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Predicting AMD Magny-Cours Performance for a Suite of NNSA/ ASC Applications

(Preliminary Results for Hot Chips 2010 Submission)

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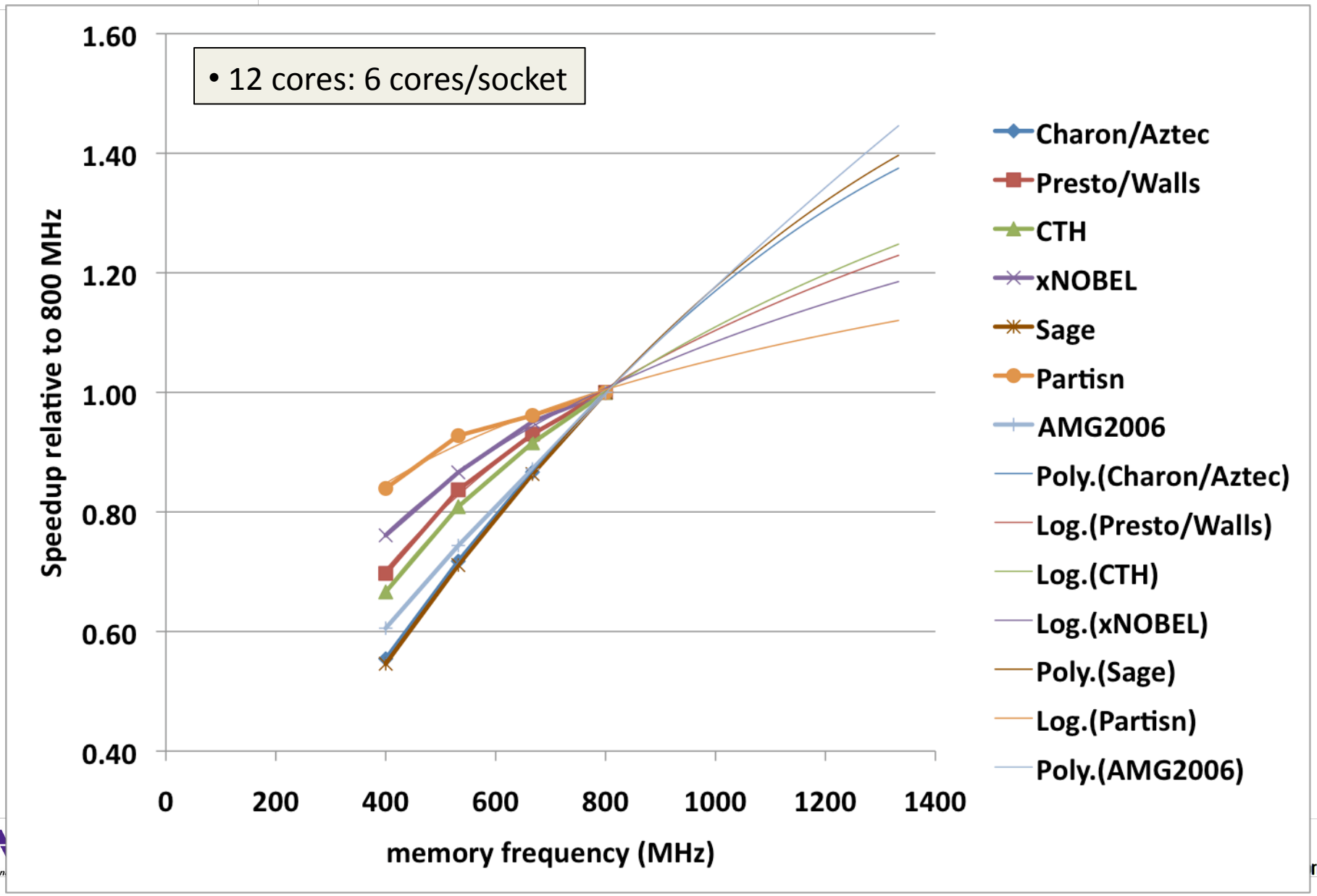
AMD's Next Processor: Magny-Cours

- Now: Istanbul
  - 6 cores @ up to 2.6 GHz
  - Two channels of DDR2 @ up to 800 MHz
  - 62.4 peak GFLOPs with 12.8 GB/s peak memory BW
- Next: Magny-Cours
  - Two Istanbul die integrated into an MCM
  - 8-core & 12-core versions
  - Frequency will be < 2.6 GHz to maintain power envelope
    - Assume 2.1 for 12-core, 2.4 for 8-core
  - Two Die -> 4 memory channels
    - DDR3 with new G34 socket
    - Up to 1333 MHz
  - 8-core: 76.8 peak GFLOPs with 42.7 GB/s peak memory BW
  - 12-core: 100.8 peak GFLOPs with 42.7 GB/s peak memory BW

