CS 594 – 31778
Understanding Parallel Computing

Web page for the course:

CS 594 –
Wednesday’s 1:30 – 4:00

◆ Understanding Parallel Computing:
  From Theory To Practice
  ◆ Spring 2003 – 3 credits
  ◆ Jack Dongarra, Professor
  ◆ Class will meet in Room C211, Claxton Building

To Get Hold of Us

◆ Email: dongarra@cs.utk.edu
  ◆ Room: 413, Claxton
  ◆ Phone: 974-8295
◆ Office hours:
  ◆ Wednesday 11:00 – 1:00, or by appointment
◆ TA: Fengguang Song, song@cs.utk.edu
  ◆ 307 Claxton Complex, 974-0517
  ◆ OH: 10am-11am TR, or by request

Schedule of Topics

◆ Introduction
◆ Parallel Programming Models and Machines
  ◆ Shared Memory and Multithreading
  ◆ Distributed Memory and Message Passing
  ◆ Data parallelism
◆ Sources of Parallelism in Simulation
  ◆ Algorithms and Software Tools (depends on student interest)
  ◆ Dense Linear Algebra
  ◆ Partial Differential Equations (PDEs)
  ◆ Load balancing, synchronization techniques
  ◆ Sparse matrices
  ◆ Visualization and monitoring
  ◆ Debugging parallel programs
  ◆ Sorting and date management
  ◆ Metacomputing
  ◆ Applications (including guest lectures)
  ◆ Project Reports

Grades Based on:

◆ 30% on weekly homework
  (the lowest homework grade will be dropped)
◆ 30% on a written report and presentation
  (20 pages circa.)
◆ 30% on a final exam (2 hours)
◆ 10% on class participation.

Homework

◆ Usually weekly
◆ Lowest grade will be dropped
◆ Must be turned in on time (no late homework)
◆ Don’t copy someone else’s homework.
◆ Sometimes problems, sometimes programming
  assignment, sometimes requiring running a
  program to find the solution.
Homework (continued)

• We expect an analysis and detailed discussion of the results of your efforts.
• The program itself is not very interesting.
• Programming in C or Fortran.
• Will go over the assignments the week they are due.
• See class web page weekly for details.

Using the SInRG Clusters

• Boba Cluster
  • 32 Dell Precision 530s
  • Dual Pentium 3V Xeon 2.4 GHz Processors
  • 512 KB Cache
  • 2 GB Ram
  • 2 736 MB MAXTOR 6L080J4 Disk Drives
  • On board 3com Corporation 3c905c NIC
  • Intel e1000 10/1000 NIC
• Frodo Cluster
  • 65 dual AMD-Opteron 240 nodes
  • 2 GB RAM per node
  • Myrinet 2000 interconnect
• Neo Cluster
  • 16 Dual 450MHz UltraSparc-II 64-bit RISC processors with 4MB L2 cache
  • 512MB (4x128) ECC SDRAM DIMM memory installed
  • 5SCSI: Integrated dual 40 MB/sec UltraSCSI channels
  • 27 IDE (1-18GB, 1-9GB) UltraSCSI 10,000 RPM Hard Drives
  • TP Ethernet 10/100BASE-TX
  • SysKonnect Gigabit Ethernet

Project

• Topic of general interest to the course.
• The idea is to read three or four papers from the literature (references will be provided)
• Synthesize them in terms of a report (~20 pages)
• Present your report to class (~30 mins)
• New ideas and extensions are welcome, as well as implementation prototype if needed.

Remarks

• Hope for very interactive course
• Willing to accept suggestions for changes in content and/or form

Final Exam

• In class
• Will cover the material presented in the course
• ~2 hours

Material

• Book:
• For each lecture a set of slides will be made available in pdf or html.
• Other reading material will be made available electronically if possible.
• The web site for the course is: http://www.cs.utk.edu/~dongarra/WEB-PAGES/cs594-2005.html
Other Sources

- Will use material from the internet (manuals, papers)
- Will use a variety of book sources; including
  - Ian Foster
    » Designing and Building Parallel Programs
  - Alices E Koniges
    » Industrial Strength Parallel Computing
  - Jack Dongarra et al.
    » Sourcebook of Parallel Computing
  - Ananth Grammas et al.
    » Introduction to Parallel Computing
  - Michael Quinn
    » Parallel Programming
  - David E. Culler & Jaswinder Pal Singh
    » Parallel Computer Architecture
  - George Almasi and Allan Gottlieb
    » Highly Parallel Computing

Important Place for Software

- Netlib - software repository
  Go to [http://www.netlib.org/](http://www.netlib.org/)

What will we be doing?

- Learning about:
  - High-Performance Computing.
  - Parallel Computing
  - Performance Analysis
  - Computational techniques
  - Tools to aid parallel computing.
  - Developing programs using PVM, MPI, HPF, and perhaps OpenMP.

Outline of the Course

1. January 12 - Introduction
2. January 19 - Parallel Architectures
3. January 26 - Parallel Programming, Memory Hierarchy and Cache
4. February 2 - ?
5. February 9 - Message Passing
6. February 16 - Message Passing continued
7. February 23 - Dense Linear Algebra
8. March 2 - Dense Linear Algebra continued
9. March 9 - Iterative Linear Algebra Methods
10. March 16 - Iterative Linear Algebra Methods continued
11. March 23 - Spring Break
12. March 30 - Grid Computing
13. April 6 - Grid Computing continued
15. April 20 - Tools continued
16. April 27 - Last Class

What you should get out of the course

In depth understanding of:
- When is parallel computing useful?
- Understanding of parallel computing hardware options.
- Overview of programming models (software) and tools.
- Some important parallel applications and the algorithms
- Performance analysis and tuning

Background

- C and/or Fortran programming
- Knowledge of parallel programming
- Some background in numerical computing.
Computer Accounts

- For much of the class computing you can use one of our set of computer clusters. More on this later
- If you have an account in the Department you have access to the TORC cluster: torc1 through torc8.
- Cluster of PC's: http://icl.cs.utk.edu/internal/iclhelp/clusters.html