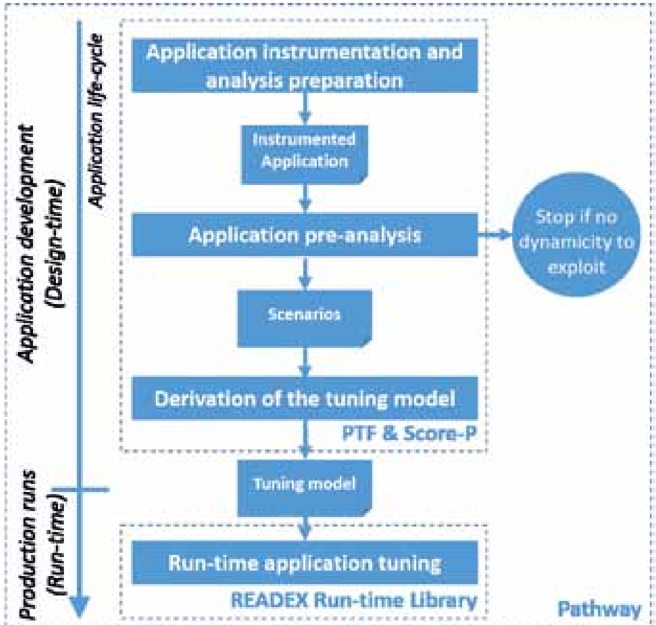
The System Scenario Methodology has been designed for exploiting the dynamic behaviour of software in the embedded systems domain. At design-time, different run-time situations (RTS) are detected based on identifiers, e.g., control variables. RTS with similar cost characteristics are then grouped into scenarios for which a tu¬ning model is developed. At run-time, the upco-ming scenario is predicted using the identifiers and the optimized system configuration is ap-plied based on the tuning model. A calibration step can be used to react to previously unseen scenarios and to further refine the tuning model.

Periscope Tuning Framework

PTF has been developed in the AutoTune FP7 project and provides an integrated process for static auto-tuning of whole application runs. Expert knowledge is codified in tuning plugins that are controlled by the Score-P measurement in¬frastructure to ensure maximum scalability. The Pathway GUI is used as a frontend for users to track the progress of the tuning process.

READEX Tools-Aided Methodology

The READEX Tools-aided methodology will combine the System Scenario Methodology from the embedded systems domain with the technologies developed in the AutoTune project. At design-time, a (semi-)automatic analysis will find relevant run-time scenarios and their optimized platform configurations on dif¬ferent layers of the system, ranging from the hardware, through the operating system to the system software layer. In addition, the READEX user API will allow users to provide knowledge on application dynamic behaviour as well as application-level configuration parameters to the tuning library. The READEX tool-suite is based on Score-P, PTF, and Pathway to ensure scalability and usability. A special focus will be put on the lightweight READEX Runtime Library (RRL) used for scenario prediction and switching used for scenario prediction and switching.



Expected Impact and Validation

In order to validate the impact of the READEX project, several real-world applications will be employed, including the industry-grade simulation codes Indeed (FEM), Elmer (FEM), and OpenFOAM (CFD). Furthermore, the ESPRESO and PERMON libraries will be used as well as the CORAL and Proxy Apps benchmark suites. In a co-design approach, selected applications will be hand-tuned and both the improvements in energy-efficiency and the effort spent will be compared with the automatic tuning approach. An overall improvement of up to 22.5% in energy-efficiency is expected to be achieved through automatic tuning.