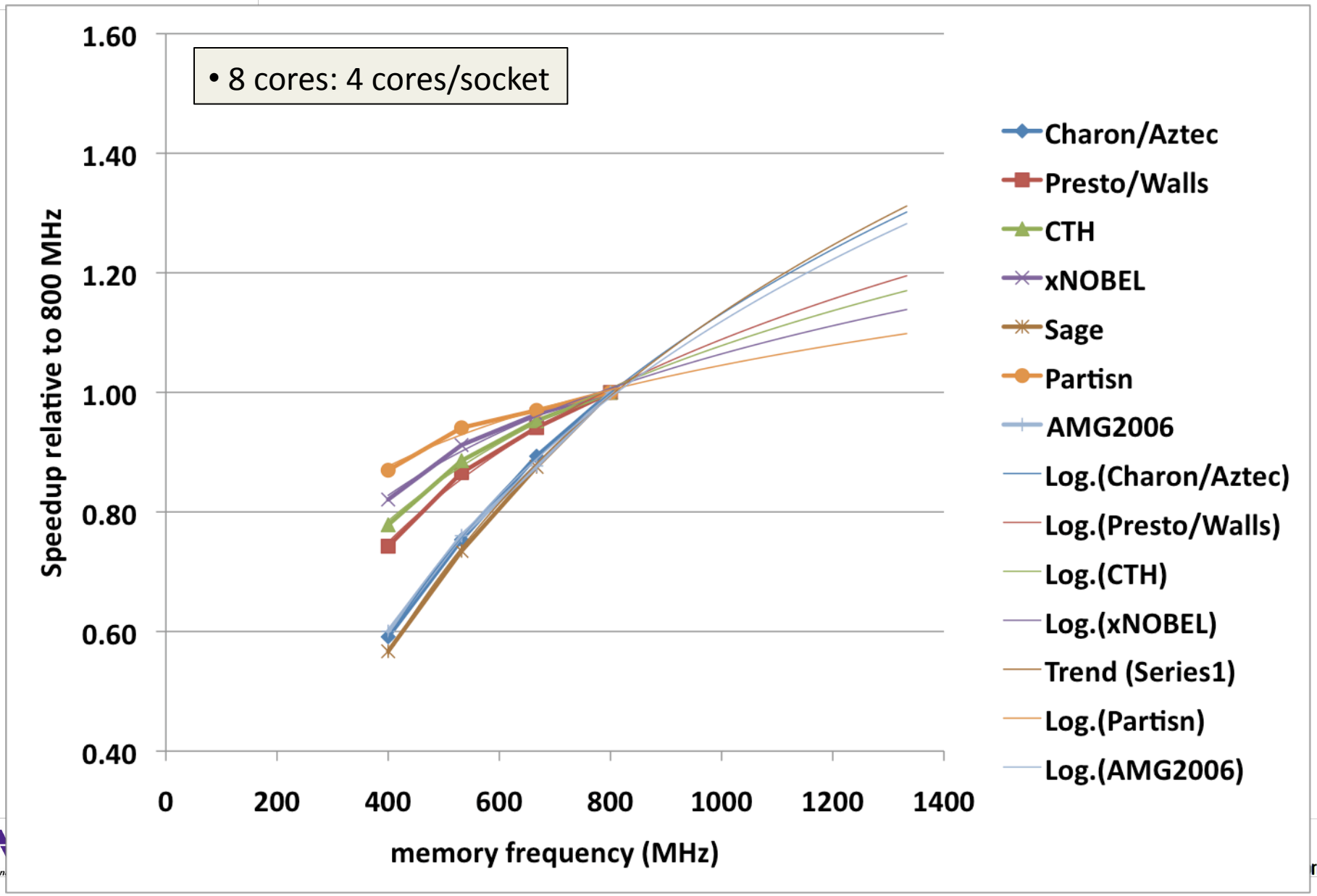
Method for Estimating Magny-Cours Performance

- Memory sensitivity analysis can be performed by varying DDR frequency
- Test Platform
  - Two socket AMD Istanbul (2x6 cores) node
  - 2.6 GHz core frequency w/two channels of 800 MHz DDR2
  - Using BIOS settings, memory controller DDR frequency can be set to 400, 532, 667 or 800 MHz
- Trend analysis is used to derive an equation that can be used to predict performance at other memory speeds
  - Excel used for trend analysis
  - Log or polynomial fit provided the best results
  - Resulting equation used to predict performance at a given frequency
  - Accuracy of the estimation is primarily dependent on the quality of the trend line

