CSS 600 Final Progress Report
Timothy Chuang
December 14, 2010

Introduction
This is the final progress report which details the work that was performed on the MASS library. The current short term goal of the MASS library is project acceptance by one of the major parallel computing platform conferences. The MASS library would eventually be used as a teaching instrument for future CSS classes.

During this past quarter, only two students, including me, worked on the library and the main focus had been completing the basic functionalities to support applications such as Wave2D and fine-tuning the performance.

Problems were discovered early in the quarter and my goal shifted from merging multi-process and multi-threaded versions into one to completing the multi-threaded version using the newly proposed primitive-based implementation.

Work Completed
A performance problem was discovered early in the quarter that java object casting could result in additional undesired overhead. The proposed solution was to implement an overhaul in the MASS library so that primitive types may be specified if the user desires.

As such, I implemented a new version of the MASS library that accepts primitive types. Instead of instantiating an array of Place objects, the MASS library now only instantiates an array of the chosen primitive type with a sub array that can be used to store user defined variables, such as neighbor information.

I was able to fully implement both double and float functionalities and verified their correctness with the provided Wave2D program.

Challenges
During my preliminary performance tests, I found that Exchange All functionality is one of the major factors in the slower-than-expected performance. Without Exchange All calls, the Wave2D performance could almost be on par with the single version without graphics enabled.

However, the performance with graphics enabled exhibits very similar trend when compared to the regular multi-threaded version of the Wave2D program. The bottleneck seems to be where the graphics are displayed to the GUI. The main thread handles most of the work load and becomes the bottleneck of the entire simulation.

Future Work
The MASS Library work is expected to continue into winter quarter. There are some cleanups needed for the multi-threaded version and there are also opportunities to be explored for performance increase. One of the viable solutions is to cache neighbors for subsequent ExchangeAll calls.
I will be coordinating with both Johns on merging the multi-process and multi-threaded versions into one version in the upcoming quarter.

**Conclusion**
The progress on the MASS library has been lower than expected due to several technical difficulties. My goal of this quarter was to merge the two versions, but John S. encountered numerous challenging problems during multi-process version development and it is not going to be completed until after the winter break. The merging of two versions will not take place until then.

So far, the test results show that the MASS library appears to be quite scalable, but the performance comparison between the single Wave2D version and the MASS version leaves much to be desired. Future fine-tuning work needs to be done on the ExchangeAll functionality to reduce performance cost.

**Test Data**

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Test Graphs

Wave2DMASS No Gfx

Wave2DMulti No Gfx