

Simulation Cluster

Overview

- **Presentation:** *MULTICUBE Explorer: An Open-Source Design Space Exploration Tool for CMPs* , Cristina Silvano, Politecnico di Milano
- **Discussion:** Simulation use cases
- **Discussion:** Workplan ?
- **Misc.:** PostDoc for simulation cluster, next meetings;
- **Presentation:** *TotalProf: A Fast and Accurate Retargetable Profiler – From Simulation Perspective of View* , Lei Gao, Aachen University

Simulation Use Cases

- Initial discussion in Barcelona, May 2008;
- Draft use cases (Paolo, Rainer, Olivier)
- Finalizing use cases

Micro-Architecture Use Case

- **What do we want to achieve ?**
 - Accurately compare two design points
 - Assess absolute performance (less accurate)
- **Why do we need simulation ?**
 - May be “overused”; analytical modeling, etc, for high-level decisions
- **Characteristics:**
 - Speed. A benchmark in a few seconds to a few hours
 - Accuracy. About 1% in relative performance between two design points
 - Target ISA. Simply the most popular ISAs
 - Abstraction level. Cycle-Level for one core; Transaction-Level probably OK for multi/many cores
 - Full-System desired for one core; necessary for multi-cores
 - Applications. Future computationally intensive workloads; multiple data sets badly needed
- **Research Issues:**
 - Simulation speed. First and foremost; multi/many cores; no clear technique emerges
 - Full-System. Experimentally heavy; good options ?
 - Factoring technology. How do we do that ? Even power models are limited

MPSoC Use Case

- **What do we want to achieve ?**
 - executable HW/SW platform specification;
 - sufficiently fast yet accurate for system-level exploration;
- **Why do we need simulation ?**
 - analytical models do not deliver sufficient accuracy;
- **Characteristics:**
 - Speed. Close to (possibly even faster than) real time.
 - Accuracy. No promise on absolute accuracy, but being able to predict trends correctly;
 - Target ISA. Embedded processors and accelerators;
 - Abstraction level. Loose to approximate models
 - Applications. Wireless communication terminals, consumer electronics, automotive,...
 - Validation. Executing applications, including I/Os

Data Center Use Case

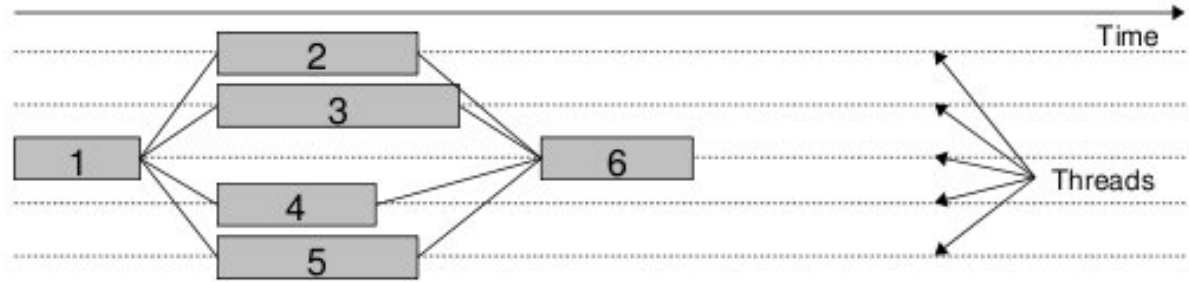
- **What do we want to achieve ?**
 - Model entire computing system; application development or data center dimensioning;
- **Why do we need simulation ?**
 - Some components may not exist, or may not be feasible to add instrumentation to a real system
- **Characteristics:**
 - Speed: hundred of simulated MIPS, i.e. a 10x-20x slowdown vs. native execution.;
 - Accuracy: absolute error 10%-20% vs. a real machine
 - Target ISA: industry standard general purpose CPUs;
 - Abstraction level: capability to run unmodified commercial OS, application stack, and device details;
 - Validation: metric-level (performance, energy) must be validated vs. real hardware on few standard benchmark and a few machine configurations
 - Applications: standard software stack, typical benchmarks running for a few minutes of real time

Workplan

- Recap:
 - no single simulator, but a simulator ec;
 - multiple tools (simulators, models, speed techniques,...);
 - APIs to have them interoperate;
- For STREP call, tentative definition of a workplan (INRIA, Aachen Univ., Ghent Univ., EPFL, HP Labs Barcelona, Thales TRT).
 - Simulation speed
 - Simulator complexity
 - Economics of simulation
- Embryo of a workplan for cluster ?
- Very open: interoperate with other simulators, models, speed techniques,...;

Simulation Speed

- Sampling
- Parallel simulation
- Synthetic benchmarks
- Transaction-Level modeling
- Combinations



