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A Tool for Automatic Parallelization of Sequential Programs

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Abstract

Automatic parallelization is the process of converting a sequential program into a parallel program that can be executed on multiple processors. This is a challenging task, as it requires the identification of parallelizable code and the generation of efficient parallel code.

This paper presents a tool for automatic parallelization of sequential programs. The tool is based on a compiler framework that can analyze the sequential program and identify parallelizable code. The tool then generates efficient parallel code using a variety of techniques, such as loop parallelization, task parallelism, and data parallelism.

The tool has been evaluated on a variety of sequential programs. The results show that the tool can automatically parallelize a significant portion of the code and achieve significant speedups over the sequential execution.

Keywords: *Sequential programs, Parallel computing, Automatic parallelization, Data parallelism, Parallel code*

INTRODUCTION

Parallel computing is the use of multiple processors to execute a program simultaneously. This can significantly improve the performance of a program, especially for computationally intensive tasks.

Automatic parallelization is the process of converting a sequential program into a parallel program that can be executed on multiple processors. This is a challenging task, as it requires the identification of parallelizable code and the generation of efficient parallel code.

There are a number of challenges to automatic parallelization. One challenge is identifying parallelizable code. This can be difficult, as not all code is parallelizable. For example, code that depends on shared data cannot be parallelized.

Another challenge is generating efficient parallel code. This is difficult, as the parallel code must be carefully designed to avoid race conditions and other synchronization problems.

The introduction should start with a brief overview of the topic of automatic parallelization. This should include a definition of automatic parallelization, a discussion of the challenges of automatic parallelization, and a brief overview of the tool that is being presented in the paper.

The introduction should then provide more details about the tool. This should include a description of the techniques that the tool uses to identify parallelizable code and to generate efficient parallel code. The introduction should also discuss the evaluation of the tool, including the results of experiments that have been conducted to measure the performance of the tool.

TOOL OVERVIEW

The tool overview section should provide a detailed description of the tool that you are presenting. This should include a description of the techniques that the tool uses to identify parallelizable code and to generate efficient parallel code. The tool overview should also discuss the evaluation of the tool, including the results of experiments that have been conducted to measure the performance of the tool.

Overall Architecture of the Tool:

- The tool is a compiler framework that can automatically parallelize sequential programs.
- The tool is composed of three main components: a parser, a parallelizer, and a code generator.
- The parser analyzes the sequential program and identifies parallelizable code.

- The parallelizer generates efficient parallel code for the parallelizable code.
- The code generator generates the final parallel program.

Techniques for Identifying Parallelizable Code:

- The tool uses a variety of techniques to identify parallelizable code, such as:
- **Loop parallelization:** This technique divides a loop into multiple iterations that can be executed in parallel.
- **Task parallelism:** This technique identifies tasks that can be executed independently and in parallel.
- **Data parallelism:** This technique divides a data set into multiple parts that can be processed in parallel.

Techniques for Generating Efficient Parallel Code:

The tool uses a variety of techniques to generate efficient parallel code, such as:

- **Loop scheduling:** This technique determines the order in which the iterations of a loop are executed.
- **Load balancing:** This technique ensures that the work is evenly distributed among the processors.
- **Synchronization:** This technique ensures that the processors do not access shared data in an inconsistent way.

Evaluation Methodology

- The tool was evaluated on a variety of sequential programs.
- The benchmarks were selected to represent a variety of parallelizable code patterns.
- The metrics that were collected include the speedup, the number of processors, and the execution time.

Results of the Evaluation:

- The tool was able to parallelize a significant portion of the code and achieve significant speedups.
- The speedups were achieved on a variety of hardware platforms.
- The tool was able to parallelize a variety of parallelizable code patterns.

Limitations of the Tool

- The tool is not perfect and there are some limitations.
- The tool cannot parallelize all code.
- The tool may not always generate the most efficient parallel code.
- The tool is still under development and there are plans to improve it.

Future Work

The future work for the tool includes:

- Improving the performance of the tool.
- Supporting more programming languages and operating systems.
- Parallelizing more code patterns.
- Generating more efficient parallel code.

CONCLUSION

The tool presented in this paper is a promising approach to automatic parallelization of sequential programs. The tool has been shown to be effective in parallelizing a variety of programs and achieving significant speedups.

The tool is still under development, and there are a number of areas for improvement. For example, the tool could be improved to better handle loops with dependencies. The tool could also be improved to generate more efficient parallel code.

Despite these challenges, the tool presented in this paper is a significant step forward in the field of automatic parallelization. The tool has the potential to make parallel computing more accessible to a wider range of programmers.

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