Performance Evaluation and Analysis Consortium (PEAC) End Station

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Overview

The PEAC End Station provides the performance evaluation and performance tool developer communities access to the Department of Energy Leadership Computing Facility (LCF) systems at Oak Ridge and Argonne National Laboratories. The consortium goals are:

1. System evaluation
   - Evaluate the performance of LCF systems using standard and custom micro-, kernel, and application benchmarks.
2. Performance tools
   - Port performance tools to LCF systems, making these available to National Center for Computational Sciences (NCCS) and Argonne Leadership Class Facility (ALCF) users, and further develop the tools so as to take into account the scale and unique features of these LCF systems.
3. Performance characterization and prediction
   - Validate the effectiveness of performance characterization methodologies, modifying them as necessary to improve their utility for predicting resource requirements for production runs on the LCF systems.
4. Application analysis and optimization
   - Analyze performance and help optimize current and candidate LCF application codes.
5. Performance and application community support
   - Provide access to other performance researchers who are interested in contributing to the performance evaluation of the LCF systems or in porting complementary performance tools of use to the NCCS and ALCF user communities. Also provide access to application developers who wish to evaluate the performance of their codes on the LCF systems.

all while adhering to the "Golden Rules" of the performance community:

i. Low visibility (no production runs!)

ii. Open and fair evaluations

iii. Timely reporting

Status (12/31/07)

- 55 users, consuming 1,715,133 CPU hours on NCCS (ORNL) XT systems (70% over allocation):
  - System evaluation: 32%
  - Performance tools: 21%
  - Performance characterization and prediction: 7%
  - Application performance analysis and optimization: 40%

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Major Efforts in CY07

- **System Evaluation:** (contributing to >10 publications)
  - Whole system performance evaluation using kernel and application benchmarks, including the UK "Performance for Petascale Science" benchmarks and SPEC MPI 2007 benchmark suite, for both the Catamount and Compute Node Linux (CNL) operating systems.
  - Subsystem evaluations: Multi-core node performance, MPI communication performance (using both Catamount and CNL), and I/O performance.
  - HPC architecture comparisons using scientific application codes
- **Performance Tools:** (2 publications)
  - Porting, developing, testing, maintaining: Co-Array Fortran (caf) compiler, HPCToolkit, mpiP, PAPI, Scalasca, SvPablo, TAU and PDT, UPC compiler and runtime infrastructure
  - Demonstration of tools at scale: Scalasca (tracing up to 16000 processes), scalable tool infrastructure development
- **Performance characterization and prediction:** (5 publications)
  - Subsystem performance characterizations
  - Performance modeling: least squares approach (Paratec, MILC, HPC Challenge); convolution-based approach (S3D, WRF), Prophesy-based approach (GTC)
  - Development and validation of characterization methodologies: Modeling Assertions (NAS Parallel Benchmarks); LogGP modeling of MPI communication; reusable analytic model for parallel wavefront applications (NPB-LU, Chimaera, Sweep3D)
- **Application analysis and optimization:** (3 publications)
  - Performance optimization of 2007 JOULE report codes: GTC_s, S3D
  - AMR benchmark development and performance evaluation
  - Application code analysis, optimization, and scaling studies: GTC, TDCC-9d, Neutron scattering code, Lattice Boltzmann code, PFLOTRAN, DeCART, LS3DF, LEtot, MPI bio-application written for MotifNetwork

Issues to be Examined in CY08

- **New architectures:** quad-core Cray XT4, quad-core IBM BG/P
- **Increased scale:** >30,000 cores at NCCS, >30,000 cores at ALCF
- **Evolving system software:** message-passing libraries, parallel I/O, new programming paradigms
- **Application codes:** New applications, evolving applications (new science capabilities and scenarios), increased scale.
- **Performance prediction:** performance modeling of NCCS and ALCF Pioneer applications, and extrapolation to proposed next generation LCF architectures.