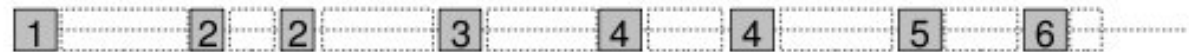
Normal Multi-Core Execution



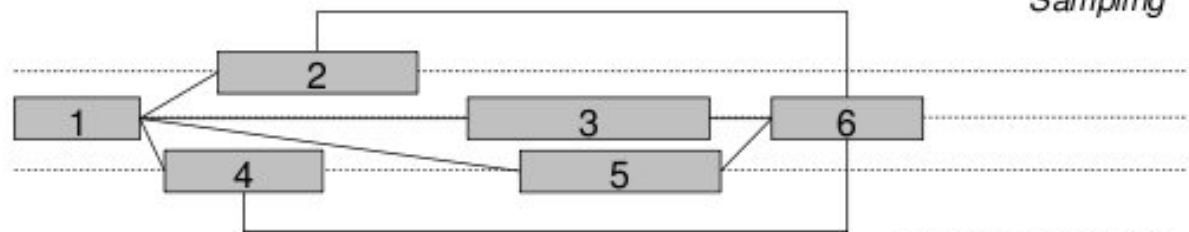
Standard Simulation



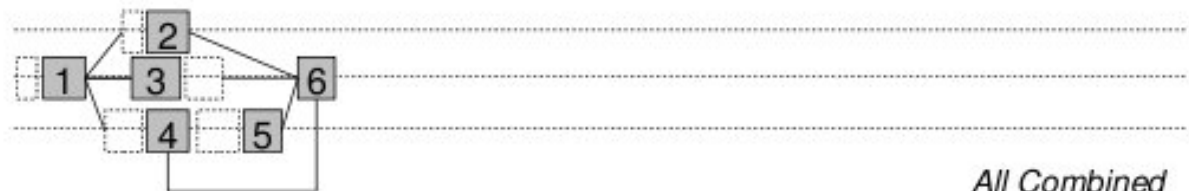
Synthetic Benchmarks



Sampling



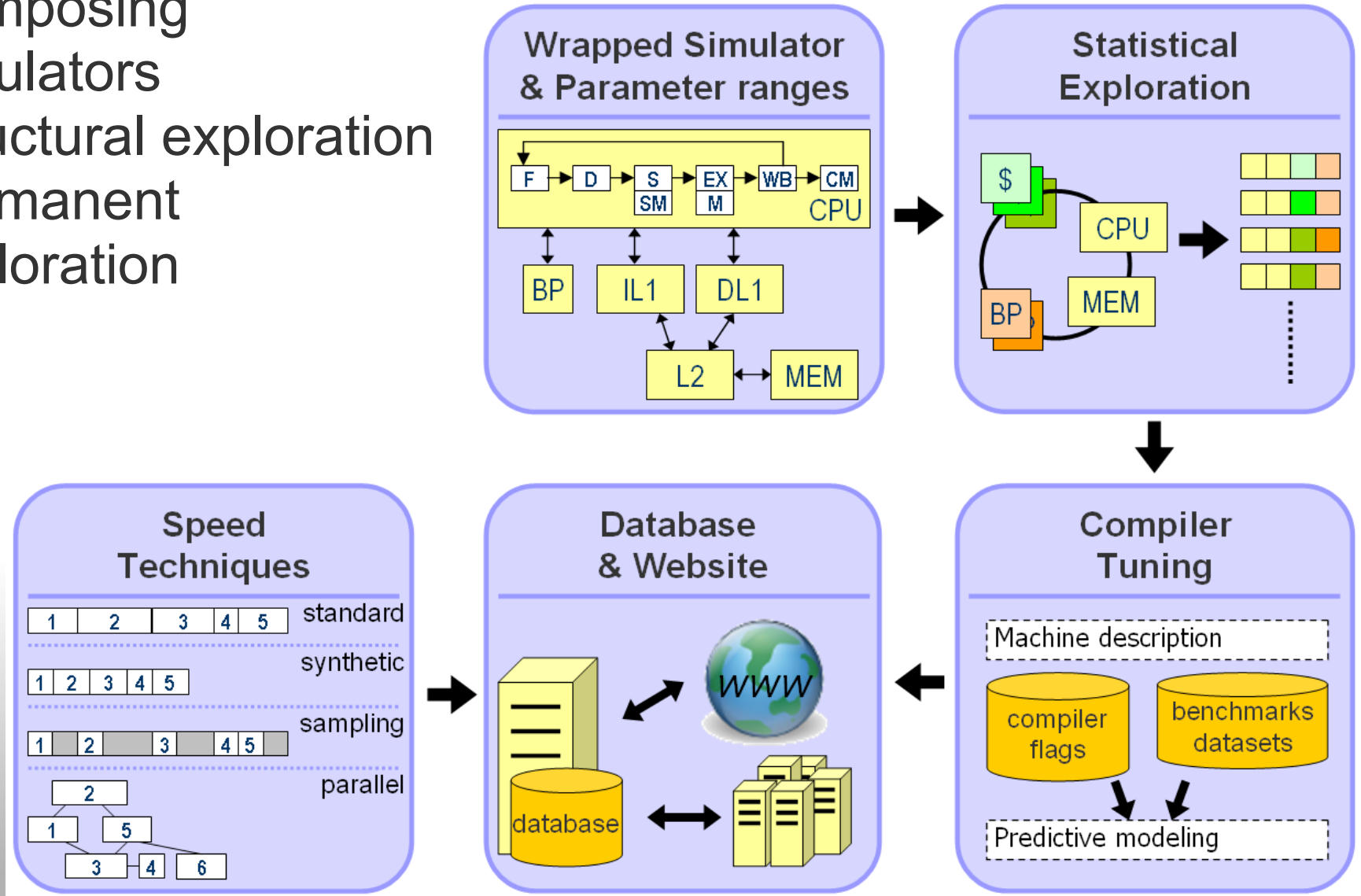
Parallel Simulation



All Combined

Simulation Complexity

- Composing simulators
- Structural exploration
- Permanent exploration



Economics of Simulation

- **Design companies:** Simulators too heavy/complex development for many companies (same as compilers)
- **System companies:** Huge trend towards software prototyping (all industries, not just computing)

 Simulation as a service

Miscellaneous

- Tutorial-like (long, in-depth, "how to use") presentation(s) on your simulation/modeling tools & approaches;
- Opening call for joint collaborations;
- Recruiting Zheng Li as the **cluster postdoc** starting fall 2009;
 - Cluster animation;
 - His research: automatic micro-architecture exploration;
 - Can help define common interfaces between tools for easier plugging;
 - What other role do we want for cluster postdoc ?

