CSE 598F: Advanced Topics in Scientific Computing

Padma Raghavan, 343-K IST, (raghavan@cse.psu.edu)
Meeting Times: M, W: 9:00-10:15 a.m. Room 333 IST
Credits: 3, Spring 2004; Schedule No.: 367108.

Scientific computing concerns the design of algorithms and software to enable large-scale scientific and engineering applications. This course will involve the study of algorithms, their parallelization, their implementation as reusable software objects, and, their use in modeling and simulation applications.

Grades will be determined based on 4 assignments and a project with a written report and a short presentation. Lecture notes will be provided online along with pointers to research papers and resources on the web. The course is in the form of four major units which are described below.

• Introduction to large-scale modeling applications (3 weeks). Characteristics of scientific and engineering applications; dense versus sparse/irregular structures and and their affect on application design. Examples from document classification, image processing, and financial modeling.

• Introduction to parallel computing (3 weeks). Local and global addressing models; developing parallel kernels using MPI (message passing) and OpenMP (thread based parallelism). Parallel FFT (Fast Fourier Transforms) and its application.

• Performance modeling and analysis and statistical testing (6 weeks). Factors determining the serial and parallel performance of scientific computing codes. Predicting and improving performance using modeling, analysis and instrumentation. The role of statistical testing in scientific computing. Case studies involving document classification, image processing, financial modeling, and parallel FFT.

• Component software architectures (4 weeks). Object-oriented design, interface description languages, and common object broker resource architectures for scientific computing. A study of SIDL, a Scientific Interface Definition Language and CCA, the Common Component Architecture specification.