CHECS

Center for High-End Computing Systems
www.checs.eng.vt.edu
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, SGI, clusters.
- Funding: NSF, DOE, DOD, NIH, DOA, …
- Lots of collaborations across VT campus.
- System X (03).
• **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 policies 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-sizeable 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