Course Information

Course Objectives:

This course is intended as an introduction and overview of the SOFTWARE aspects of parallel computing. The course will concentrate on the issues involved in effectively exploiting the potential parallelism in high performance computing systems through parallel programming. The course will contain hands-on experience programming and analyzing the performance of parallel programs on a cluster of workstations. The course will not cover the details of automatic parallelizers; this material is covered in CIS 872. The course will only briefly discuss parallel architectures; this material is covered in depth in CIS 662. The course will not concentrate on developing and analyzing parallel algorithms; this material is covered in depth in CIS 821.

Recommended Prerequisite: CIS 662 - Computer Architecture

Lectures:

TR 11:00-12:15PM (3 hours) 102A Smith Hall

Instructor:

Lori Pollock pollock@cis.udel.edu
406 Smith Hall (831-1953)

Office Hours:

TTh 1:30-2:30 PM
By appointment.

Required Textbook:

Ian Foster, *Designing and Building Parallel Programs*, Addison Wesley, 1995.

Programming Environment and Computer Usage:

There will be MPI, HPF, and Linda programming, all of which will be implemented on a dedicated network of DEC alpha workstations. There may also be threads programming on a 4 processor SUN workstation.

Requirements and Grading:

- (50%) Programming exercises.
- (20%) Oral presentation on a current parallel programming paradigm.
- (30%) Experiment.

Course Outline:

- Introduction and Overview
- Parallel Architectures and Paradigms of Parallelism
- Basic Steps of Designing Parallel Programs
- Performance Evaluation
- Distributed Memory, Message-Passing Paradigm and MPI
- Data Parallel Programming and HPF
- Shared Memory MIMD Parallel Paradigm
- Distributed Shared Memory Systems
- Task and Loop Scheduling
- Debugging Parallel Programs
- Alternate Parallel Programming Paradigms

Details on Course Requirements:

1. Programming Exercises:
These assignments consist of writing, compiling, and running small parallel programs in MPI, Linda, and HPF on the DEC alpha cluster. The intent of these assignments is to give you hands-on experience writing and debugging parallel programs on a current parallel architecture, as well as to give you the opportunity to observe and experiment with various issues to be faced in getting good performance from parallel programs.

2. Oral Presentation:
The objective of this assignment is to give you experience in reading and critiquing an article in a particular parallel programming paradigm, preparing and giving an oral presentation, and learning about yet another paradigm of parallel programming. Your task is to choose one article from the book *Languages for Parallel Processing* by David Skillicorn and Domenico Talia, IEEE Computer Society Press, (located in my office), read the article several times to fully understand the paradigm of parallel programming they are presenting, prepare and give a 30 minute oral presentation to the class, and come prepared with 3-5 discussion questions to prompt class discussion of the article. These presentations can be done throughout the semester. You should tell me your proposed presentation date before Friday, September 20.

3. Experiment:
The objective of this assignment is to give you experience in designing and actually performing an empirical study of a particular aspect of programming parallel systems. In particular, your task is to:

(1) Choose one of the following concepts to investigate: scalability, locality, granularity, load balancing, nondeterminism, Amdahl's law, or another concept approved by the instructor.

(2) Design an experiment that demonstrates the various aspects of this concept. That is, you could design an experiment that shows how one program is scalable, and how one is not scalable. Your hypothesis would state something about the characteristics that make the one scalable and the other not scalable. Write a detailed proposal for the experiment stating the hypothesis and methodology of the experiment. Proposals are due by Thursday, October 31.

(3) Perform the experiment collecting adequate data to come to some conclusions about your hypothesis.

(4) Write a report that clearly restates the hypothesis, methodology, tables of collected data, results, and conclusions. This report should be typed with a word processor/text formatter. With your report, you should include a pointer to the files of code etc that you used for your experiment so that I can reproduce your experiment. Reports are due by Thursday, December 5.

(5) Give a 20 minute oral presentation on your experiment.