

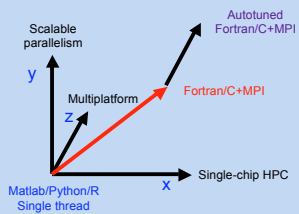
# CScADS - Center for Scalable Application Development Software

## Center Goals

- Conduct research leading to the design and construction of software tools and systems to help applications scale to the petascale and beyond
  - Focus on DOE Leadership Class Facilities and parallel systems composed of multicore processors
- Catalyze activities within the computer science community that will lead to visionary new ideas for application development support software
  - Focus on interactions with systems vendors, application developers, and library designers
- Foster development of new tools by the computer science community through support of common software infrastructures and standards

## Scalable Application Development

- Scalable from high-level to high-performance
- Scalable from uniprocessor (or multicore) to petascale
- Scalable from single platform to multiple platforms



## Scalability Dimensions

- Scaling from Domain Language to Fast Uniprocessor Application
  - Example: Translate Matlab to C or Fortran
  - Constraint-based type analysis: determine array sizes and types
  - Replace calls to domain library with calls to pre-optimized versions, specialized to parameter type signature
  - Scalarize array statements
  - Example: Source-to-source performance optimization
  - Inlining, loop fusion, tiling for multiple levels of cache
- Scaling from One to Many Processors
  - Example: Matlab with data distributions
  - Direct translation to Fortran+MPI via HPF compilation strategy
  - Example: Tools for performance understanding
  - HPCToolkit reveals where parallel efficiency is lost
- Scaling to Many Platforms
  - Example: Automatic tuning to different machine architectures

## CScADS Model

- Research: Application-driven software systems research
- Community vision building
  - Summer workshops on focused topics of relevance to scalability
- Open-source software development and integration
  - Software infrastructures: Open64, ROSE (with LLNL), Telescoping Languages, D System, Dyninst, HPCToolkit
- Collaborations
  - DOE
    - National laboratories (ORNL, LBNL, ANL, and others)
    - Application, library, and system software developers
    - Other SciDAC Centers and Institutes: e.g., PERI, APDEC, TASC
  - NSF: TeraGrid, NSF Petascale Track 1 and 2
  - Industry: Vendors of systems and software

## Research Focus Areas

- Compilers, libraries, and tuning systems
  - Automatic tuning for multicore chips and scalable systems
- Programming models and compilers for scalable parallel computing
  - Co-Array Fortran, UPC, Titanium, HPCS languages
  - Extensions to standard languages (C, C++, Fortran)
  - High-level domain languages based on scripting languages
  - Example: Matlab (with parallelism) plus domain libraries
- High performance component integration frameworks
  - Application of telescoping languages
- Performance tools for scalable parallel systems
  - Binary analysis for instrumentation and interpretation of measurements

## Research and Development Plan

- FY07-08: Tools to support applications on DOE Petascale systems
- Performance tools for improving node performance and scalability
  - Use critical applications to drive research development

- FY09-11: Increase focus on application developer productivity
- High productivity languages, automatic tuning
  - Seed infrastructures to the CS community to accelerate research

## Summer Workshops

### Workshop Goals

- Familiarize community with challenges of DOE petascale systems
- Interface workshops between tool and application developers

### 2007 Schedule at Snowbird

- July 9 - 12 **Autotuning**  
Organizers: Kathy Yelick and Ken Kennedy
- July 16 - 19 **Performance tools**  
Organizers: Bart Miller and John Mellor-Crummey
- July 23 - 26 **Petascale architectures and performance strategies**  
Organizers: Rusty Lusk, Bill Gropp, Pete Beckman
- July 30 - Aug 2 **Libraries and algorithms**  
Organizers: Jack Dongarra and Bill Gropp



### Logistics

- Attendance limited to ~35 per workshop; invitation only
- Each workshop week runs from late Monday through late Thursday



Project URL: <http://cscads.rice.edu>