

Final Year B. Tech., Sem VII 2022-23

High Performance Computing Lab

PRN: 2020BTECS00206

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Batch: B4

Assignment No. 11

Q1. Execute the all-to-all broadcast operation (Program C) with varying message sizes.

Plot the performance of the operation with varying message sizes from 1K to 10K (with constant number of processes, 8). Explain the performance observed.

Code:

```

1  #include <stdio.h>
2  #include <stdlib.h>
3  #include <time.h>
4  #include <mpi.h>
5
6  int main(int argc, char *argv[])
7  {
8      if (argc != 2)
9      {
10         printf("Usage : alltoall message_size\n");
11         return 1;
12     }
13     int rank;
14     int num_procs;
15     int size = atoi(argv[1]);
16     MPI_Init(&argc, &argv);
17     MPI_Comm_size(MPI_COMM_WORLD, &num_procs);
18     MPI_Comm_rank(MPI_COMM_WORLD, &rank);
19     int i;
20     char input_buffer[size * num_procs];
21     char recv_buffer[size * num_procs];
22     srand(time(NULL));
23     for (i = 0; i < size; i++)
24         input_buffer[i] = rand() % 256;
25     int j;
26     for (j = 1; j < num_procs; j++)
27     {
28         int k = 0;
29         for (i = j * size; i < j * size + size; i++)
30         {
31             input_buffer[i] = input_buffer[k];
32             k++;
33         }
34     }
35     double total_time = 0.0;
36     double start_time = 0.0;
37     for (i = 0; i < 100; i++)
38     {
39         MPI_Barrier(MPI_COMM_WORLD);
40         start_time = MPI_Wtime();
41         MPI_Alltoall(input_buffer, size, MPI_CHAR, recv_buffer, size, MPI_CHAR, MPI_COMM_WORLD);
42         MPI_Barrier(MPI_COMM_WORLD);
43         total_time += (MPI_Wtime() - start_time);
44     }
45     if (rank == 0)
46     {
47         printf("Average time for alltoall : %f secs\n", total_time / 100);
48     }
49     MPI_Finalize();
50 }
51

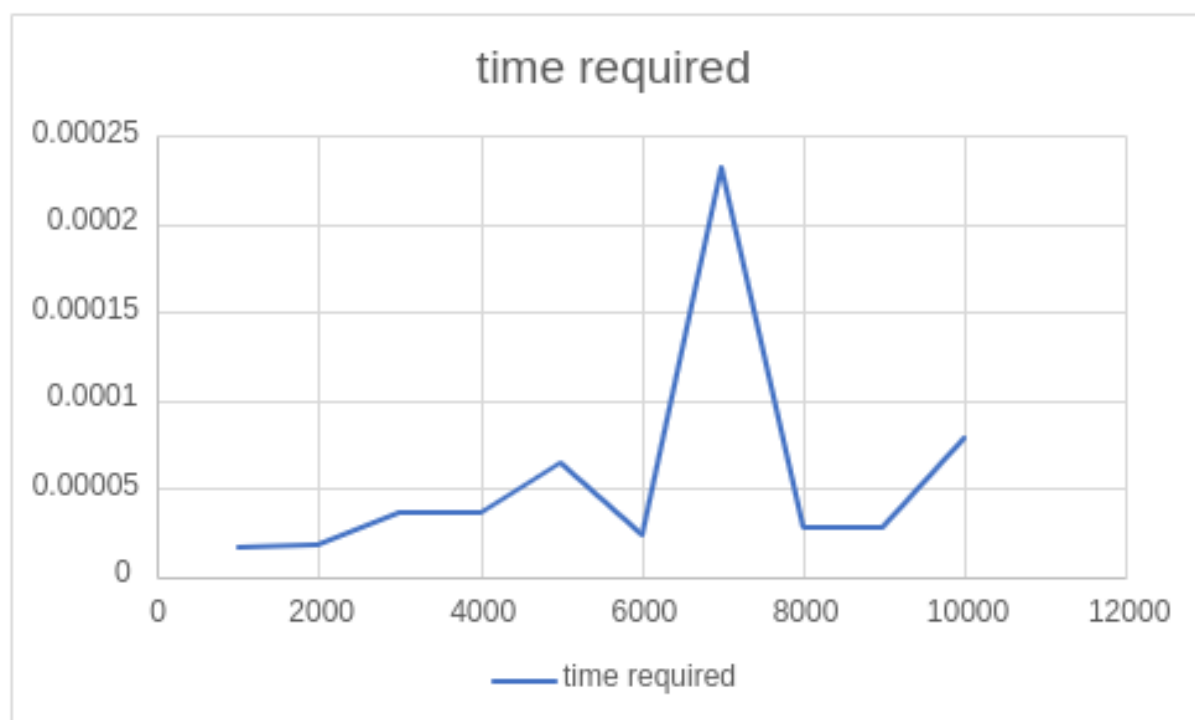
```

