Data Science for Performance
Analysis of Parallel Applications

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- Good partitioning of the problem domain (static, dynamic)
- Correctly map to increasingly heterogeneous resources
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- Do one (or more) perf. analysis operation in a good way
- Usually expects homogeneous behavior (BSP-model applic.)
- Implemented in C/C++ to scale
- Interactive (depending on scale) and user friendly (mouse interact.)
Introduction: Performance Analysis

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- Large and complex source code, difficult to extend
- Generally not designed for hybrid platforms and dynamic runtimes
- No flexible filter calls for scripting capability
- Lack custom views exploiting application and platform structure
Collect detailed traces from the application (for free with StarPU-MPI)
Understand (temporal/spatial) performance, identify scheduling problems

- Enriched models assuming variability/heterogeneity
- Detect anomalies (outliers) with a visualization-based methodology

Help StarPU-MPI runtime developers to improve scheduling heuristics
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Versatile and Extensible Visualization Framework
- Adopt modern data analysis tools for scripting
  pj_dump + R + tidyverse + ggplot2 + plotly ($\approx$ 3.5K SLOC)
- Workflow Execution: screen (1st phase, left) + org-mode (2nd phase, right)

Accepted for Wiley’s CCPE for details. Check RR seed:
https://hal.inria.fr/hal-01616632a
Ondes3D (BRGM code): Spatial and temporal load imbalances
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Application-level rescaling
1. Change temporal/spatial domain resolution to accelerate execution
2. Reconstruct original behavior from the traces
Alya code (developed @BSC, highly scalable)

- Use irregular mesh, with Metis and SFC partitioning

Goal: Improve the LB of SFC partitioning, iterative loop

1. Gather real measurements in the real machine
2. Adjust the SFC partitioner by providing correction factors
Green Cloud Collaboration Opportunities

How can we collaborate? Target applications + Methodology

- Interesting HPC application with performance issues
  - Dynamic time/spatial load
  - Irregular applications
  - Heterogeneous architectures (GPU+CPU+...)
- Trace enough details to formulate hypothesis
  - Verify using a prototype-based approach
  - Adopt modern data science tools

Green Cloud Work packages

- Pacote #6: Análise de Desempenho de Aplicações em Nuvem
  - Pacote #4: Balanceamento de Carga, Mapeamento e Provisionamento
Thank you for your Attention! Questions?

Contact for further details
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Publications

A Visual Performance Analysis Framework for Task-based Parallel Applications running on Hybrid Clusters (accepted to Wiley’s CCPE)
https://hal.inria.fr/hal-01616632 + https://gitlab.in2p3.fr/schnorr/ccpe2017

Using Simulation to Evaluate and Tune the Performance of Dynamic Load Balancing of an Over-decomposed Geophysics Application (Europar 2017) + Performance Modeling of a Geophysics Application to Accelerate Over-decomposition Parameter Tuning through Simulation (submitted to Wiley’s CCPE) – https://hal.inria.fr/hal-01567792

Open Source Software for Open Science (StarVZ)

- Chameleon: https://gitlab.inria.fr/solverstack/chameleon
- StarPU: http://starpu.gforge.inria.fr/
- StarVZ: http://github.com/schnorr/starvz/
- Analysis Framework: https://gitlab.in2p3.fr/schnorr/ccpe2017
  - Including 20GBytes of collected traces