

# COMP3036J Parallel and Cluster Computing: MPI Implementations for Array Summation

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## Overview

This document provides instructions for compiling and running four different MPI implementations to sum the elements of a large array. Each implementation uses a different combination of MPI operations.

## Implementations

- 1. Point-to-Point Only
- 2. Send/Recv for Segment Distribution
- 3. Broadcast Entire Array
- 4. Broadcast with Reduce

## MPI Implementations Comparison Table

This table compares four MPI implementations based on various features to understand their differences in communication strategies.

### Comparison Table

Feature/Implementation	Point-to-Point Only	Send/Recv for Segment Distribution	Broadcast Entire Array	Broadcast with Reduce
Communication Strategy	Direct send and recv for segments and sums	Direct send and recv for segments only, followed by manual collection of results	bcast used for distributing data, send and recv for collecting results	bcast for distribution, reduce for summing results
Data Distribution	Sends only the required segment to each process	Sends only the required segment to each process	Sends the entire array to all processes	Sends the entire array to all processes
Memory Usage per Process	Low (each process holds only its segment)	Low (each process holds only its segment)	High (each process holds the entire array)	High (each process holds the entire array)

## Installation and files

Download zip file from Moodle or

```
git clone https://github.com/nimaafraz/MPI_Sum_Array.git
```

## Compilation and Execution

### 1. Point-to-Point Only

- **Source File:** `sum_large_array_p2p_only_mpi.c`
- **Compile Command:**

```
mpicc -o sum_large_array_p2p_only_mpi sum_large_array_p2p_only_mpi.c
```

- **Run Command:**

```
mpirun -np 4 ./sum_large_array_p2p_only_mpi
```

### 2. Send/Recv for Segment Distribution

- **Source File:** `sum_large_array_send_recv_mpi.c`
- **Compile Command:**

```
mpicc -o sum_large_array_send_recv_mpi sum_large_array_send_recv_mpi.c
```

- **Run Command:**

```
mpirun -np 4 ./sum_large_array_send_recv_mpi
```

### 3. Broadcast Entire Array

- **Source File:** `sum_large_array_bcast_mpi.c`
- **Compile Command:**

```
mpicc -o sum_large_array_bcast_mpi sum_large_array_bcast_mpi.c
```

- **Run Command:**

```
mpirun -np 4 ./sum_large_array_bcast_mpi
```

## 4. Broadcast with Reduce

- **Source File:** `sum_large_array_bcast_reduce_mpi.c`
- **Compile Command:**

```
mpicc -o sum_large_array_bcast_reduce_mpi  
sum_large_array_bcast_reduce_mpi.c
```

- **Run Command:**

```
mpirun -np 4 ./sum_large_array_bcast_reduce_mpi
```

## Notes

- Replace `4` in the `mpirun` command with the number of processes you wish to use.
- Ensure MPI is installed and properly configured on your system or alternatively use the **Beckett4** server.