TJHSST Senior Research Project Applications of Parallel Programming 2007-2008

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Abstract

My main areas of interest with this project is parallel programming and its contribution to solving problems of graph theory. This project will eventually explore the Ear Decomposition Search and try to implement it on a Travelling Salesman Problem in an effort to find a connection.

Keywords: Parallel Programming,Travelling Salesman, Ear Decomposition, st-Numbering

1 Introduction - Problem Statement and Purpose

1.1 What is Sought

The purpose of this experiment is to find an st-Numbering system that will allow for points of a Travelling Salesman Problem to be added one at a time so as to minimize the distortion of the previous path. The Ear Decomposition Search (EDS) will be the method used in finding the st-Numbering of the graph. In order to use the EDS, knowledge of parallel programming is needed.

1.2 Why is it Sought

The two aspects of this project occur in very different fields of Computer Science, parallel computation and theory. Yet, they are connected by a common goal, an increase in run-time efficiency. The expected results of this project will provide three advancements in knowledge:

1. Research in the field of parallel programming

2. Research in the study of NP-Complete problems

3. Research in the applications of st-Numbering

2 Background

subsectionParallel Programming and its Applications 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. subsectionTravelling Salesman Problem The Travelling Salesman Problem (TSP) is a well known NP-Complete problem. In its simplest form, a salesman needs to visit a certain number of cities and then return home. The TSP asks for the shortest path or cheapest cost the salesman should take. With a BigOh value of n!, the solution to problems with a large number of cities is almost impossible. The NP-Complete problem asks for an algorithm that runs in polynomial time that solves either the TSP or the many other NP-Complete problems.

3 Procedures

For the continuation of the calandar year, my main focus will be in completing the Informal Parallel Programming Course for High School Students. I will also continue my research of EDS and TSP. My first step will be to implement an Ear Decomposition on any bi-connected graph. Then, I will implement the EDS on a TSP data set. Finally, I will need an st-Numbering system that acts as the most efficient in minimizing the previous path with each subsequent path.

3.1 Software

Computer language, libraries, and hardware I will be using:

1. C
2. XMT-C
3. OpenGL
4. 64-processor PRAM chip provided by the University of Maryland

4 Expected Results

By December 11, I expect to complete the Informal Parallel Programming Course. By the end of January, I expect to complete a working Ear Decomposition Search on a TSP data set. My program should find an st-Numbering that minimizes the changes from sub-Tours with the final tour (the solution tour). By minimizing the number of changes, the algorithm can safely eliminate non-optimal tours without checking them, in effect improving run-time. I consider a working algorithm, even if it may only be a heuristic, a successful project.