Results for 12-core Analysis



Results for 8-core Analysis



Method for Estimating Magny-Cours Performance

- Fraction of memory and compute is determined by knowing the following equations and solving:
  - t′ = t * (mem_speedup * frac_mem_bound + cpu_speedup * frac_comp_bound)
  - frac_mem_bound + frac_comp_bound = 1
  - for above basis data: cpu_speedup = 1
- Substituting and solving
  - t′/t = mem_speedup * frac_mem_bound + 1 – frac_mem_bound
  - t′/t – 1 = frac_mem_bound * (mem_speedup – 1)
  - frac_mem_bound = (t ′/ t – 1) / (mem_speedup – 1)
  - then
  - frac_comp_bound = 1 – frac_mem_bound

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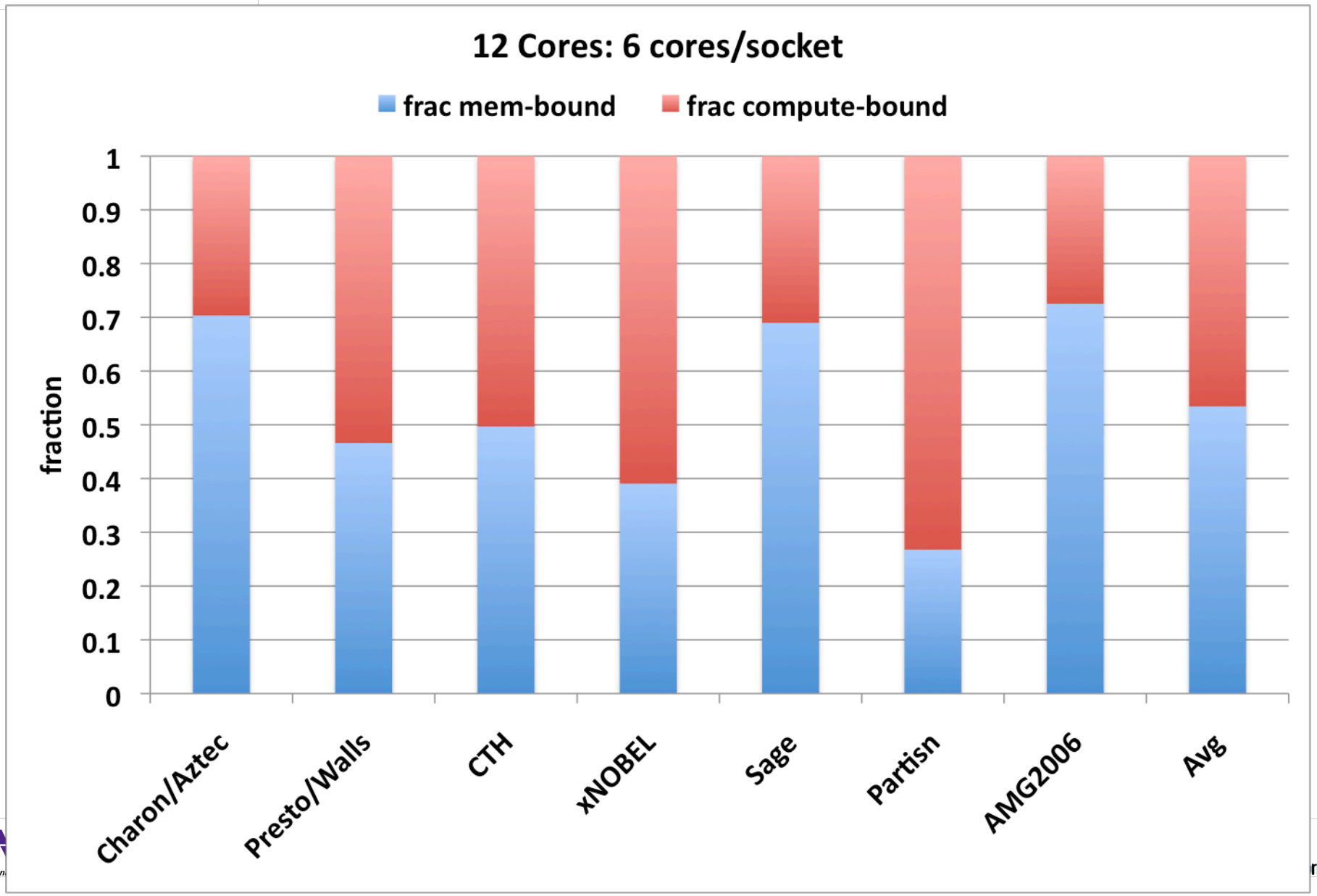
Fraction compute and memory bound is estimated via an empirical study measuring performance with varying memory subsystem frequencies



