**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

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**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/MPF via MPF 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

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**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, LLNL, ANL, and others)
  - Application, library, and system software developers
    - Other SciDAC Centers and Institutes: e.g., PERI, APDEC, TASCs
    - NSF, TeraGrid, NSF Petascale Track 1 and 2
    - Industry: Vendors of systems and software

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**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
- High performance component integration frameworks
  - Application of telescoping languages
- Performance tools for scalable parallel systems
  - Binary analysis for instrumentation and interpretation of measurements

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**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

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**Summer Workshops**

**2007 Schedule at Snowbird**

- **July 9 -12:** Autotuning
  - Organizers: Kathy Yelick and Ken Kennedy
- **July 16 - 19:** Performance tools
  - Organizers: Bill Miller and John Mellor-Crummey
- **July 23 - 26:** Petascale architectures and performance strategies
  - Organizers: Rusty Luke, 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

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**Project URL:** [http://cscads.rice.edu](http://cscads.rice.edu)