Integrating Performance Modeling (PM) concepts into performance tools

- Automatic construction of performance models based on direct measurements (without code instrumentation) seems feasible
- A “performance model” in this context must be something simple (resource/bottleneck-based).
  - restrictions compared to fully analytic model
  - Roofline (from measured flop rate & memory traffic) or ECM (ditto)
  - IB/network traffic may be incorporated into the model
- HPCToolkit already solves most of the problems?
  - phase detection ← counter-based call stack sampling
  - steady state problem ← associating samples to code regions/loop bodies)

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- Phase detection may be implemented by / based on object detection algorithms (e.g., Llort et al. SC13)
  - Possible metrics: IPC, flop/s, arith. intensity, or a combination
  - IPC often misleading
- “Low-hanging fruits” are “easy” if metrics are available (scalar loads? Flops?)
  - load imbalance
  - non-SIMD
  - NUMA traffic
- So, “data acquisition” is not the problem, but how about automatic interpretation of the data?

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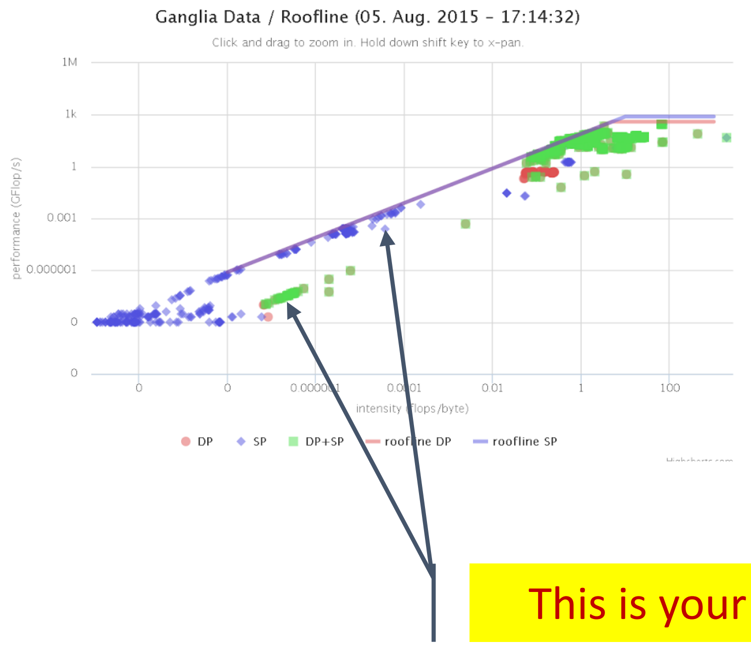
- PerfExpert provides "simple" resource-based advice
  - "What, based on our in-situ measurements, seems to be the bottleneck in your code?"
  - this *is* the essence of Roofline
- Could be augmented by "beyond Roofline" thinking providing, e.g., ranges (best vs. worst case)
  - ECM model, T_comm/T_comp overlap/non-overlap etc.
- Phases must be exposed to user



This is your run!

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- “Performance patterns” may be helpful in categorizing “issues”
  - max resource utilization / hazards / work-related
  - Some patterns require more than in-situ measurements → not directly accessible by automatic tools
- Patterns provide another refinement (besides ECM, etc.) of the bottleneck thinking
- In summary, the measurement infrastructure and simple resource-based modeling based on the data seems to be there; accurate phase detection seems possible but not really ready for prime time (one bottleneck record per phase).

- Link to “Patterns” slides: https://www.dropbox.com/s/la0b91s2tj6cdje/Patterns.pdf?dl=0

- “Patterns” paper: http://dx.doi.org/10.1007/978-3-642-36949-0_50

Thank you!

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