Assignment 3, Parallel Computing

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1 Setup Blue Gene/Q (BG/Q)

In CCI Blue Gene/Q system, the main steps of obtaining execution contains three steps: compile, srun, and sbatch.

(a) compile: one should load "xl" before using compiler "mpicc" in BG/Q. See below commands for compiling code "p2p.c" to executable file "p2p.xl".

```
module load xl
mpicc -g p2p.c -lm -o p2p.xl
```

(b) srun: The bash script file "run_p2p.sh" for srun is shown below, in which # of ranks (as every node contains 64 ranks) is passed to the filename of output.

```
#!/bin/sh
fname="output_"
let "rank = 64 * $1"
srun --ntasks-per-node=64 --overcommit -o "$fname$rank" \
/gpfs/u/home/PCP8/PCP8fngj/barn/p2p.xl
```

(c) sbatch: another bash script is applied to execute "srun" iteratively as we have to run with different MPI ranks. "n" is the number of nodes. Thus $n = 1$ corresponds to 64 ranks, and $n = 128$ corresponds to 8192 ranks.

```
#!/bin/sh
n=1
while [ "$n" -le 128 ]
do
if [ "$n" -lt 64 ]; then
    sbatch --partition debug --nodes "$n" --time 1 ./run_p2p.sh "$n"
elif [ "$n" -eq 64 ]; then
    sbatch --partition small --nodes 64 --time 1 ./run_p2p.sh 64
else
    sbatch --partition medium --nodes 128 --time 1 ./run_p2p.sh 128
fi
n=$(( n*2 ))
done
```

2 Collective - execution at different ranks

The execution versus number of ranks based on collective approach is shown in Table 1 and Figure 1 below, which indicates that execution time is decreasing with the increase rank number. Moreover, the execution time is reduced to its half when MPI ranks double every time. This is reasonable as when MPI ranks is doubled, the size of local array to be summed in each rank is reduced by half.

Table 1: Execution time of collective method at differnet MPI ranks

Rank	64	128	256	512	1024	2048	4096	8912
Execution	0.743647	0.372150	0.188339	0.094208	0.047130	0.023601	0.011818	0.005934

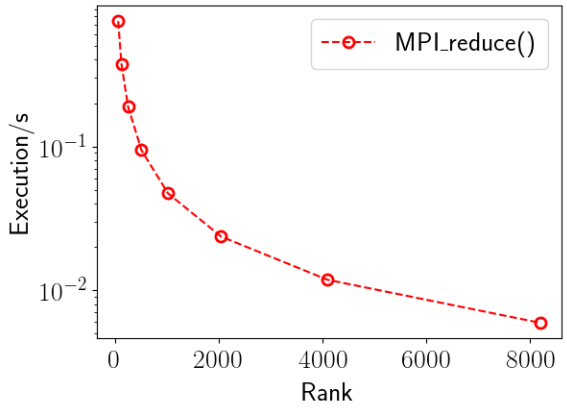

Figure 1: Execution time of collective method at differnet MPI ranks

3 Point2Point- execution at different ranks

The execution versus number of ranks based on point2point approach is shown in Figure 2 below, which has almost the same trend with collective method.

Table 2: Execution time of collective method at differnet MPI ranks

Rank	64	128	256	512	1024	2048	4096	8912
Execution	0.743647	0.372150	0.188339	0.094208	0.047130	0.023601	0.011818	0.005934

4 Compare two methods

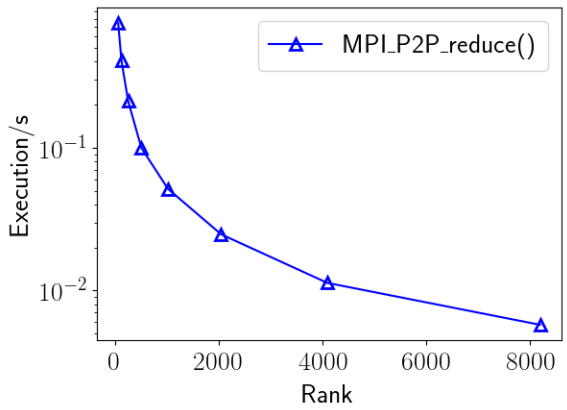

Figure 2: Execution time of Point2Point at differnet MPI ranks