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Building Analytical Models into an Interactive Performance Prediction Tool

by

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Title: Building Analytical Models into an Interactive Performance Prediction Tool

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Abstract:
In this paper we describe an interactive tool designed for performance prediction of parallel programs. Static performance prediction, in general, is a very difficult task. In order to avoid some inherent problems, we concentrate on reasonably structured scientific programs. Our prediction system, which is built as a sub-system of a larger interactive environment, uses a parser, dependence analyzer, database and an X-window based front end in analyzing programs. The system provides the user with execution times of different sections of programs. When there are unknowns involved, such as number of processors or unknown loop bounds, the output is an algebraic expression in terms of these variables. We propose a simple analytical model as an attempt to predict performance degradation due to data references in hierarchical memory systems. The predicted execution times of some Lawrence Livermore loop kernels are given together with the experimental values obtained by executing the loops on Alliant FX/8.

Keywords: parallel processing
performance prediction
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Building Analytical Models into an Interactive Performance Prediction Tool

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1 Introduction

As the field of parallel computation has evolved from a theoretical subdicipline of computer architecture and algorithm design to an active branch of experimental computer science it has become increasingly dependent upon performance analysis as the principle tool for explaining the behavior of multiprocessor systems. In particular, researchers working on parallelizing large applications are increasingly dependent on their techniques. While automatic parallelizers for FORTRAN and C are becoming more powerful, they still frequently fail to recognize potential concurrency (especially if it involves interprocedural analysis). When they do fail, it is up to the user to determine where parallelization and vectorization are best applied in the given application.

In this paper we consider the design of an interactive performance predictor that allows users to consult an analytical model of the performance of a machine and the output of the compiler in order to help them better explain the performance of their applications. To see where a tool like the one we will describe fits into the activities of a user, it is best to briefly consider an anatomy of a performance evaluation session for a user with a large application which, for some unknown reason, is failing to get the desired performance on a vector multiprocessor supercomputer. We view the process as a sequence of five levels of analysis.

- *Global View.* At this level the user would like to understand the performance of the application in the large. To understand why the program might be running slowly, a global view of the