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Course: PARALLEL COMPUTING COMP-3450

2/15/2025

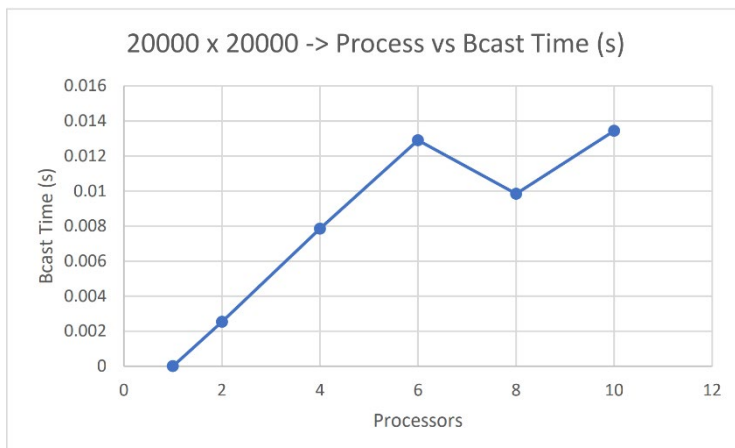
## PA3

# Analysis of Parallel Processing Performance for Matrix Operations

This is a project proposed by Professor Micah Schuster, which aims to analyze the performance of parallel processing for matrix operations across different matrix sizes that ranges from 10000 x 10000 until 40000 x 400000 and varying numbers of processors. The key metrics analyzed include Bcast Time, Scatter Time, Calculation Time, and Gather Time.

### Bcast Time

**Bcast Time:** It is expected that the time will increase according to the number of processors used. As can be seen in the graph below, the expected result would be a linear graph or at least something close to it.

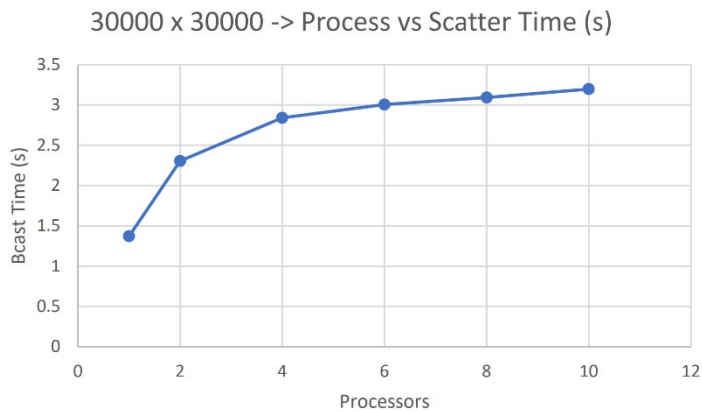


Graph 1.

The small deviation or noise in the data may be due to network congestion or latency fluctuations. When more processes participate, network contention increases. MPI may not always efficiently balance communication between nodes, among other reasons.

## Scatter Time

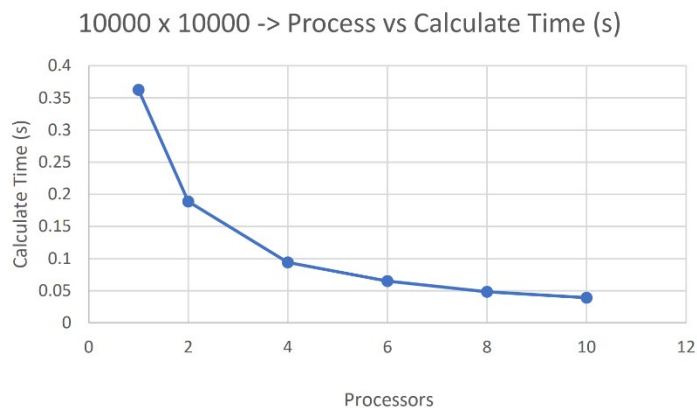
Scatter Time, which represents the time taken to distribute data across processors, increases with both matrix size and the number of processors. The increase may be more pronounced in the initial processors, but it will stabilize as the number of processors used grows.



Graph 2.

## Calculation Time

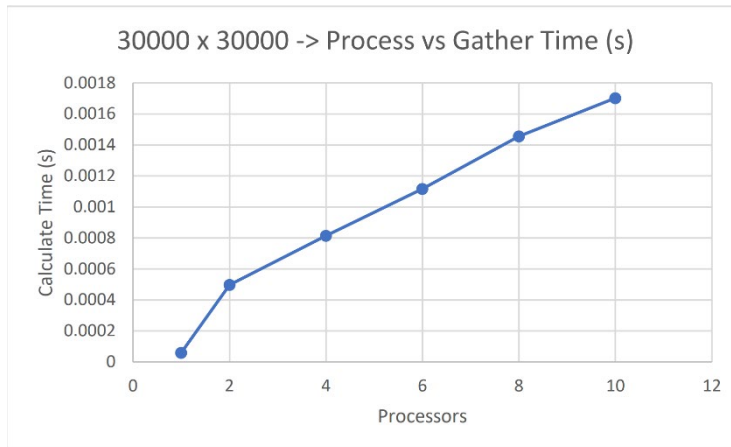
Calculate Time, which represents the time taken to perform the actual computation, decreases significantly as the number of processors increases. Similarly to the time in Scatter, but this time in an inverse manner, the graph shows a substantial decrease in time as the number of processors used increases. However, after a certain point, the time stabilizes as the number of processors grows.



Graph 3.

## Gather Time

Gather Time, which represents the time taken to collect results from all processors, is expected to increase as the number of processors grows, similar to Broadcast Time. In the example below, the graph shows a linear trend.



Graph 4.

## Conclusion

This project analyzed the performance of parallel processing for matrix operations, showing expected trends in communication and computation times. Broadcast and Gather times increased with more processors, while Scatter and Calculation times stabilized after an initial drop.

All graphs and tables are in separate documents: Graph Plots One, Graph Plots Two, Graph Plots Three, and Graph Plots Four