Modeling HPC applications for in situ Analytics
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High Performance Computing

- Application
  - Simulation: compute-intensive
  - Analysis: post-processing of data
- Data management, fault tolerance & large-scale scheduling
- out-of-machine vs in-machine paradigm

Objective

- Optimize resource allocation between the analysis and the simulation
- Provide efficient algorithms to perform both
  - resource partitioning
  - analysis allocations

Contributions

- General model for HPC applications (simulation, analysis, target architecture ...) 
- New algorithms for
  - resource partitioning problem (theoretical analysis of the model)
  - scheduling problem (optimal non-polynomial + greedy)
- Evaluation on synthetic applications: extract key elements for in situ functions

Resource Partitioning Problem

- Application time: maximum between simulation phase \((T_S)\) and analysis \((T_A)\)
- Given a scheduling \((A^S, A^A)\), find \(n^*\) and \(c^*\) that minimize
  \[
  \max (T_S(n^*, c^*), T_A^S (A^S, n^*, c^*), T_A^A (A^A, n^*))
  \]
- How to determine the scheduling \((A^S, A^A)\) ?

Simulation Results: Asynchronous Scenario

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<th>Algorithms</th>
<th>Increasing Peak</th>
<th>Decreasing Peak</th>
<th>Increasing Time</th>
<th>Decreasing Time</th>
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Simulation Results: Importance of in situ Resource Usage

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<th>Algorithms</th>
<th>Decreasing Peak AS</th>
<th>Decreasing Peak S</th>
<th>Increasing Time AS</th>
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https://www.labri.fr/