CSCI5451 - Parallel Computing Assignment 2
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How I solve the problem

Assume I have 4 processors, and N = 16. Initially they generate list of numbers individually.

P0: 2 3 5 7
P1: 4 5 1 2
P2: 9 3 2 1
P3: 7 7 6 6

We randomly select the pivot from each processor

P1: 2, P2: 5, P3 9, P4: 6

Use MPI_Gather( ) and processor 0 gathers all of the pivots. Processor 0 sort it and broad the medium 6 using MPI_Bcast. Now every processor knows they should part the data with pivot 6.

P0: 2 3 5 / 7
P1: 4 5 1 2 /
P2: 3 2 1 / 9
P3: 6 6 / 7 7
The data in each processors are divided into two part, < and >= part.
Then we divide the communicators(processor) into two groups. (P0,P1) and (P2,P3). (P2,P3) send its < part to (P0,P1) and (P0,P1) send its >= part to (P2,P3). Specifically P0 - P2, P1 - P3.

This part using MPI_Send and MPI_Recv.

Now

P0: 2 3 5 3 2 1
P1: 4 5 1 2 6 6

P2: 9 7
P3: 7 7

Then recursively do the previous procedure in each group, until each group only have one communicator. Then naively quick sort it.

After quick sort. Every processor hold part of the array in order. And P0<=P1<=P2<=P3. So I finished the problem. Then use MPI_Send& MPI_Recv to

gather all of the data in processor with world rank 0. And Processor 0 use MPI_Scatter to make sure each processor has N/P elements.

Excution Time

	N = 10^6	N = 10^7	N = 10^8
P = 1	0.2813s	3.0506s	37.0299s
P = 2	0.3008s	2.1368s	28.4473s
P = 4	0.2804s	2.4349s	18.5802s
P = 8	0.0839s	1.0315s	15.6301s
P = 16	0.1235s	1.2213s	8.6602s