CS633 - Assignment 2

Group 42
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1 Explanation of Hierarchical Communication

We have assigned the leftmost process in each row as the leader. As processes in each row belong to a single row, the left-right communication remains unaffected. Only the top-bottom communication gets affected, for which we have used `MPI_Gather` and `MPI_Scatter` calls. Each process in the row sends its data to the leader using `MPI_Gather` call. Similarly, each process receives data from the leader using `MPI_Scatter` call. The leaders communicate using `MPI_Send` and `MPI_Recv` calls. Please refere to this figure[3]

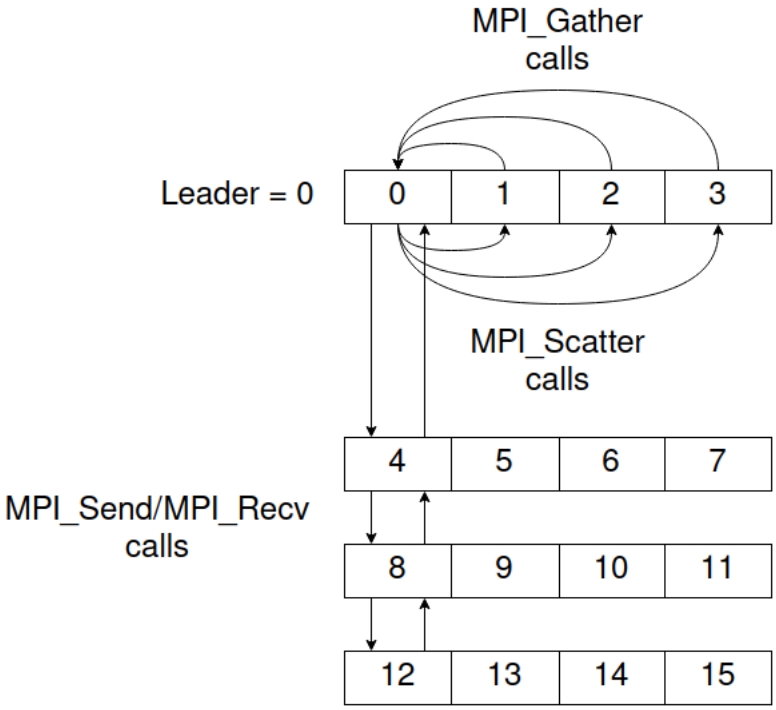

Figure 1: Heirarchical Communication among processes

Regarding mode of communication, we have used blocking `MPI_Send` and `MPI_Recv` calls. To avoid deadlock, we have used odd-even-communication pattern.

2 Timing plot

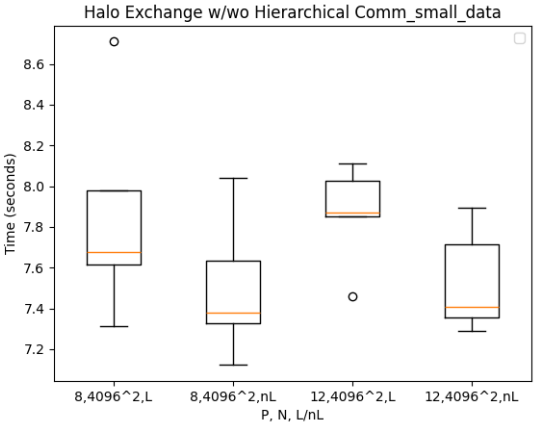

Figure 2: Time Plot-Small Data

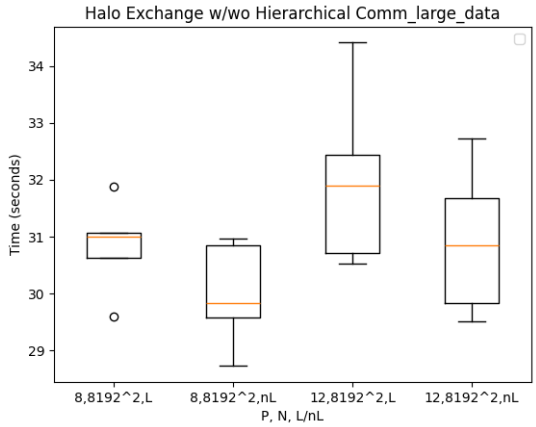

Figure 3: Time Plot-Large Data

3 Observations, Comparison and Reason

1. For 8 processes, we don't see a significant difference between the time taken by the processes. The time taken is a little less without hierarchical communication. We think that the possible reason for this is that the overhead caused by assigning leaders and then communicating through them has overshadowed the benefit that we are getting out of less inter-node communication involving one process (leader) per node. Coming over the size of data the time required increases as the size of data increases. This is obvious because as communication volume increases, the time required increases.

2. For 12 processes, nothing changes much except that the difference between the time required becomes clearer. There is a significant difference between the timing requirement without and with leader in both small as well as large data size. We think that the possible reason for this is that the overshadowing of benefit (as discussed above) is more prominent in this case as more processes are involved.

3. Regarding 8 and 12 processes, the timing increases. This is obvious because the more processes involved in communication and the more communication volume there is, the more time is required.

4. Finally, the order of time required is as follows: $(8, 4096{*}4096, \text{With leader}) < (12, 4096{*}4096, \text{With leader}) < (8, 8192{*}8192, \text{Without leader}) < (8, 8192{*}8192, \text{Without leader})$