BCCD/LittleFe: Computational Science Education on the Move

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What is BCCD/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
- Uses the Bootable Cluster CD distribution and a single system disk image
- Real science applications, not a toy (but it is fun to use)
- See `http://LittleFe.net` for pictures and construction information

Why is BCCD/LittleFe Useful?

- Reduces the friction associated with high performance computing (HPC), Grid, 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 π with a simulated dart-board
  - Visceral, engages students in ways that distant, invisible HPC computing resources can't
- Computational science, education; as opposed to computational, science education
- Not reasonable to teach HPC/CS/Grid 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
  - Torque and Maui scheduler support
  - octave, gnuplot, Mozilla's Firefox and about 1,400 userland utlities
  - Network configuration and debugging utilities
  - Ganglia and other monitoring packages

Computational Science Education Reference Desk

- Computational science portal to the NSFs 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:

  - Validation - is it the right model to solve?
  - Verification - is the model correctly implemented?
  - Accreditation - is the model useful for teaching?

- Tutorials on MPI including example programs

- `http://cserd.nsdl.org`

Hardware Manifest

- 6 - Via EPIA-M motherboards, 1GHz Eden processors, 1GB/512MB RAM
- 1 - PW200- M power supply
- 5 - PW70 power supplies
- 1 - SPF-320 320 Watt switching power supply
- 6 - Micro power switch/LED assemblies
- 6 - CAT-5 Ethernet cables
- 1 - 60GB 7200RPM 8MB cache laptop form-factor disk drive
- 1 - CD-RW/DVD drive
- 1 - Netgear 10-port 100 MB Ethernet switch
- 1 - Subrack and rails
- 1 - Aluminum channel and mounting hardware
- 1 - Pelican 1610 case