# CHECS

## Center for High-End Computing Systems

www.checs.eng.vt.edu


VirginiaTech

# Mission/Vision/Goals

- " … world-class computer systems research in the service of high-end computing."
- A consortium of CS research labs/groups.
- Core focus on computer science systems research.
- A "College center," with seed funding from the College of Engineering.
- Committed to collaboration with HPC users.

# Member Labs

- Computing Systems Research Lab (CSRL)
- Distributed Systems and Storage Lab (DSSL)
- Laboratory for Advanced Scientific Computing and Applications (LASCA)
- Parallel Emerging Architectures Research Lab (PEARL)
- Scalable Performance Laboratory (SCAPE)
- Systems, Networking and Renaissance Grokking Lab (SyNeRGY)

# Objectives

1. Technical
   - "… develop the next generation of powerful and usable high-end computing resources."
   - Prominence in a few key sub-areas.

2. Non-Technical
   - Professional growth for faculty and students
   - Build a culture/community, have fun.

# Historical Background

- People: Watson (78), Kafura (82), Ribbens (87), Varadarajan (99), Back (04), Cameron (05), Feng (06), Tilevich (06), Butt (06), Nikolopoulos (06)
- Machines: Sequent Symmetry, Intel iPSC/2 and Paragon, SGIs, clusters.
- Funding: NSF, DOE, DOD, NIH, DOA, …
- Lots of collaborations across VT campus.
- System X (03).

# Current Projects (Back)

- **Top**: A framework for flexible, high-level instrumentation of binaries
- **Cadus**: Co-Scheduling of real-time threads and garbage collection
- **Practical Fair-Sharing scheduling**: finding automatically adopting policies for stock kernels
- **DyniX**: A framework for combined static/dynamic analysis of Java code

# Current Projects (Butt)

- **FlexiCache**: Improving OS file system performance by developing an interface to support a repertoire of (pluggable) cache replacement polices in the kernel.
- **PeerStripe**: P2P-based distributed storage for large data files

# Current Projects (Cameron)

- **High-performance, power-aware computing**: frameworks for power, energy, and thermal measurement, analysis, and optimization
- **Performance evaluation and prediction**: creating scalable statistical, empirical, and analytical performance models, techniques, and tools for design, analysis and optimization of high-performance systems.
- **High-performance applications**: creating scalable high-performance algorithms and applications for emergent computational domains such as biology.

# Current Projects (Feng)

- **High-performance networking:** architecture, protocols,performance (modeling, evaluation, auto-tuning) in system-area & wide-area networks
- **'MAGNETizing' SystemTap**: Enabling dynamic, on-the-fly probing and export of kernel information.
- **Supercomputing in small spaces**: low-power & power-aware supercomputing
- **mpiBLAST:** high-performance bioinformatics

# Current Projects (Nikolopoulos)

- **Programming Layered Multiprocessors**: a unified programming approach for layered shared-memory multiprocessors, with multithreaded or multicore execution components.
- **MELISSES**: Continuous hardware monitors for power-performance adaptation schemes on layered parallel architectures.

# Current Projects (Ribbens)

- **Operation stacking framework**: algorithms and tools for improving the performance of large-scale ensemble computations.
- **ReSHAPE**: improving utilization and throughput on clusters via dynamically re-sizable parallel computations.

# Current Projects (Tilevich)

- **MPI On-Ramp**: Removing the difficulties of mapping communication design abstractions to MPI code through visual tools and code generation.
- **Remote Multi Method Invocation**: An extension to Java RMI that enables the execution of multiple remote methods in one batch.
- **Code Generation on Steroids**: enhancing the functionality of automatically generated code through Generative Aspect Oriented Programming.
- **Mapping Deductive Databases to Java**: a middleware facility that enables seamless interoperation between Java & deductive databases.

# Current Projects (Watson)

- **Surrogate approximation**: mathematical construction of functional approximations using sparse data in high dimensions, with ultimate application to multidisciplinary design optimization (MDO).
- **WBCSim**: a problem solving environment for wood based composites manufacturing processes.
- **Mathematical software for terascale machines**: scalable algorithms for polynomial systems of equations, global optimization, MDO, and interpolatory approximation.

# Current Projects (Watson)

- **Robust design optimization**: solving optimization problems with stochastic variables and constraints.
- **Remote sensing**: parallel algorithms for remote sensing applications.
- **Stochastic modeling**: parameter estimation for stochastic cell cycle models.
- **pDIRECT**: massively parallel direct search algorithms for global optimization.

# What's Next?

- Take classes, do research, write papers, graduate
- Collaborate
- Attend mixers ~ 2/month
- Try out new equipment
- Meet with visitors
- Contribute to proposals

# Why Should You Care?

- Rising tide floats all boats
- Enhance your current work
- Enhance your current quality of life
- Enhance your future opportunities & impact