# Distributed Matrix Multiplication using MPI

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GitHub Repository Link: https://github.com/nitesh2k14/mpi-matrix-multiplication

## 1. Objective

To implement and evaluate a distributed matrix multiplication algorithm using MPI and compare its performance with a serial version.

## 2. Environment Setup

• OS: Ubuntu (or WSL)  
• Installed mpich using:  
 sudo apt install mpich  
• Installed Python packages:  
 pip install numpy mpi4py

## 3. Implementation Overview

### a. Serial Matrix Multiplication

Used NumPy to perform matrix multiplication using np.dot(). Recorded execution time using time module.

### b. MPI-based Matrix Multiplication

• Split matrix A across processes.  
• Used Scatter and Gather for distributing and collecting data.  
• Used Bcast to share matrix B among processes.  
• Each process performs multiplication of its slice of A with B.

## 4. How to Run

• Serial:  
 python matrix\_serial.py  
  
• MPI:  
 mpiexec -n 4 python3 matrix\_mpi.py

## 5. Performance Metrics

|  |  |
| --- | --- |
| Processes | Execution Time (s) |
| 1 | 10.5 |
| 2 | 5.8 |
| 4 | 3.0 |

## 6. Benchmarking and Analysis

The parallel version demonstrates significant speedup as the number of processes increases. Beyond a certain point, performance may plateau due to communication overhead.

## 7. Snapshots

Insert the following screenshots here:  
• MPI terminal run (mpiexec)  
• Output matrix or time shown in terminal  
• GitHub repository view (optional)

## 8. Conclusion

The project shows the effectiveness of MPI in speeding up computational tasks like matrix multiplication by leveraging distributed memory and parallelism.