

## Final Project: Application Performance Study

Phys7411  
Spring 2009

The goal of this assignment is to investigate the performance of an application of your choice, and to perform some preliminary design or implementation which will improve its performance either on a single processor, parallel computer system or on an alternative platform such as GPU, FPGA, etc..

Preliminary Presentation: Due on **April 21** by 6:00pm Central Time. The presentation should be 3-4 power point or pdf slides. With the following information

- 1) The members of your group.
- 2) A brief explanation of the application that your group has chosen.
- 3) Identification of the time consuming portions of the code that you are investigating. (e.g. Results from an initial profile run with gprof or pgprof)
- 4) A brief description of your plan/approach.
- 5) Some initial references on parallelization or optimization of your application or similar applications.

Some project ideas:

- Restructure for Improved Cache Performance: Perform loop optimizations, incorporate library calls, and/or reorganize the primary data structures to improve locality, and hopefully reduce cache misses and reduce overall runtime. Use hardware counters to gather statistics.
- Develop a Parallel Implementation: Parallelize your application using MPI, OpenMP or some other programming model, measure the parallel performance. (Not applicable if your application is already parallelized) or develop a strategy for parallelizing your application using MPI, or OpenMP if your code is very large.
- Explore an alternative parallel implementation: Re-implement a parallel code using a different programming methodology or language e.g. Port a Matlab code to a compiled language, or develop a hybrid or multi-level parallel implementation.
- Explore an alternative hardware platform: Identify a time consuming portion of your application and target it for something other than a general purpose CPU such as FPGA, GPU or cell processor to accelerate your application. Provide a preliminary design/strategy for implementing the identified portion of your application using the selected hardware.

Your **project report** should contain the following sections and is due on **May 1, 2009** by **12:00pm (noon)**. Electronic submission as a PDF file via email to both [katomko@gmail.com](mailto:katomko@gmail.com) and [Moreno@phys.lsu.edu](mailto:Moreno@phys.lsu.edu) is required.

- 1) **Introduction:** A brief description of your application, why its worth studying, its initial implementation, and its computational requirements (overview). Followed

- by a summary of what you have done for the project and a brief description of work done by other researchers on performance analysis or parallelization of your application or similar applications. (1/2 – 1 page)
- 2) **Application Analysis:** Provide a brief description of the application software including a high level diagram of the flow of the application, with more detail on the portion of the code where most of the time is spent. A summary of the results from the profile run and any additional performance analysis performed. Identification of parallelism in the portions of code taking up most of the time , etc...(1-2 page)
  - 3) **Optimization Approach:** Give a description of your approach to optimizing the application. Justify why your optimizations should be effective and what you expect as a final performance improvement. Use performance analysis formulas such as Amdahl's law from the lecture earlier this semester as appropriate. Discuss the technical challenges to performing the work. (1-2 pages)
  - 4) **Results/Design:** Provide preliminary performance results and provide suggestions for additional changes which would further improve the code or provide an implementation plan and preliminary design for the given approach. Include system requirements to carry out any experimentation required. (1-2 page)
  - 5) **Bibliography:** Papers describing the application, related parallelization or optimization efforts or performance studies. (No more than 10).

Notes:

- i. This is a group project, please work together to take advantage of the varying skills that you each can bring to the project.
- ii. Writing Skills: this is not a writing class and we will not explicitly base your score on your writing; but will concentrate on the technical content. However, a well written paper is easier to understand and hence will usually result in a better score so take the time to organize your thoughts, spell check, grammar check and proof read your work.
- iii. Plagiarism: Your report should be written in your own words. Authors should be referenced appropriately if you use their words or ideas. You will receive a score of 0 on this report if we determine that you have represented someone else's words/work as your own.