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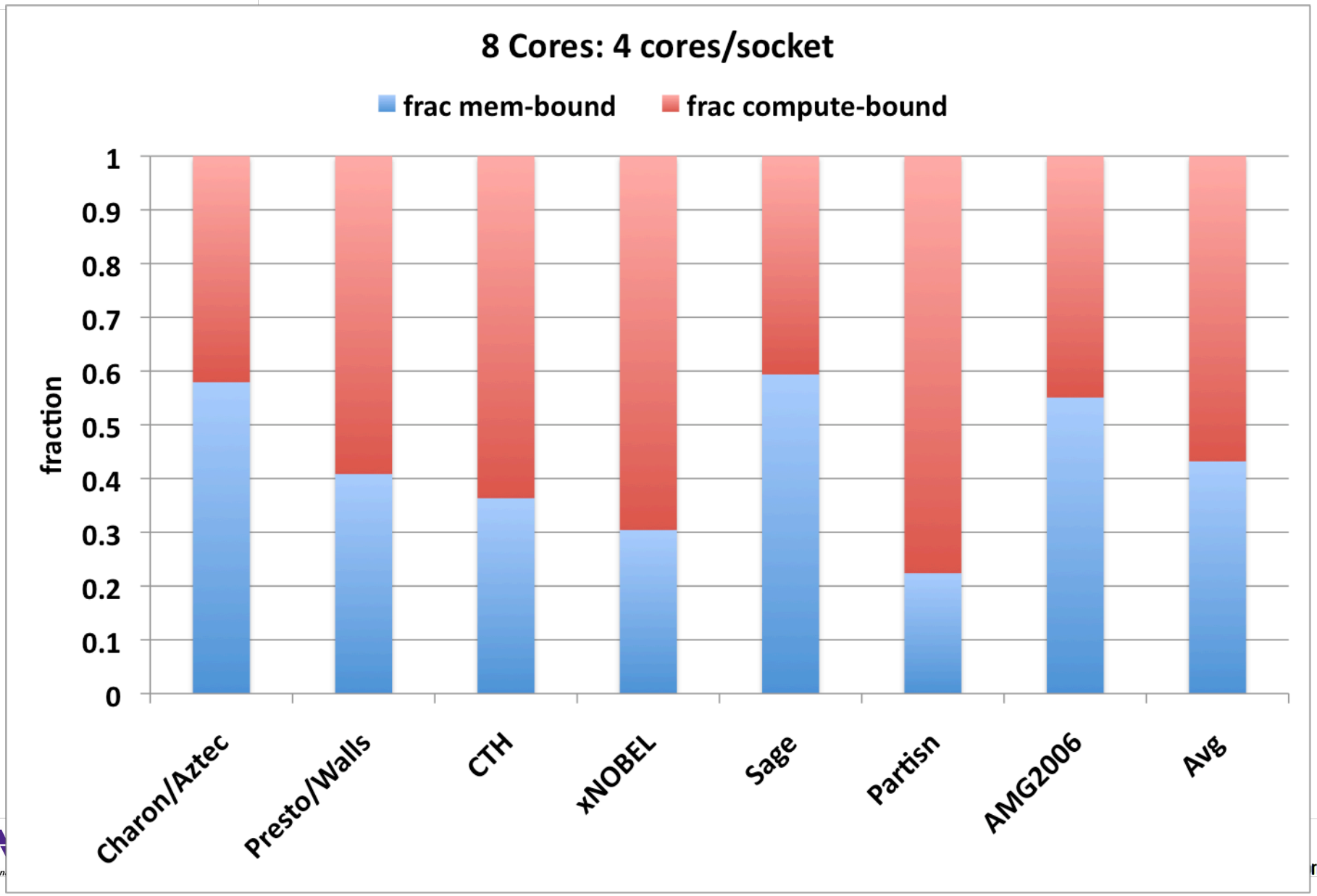

Method for Estimating Magny-Cours Performance

- Knowing the fractions, performance can be estimated for other core and memory frequencies
  - only valid for small steps in core and memory frequencies because the fractions are a function of the frequencies
  - t' = t * (mem_speedup * frac_mem_bound + cpu_speedup * frac_comp_bound)
  - speedup' = t / t' = 1 / [(mem_speedup * frac_mem_bound + cpu_speedup * frac_comp_bound)]
- Magny-Cours speedup = 2 * speedup'
  - assumes proper core and memory affinity control in order to avoid "non-local" data movement
  - In the case of Magny-Cours, non-local data movement is over the HyperTransport interconnect

Node Performance Comparison for the Cielo Application Suite