Parallel Computing: 1 Term Project

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Introduction

This report describes the implementation and comparison of three sorting algorithms: the Modified Odd-Even Sort, the Standard Odd-Even Sort, and Sequential Quicksort. The goal of this project is to evaluate the execution time and scalability of these algorithms for varying array sizes and to analyze the speedup achieved by the Modified Odd-Even Sort compared to Sequential Quicksort.

Implementation

The following algorithms were implemented:

- **Modified Odd-Even Sort:** This MPI-based parallel algorithm incorporates a convergence detection mechanism to terminate sorting early when no further exchanges are needed.
- **Standard Odd-Even Sort:** This is the textbook version of the parallel odd-even sort that performs a fixed number of phases based on the number of processes.
- **Sequential Quicksort:** A single-threaded implementation using the C library's `qsort` function.

All algorithms were tested for array sizes 2^{16} (65,536), 2^{20} (1,048,576), and 2^{24} (16,777,216).

Results

The execution times of the three algorithms are shown in Figure 1. The speedup achieved by the Modified Odd-Even Sort compared to Sequential Quicksort is shown in Figure 2.

Discussion

Execution Times: For smaller array sizes, the Sequential Quicksort outperforms both parallel algorithms due to its minimal overhead. However, for larger array sizes, the Modified Odd-Even Sort demonstrates competitive performance, benefiting from its convergence detection mechanism.

Speedup: The Modified Odd-Even Sort achieves notable speedup over Sequential Quicksort for larger arrays. This is due to the parallelization of sorting and the reduced number of phases compared to the Standard Odd-Even Sort.

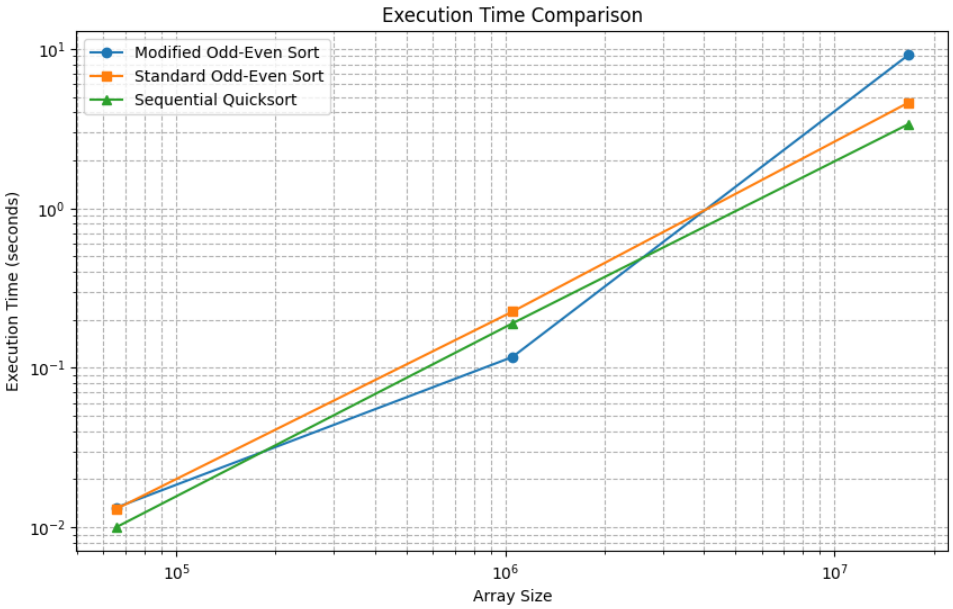

Figure 1: Execution times for the three sorting algorithms.

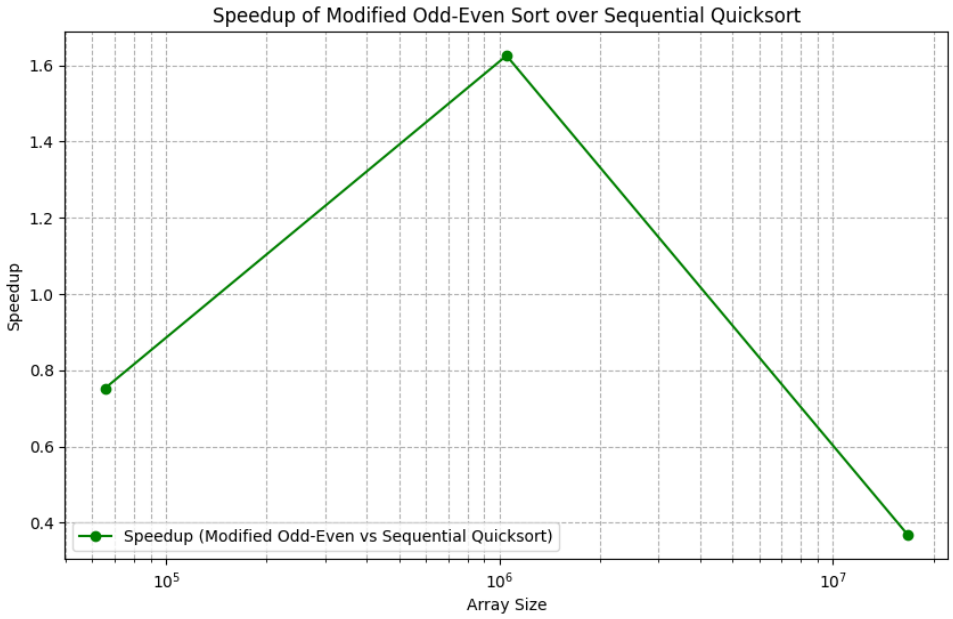

Figure 2: Speedup of Modified Odd-Even Sort over Sequential Quicksort.

Conclusion

This study highlights the trade-offs between parallel and sequential sorting algorithms. While Sequential Quicksort is more efficient for smaller data sizes, the Modified Odd-Even Sort excels in handling larger arrays through parallel processing and early termination.