The Performance Challenge

Figure courtesy Roger Logan, LLNL
How I Wasted Summer 😞

Breadth-first Multifrontal Method on Origin 2
Performance Evaluation Research Center (PERC)

Initial goal was to develop performance related tools:
- Benchmarks
- Analysis
- Modeling
- Optimization

Second phase refocused on SciDAC applications incl.:
- Community Climate System Model
- Plasma Microturbulence Project
- Omega3P accelerator model
Some Lessons Learned

Performance portability is critical
Codes outlive machines
Scientists can’t publish that they migrated code

Computational scientists were not interested in tools
They wanted experts to work with them
Such experts are not scalable
Performance Engineering Research Institute

Performance modeling of applications
How fast do we expect to go?

Automatic tuning
Long term research goal
Remove burden from scientific programmers

Application engagement
Near-term impact on SciDAC applications
Humans have been doing this for 50 years

Compilers have been doing it statically for 40 years

Recent self-tuning libraries:
PHIPAC, ATLAS, FFTW, SPIRAL, SPOOLES

Performance Engineering Research Institute goal:
Automatic performance tuning of applications
PERI Automatic Tuning Steps

Triage: where to focus effort
Semantic analysis: traditional compiler analysis
Transformation: code restructuring
Code generation: domain specific code
Off-line search: empirical experiments
Assembly: choose the best components
Training runs: performance data for feedback
On-line search: optimize long-running jobs
Early Results (MxM on Mac G-5)

Figure courtesy Mary Hall, USC
Early Results (Madness kernel)

Figure courtesy Shirley Moore, UTK
Overall Summary

SciDAC-2 Performance Engineering Research Institute

Performance modeling of scientific applications so we understand what performance is possible

Automatic performance tuning to alleviate computational scientists from this recurring problem

Near-term impact via direct engagement with SciDAC application teams
Participants

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