

# **LittleFe: Computational Science Education on the Move**

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## What is LittleFe?

- N node computational cluster (where  $4 \leq N \leq 8$  )
- Portable, weighs less than 50 pounds so it travels as checked baggage at no extra cost
- Inexpensive, about \$2,500USD
- Low friction, uses the Bootable Cluster CD distribution and a single system image (RSN)
- Real science applications, not a toy (but it is fun to use)
- See <http://LittleFe.net> for pictures and construction information

# Why is LittleFe Useful?

- High performance computing and computational science education
- Almost all of the available HPC cycles go to research, teaching is a distant second
- Need predictable, consistent access to HPC resources to teach this material effectively:
  - Immediate feedback, compute it now
  - Realistic science, no more computing  $\pi$  with a simulated dart-board
- Computational science, education; as opposed to computational, science education
- Not reasonable to teach HPC/CS in a uni-processor environment:
  - Decomposition - domain, functional
  - Speedup
  - Efficiency
  - Load balancing
  - Parallel models - *e.g.* messages, shared memory, process distribution

# The Bootable Cluster CD

- Project of Paul Gray (and others) at the University of Northern Iowa
- NCSI and additional sources of support
- Makes any x86 or PowerPC based lab into an ad-hoc cluster in minutes
- Greatly reduces the friction associated with setting-up and maintaining an HPC environment for teaching
- Science curriculum modules available via list-packages, for example:
  - GROMACS - molecular dynamics primarily for biological molecules
  - mpiBLAST - parallel implementation of the basic local alignment search tool
  - GalaxSee - N body simulation and visualization

- Linux plus many HPC/computational science tools and applications:
  - gcc, g77, and development tools, editors, profiling libraries and debugging utilities
  - Cluster Command and Control tools
  - MPICH, LAM-MPI and PVM in every box
  - The X Window System
  - OpenMosix with openmosixview and userland openMosix tools
  - Full Torque and Maui scheduler support
  - octave, gnuplot, Mozilla's Firefox and about 1,400 userland utilities
  - Network configuration and debugging utilities
  - Ganglia and other monitoring packages

# Computational Science Education Reference Desk

- Computational science portal to the NSF's National Science, Technology, Engineering, and Mathematics Education Digital Library (NSDL)
- Collects and organizes curricular materials for teaching computational science, parallel and distributed computing, and related topics
- Peer review of curricular materials based on verification, validation, and accreditation:
  - Verification - is the model right?
  - Validation - is it the right model?
  - Accreditation - is the model useful for teaching?
- Tutorials on MPI including example programs
- <http://cserd.nsd1.org>

## Hardware Manifest - x86

- 6 - Via EPIA-M motherboards, 1GHz Eden processors, 512MB RAM
- 1 - PW200- M power supply
- 5 - PW70 power supplies
- 1 - SE-600-12 110VAC-12VDC 600 Watt switching power supply
- 6 - Micro power switch/LED assemblies
- 6 - 30mm fans
- 6 - CAT-5 Ethernet cables
- 2 - 40GB 5200RPM laptop form-factor disk drives
- 1 - CD-RW/DVD drive
- 1 - Netgear 10-port 100 MB Ethernet switch
- 1 - Kattrel 6U subrack and rails
- 1 - Aluminum channel and mounting hardware
- 1 - Pelican 1620 case

## Hardware Manifest - PPC

- 4 - Pegasos II motherboards, 1GHz PPC processor, 256MB RAM
- 4 - Nano PW120 power supplies
- 2 - D-Link 5 port gigabit switches
- 10 - CAT-5E Ethernet cables
- 1 - Linksys WRT54G access point/router
- 1 - Meanwell S320-12 320 Watt 110VAC-12VDC switching power supply
- 2 - 80GB 7200RPM laptop form-factor disk drives
- 1 - CD-RW/DVD drive
- 1 - Kattrel 6U subrack and rails
- 2 - RadioShack 12VDC-7.5VDC power supplies
- 1 - Aluminum channel and mounting hardware
- 1 - Pelican 1610 case