TJHSST Computer Systems Lab Senior Research Project Applications of Parallel Programming 2006-2007

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Abstract

This paper discusses the progress of the "Informal Parallel Programming Course For High School Students" offered from the University of Maryland, College Park. The emphasis of the course is to teach a different process of thinking, one that benefits most from coding in parallel.

Keywords: parallel programming, ear decomposition, st-Numbering, high school

1 Introduction - Elaboration on the problem statement, purpose, and project scope

1.1 Scope of Study

The homework assignments given in the Informal Course will include a basic overview of Parallel Programming. The extra 'bonus assignments' will cover more advanced material, which I will be going into. The bonus assignments will cover implementing an Ear Decomposition and other algorithms on graphs. As of now, the assignments have included exchanging array elements, multiplying matrices, compacting a sparse array, and finding the nth smallest value of an un-sorted array.

1.2 Expected results

The Parallel Programming Course ends on December 11. By that time, I expect to understand parallel programming and using the XMT-C language at a fairly high level. I also expect to understand map and graph theory in more detail by that time so that I will be able to begin research on Ear Decomposition in December.

1.3 Type of research

As of now, the type of reasearch being done is purely basic. The goal is to teach High School Students how to work in parallel and to recognize when and how to abuse parallelism in an algorithm. From this new knowledge, more reasearch will be done on parallel algorithms (EDS) in an effort to optimize their efficiences.

2 Background and review of current literature and research

Parallel programming is in no way a new concept. Unfortunately, for the past fifty years more emphasis has been put in improving run-time for serial programs. Now that hardware has almost hit its serial limit, it it turning to parallel implementations; dual cores, for example, are becoming more popular. More research will hopefully be put into parallel programming in the near future.

When serial algorithms do not parallelize well, new approaches are needed to tackle problems. In the case of the Depth-First Search, it does not convert to parallel well. The Ear Decomposition Search was created as the parallel equivalent of the DFS.

One of the most common applications to the EDS is st-Numbering. st-Numbering is a method of organizing vetexes of a graph so that mathematical induction stands. For example, when using an st-Numbering for planarity, if the set of vertexes including the first vertex of each ear is planar, then, by induction, the graph is planar.

3 Procedures and Methodology

The language being used is called External Multi-Threaded C (XMT-C). XMT-C is C with two added methods, spawn( ) and ps( ). I am using a 64-processor super-computer manufactured by IBM for the University of Maryland. With an acocunt, I am capable of connecting and running my programs from any computer. The assignments for the course are very structured. They can be found at http://www.glue.umd.edu/ swatson/IPPC4HSS/.

The algorithms that will be intensely studied are the Ear Decomposition Search (EDS) and the st-Numbering. The EDS is the parallel equivalent of a serial Depth-First-Search. The st-Numbering allows for induction so that the testing of only part of a graph is necessary.