Plan (September to December 1999): Dissertation, Papers, and Work

Saleh Elmohamed,

Northeast Parallel Architectures Center
Syracuse University, Syracuse, NY 13244

saleh@npac.syr.edu

September 12, 1999

ABSTRACT

The centerpiece of this plan is the completion and defense of the dissertation. In addition, a journal quality paper on optimization to be completed no later than a month from today, around mid October. In regard to the non-optimization work, Sang Lim and I will shortly be integrating an N-body applet, originally written by Ernie Sibert and his students and later updated by me, into mpiJava. A demo using this applet for SC99 will be put together. Second, Dongmin Kim and I are integrating the CFD applet into Tango. We've already started this work and hope to complete it soon. Other applets, such as the 2D Ising Model, are also planned to be integrated afterward.

1 Some Details of the Plan

This is my roadmap to completion of my PhD, putting together two journal quality papers, and finding a good job.

- Dissertation: **Algorithms and Heuristics for Combinatorial Optimization Problems: Case Study of Academic Course Scheduling**

  In this dissertation we try to answer the following question: How do we go about solving optimization problems, in general, and academic course scheduling (or timetabling) at the university level, in particular? We give a detailed answer to the latter part, and shed some light on the case of tackling optimization problems in general. To summarize, we have investigated a variety of optimization problems, in particular, random search, hill climbing, knowledge-based systems (or expert systems), tabu search, and simulated annealing-based methods to solve the course scheduling problem. The simulated annealing-based approach includes mean-field annealing, simulated annealing with three different cooling schedules, and the use of a rule-based preprocessor to provide a good initial solution for annealing. The best results were obtained using simulated annealing with adaptive cooling and reheating as a function of cost, and a rule-based preprocessor. This approach enabled us to obtain valid schedules for the timetabling problem for a large university, using a complex cost function that includes student preferences. None of the other methods were able to provide a complete valid schedule.

- Paper: **A Comparison of Annealing Techniques for Academic Course Scheduling**

  The first version appeared in Springer Lecture Notes in Computer Science, vol 1408. The second version includes more details and analysis of the results, such as plots and figures showing the behavior of the annealing schedules used and the effects of the various constraints involved on such behavior.

- Paper: **Course Scheduling using Mean-Field Annealing – Algorithm Analysis and Implementation**

  This paper is in the final stage of completion. The only things that need to be included are few tables of data and plots of some of the obtained results from the experiments.

- Paper: **Academic Scheduling using Simulated Annealing with a Rule-Based Preprocessor**

  Results of this papers are used in the Simulated Annealing study.

- Project (programming + paper): **Integration of Java-based Educational Resources with the Collaboratory System Tango: Case study of CFD and 2D Ising Model simulation**

  The CFD and Ising Models are two applets that were designed specifically for educational purposes. They include features allowing the user, for example, to control the flow based on density, velocity, temperature, etc. in the former and the energy per spin as well as magnetization in the latter. In the case of the Ising model the user can specify the temperature with respect to the critical temperature, and in the CFD case the 2nd and 4th order damping of the flow can easily be changed throughout the simulation.

The integration will have two modes: master-master and master-slaves. In an educational setting the master will be the instructor and the slaves are the students. In the first mode, the students will have as much control over the simulation as the instructor while in the second mode the instructor will have a higher degree of control. Also, in the framework of the second mode there are instances when the instructor will allow or authorize one or more students to have more control over the simulation. For example, in the case of a student having a question about certain aspect(s) of the simulation, the student needs to have some control in order to show the points that s/he is asking about. Furthermore, the rest of the class, including the instructor, also need to be able to see what the student is asking about. In a collaborative system such as tango there may be other modes of control that need to be investigated in the framework of this integration.

- Project (programming,etc.): **mpiJava for Scientific and Engineering Applications: Case study of the N-body problem**

  For SC98, CFD simulation was shown as an example of a large scale engineering application that can be done in mpiJava. For SC99, we (Sang, Bryan, and Saleh) will implement the N-body problem in mpiJava. If all goes well, a demo of this implementation will be shown during the conference.