Output:

```

PROBLEMS 2 OUTPUT DEBUG CONSOLE TERMINAL JUPYTER
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpicc c.c -o c
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 8 ./c 1000
Average time for alltoall : 0.000016 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 8 ./c 2000
Average time for alltoall : 0.000018 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 8 ./c 3000
Average time for alltoall : 0.000036 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 8 ./c 4000
Average time for alltoall : 0.000036 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 8 ./c 5000
Average time for alltoall : 0.000065 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 8 ./c 6000
Average time for alltoall : 0.000023 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 8 ./c 7000
Average time for alltoall : 0.000232 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 8 ./c 8000
Average time for alltoall : 0.000028 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 8 ./c 9000
Average time for alltoall : 0.000027 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 8 ./c 10000
Average time for alltoall : 0.000078 secs
○ abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ █

```



Q2. Execute the all-reduce operation (Program D) with varying number of processes (1 to 16) and fixed message size of 10K words. Plot the performance of the operation with varying number of processes (with constant message size). Explain the performance observed.

Code:

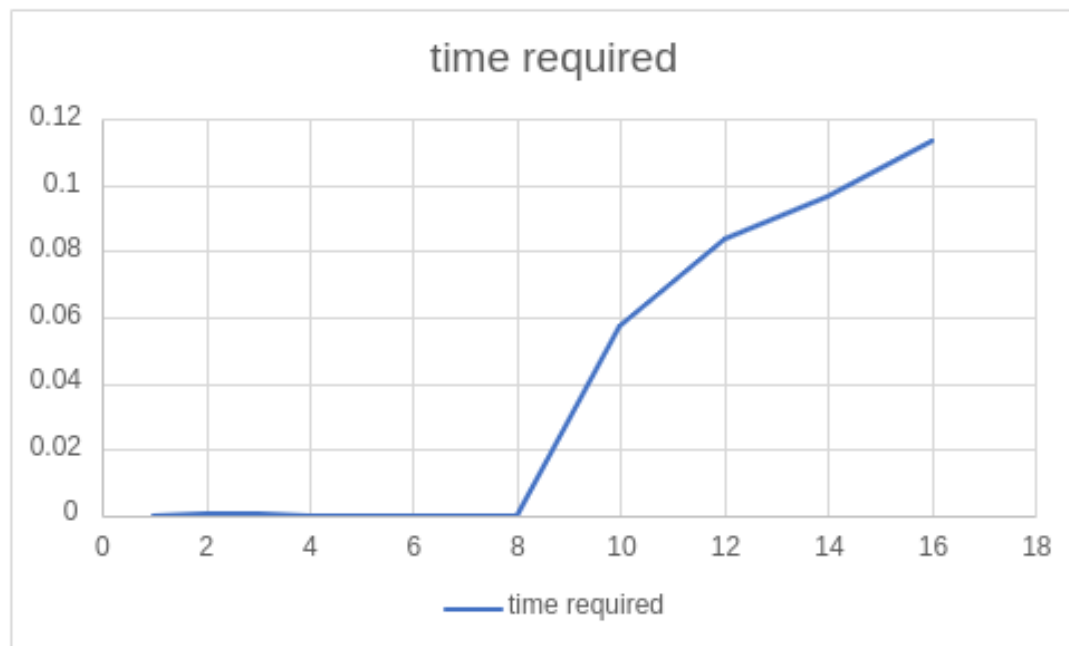
```
1  #include <stdio.h>
2  #include <stdlib.h>
3  #include <time.h>
4  #include <mpi.h>
5
6  int main(int argc, char *argv[])
7  {
8      if (argc != 2)
9      {
10         printf("Usage : allreduce message_size\n");
11         return 1;
12     }
13     int rank;
14     int size = atoi(argv[1]);
15     char input_buffer[size];
16     char recv_buffer[size];
17     MPI_Init(&argc, &argv);
18     MPI_Comm_rank(MPI_COMM_WORLD, &rank);
19     int i;
20     srand(time(NULL));
21     for (i = 0; i < size; i++)
22         input_buffer[i] = rand() % 256;
23     double total_time = 0.0;
24     double start_time = 0.0;
25     for (i = 0; i < 100; i++)
26     {
27         MPI_Barrier(MPI_COMM_WORLD);
28         start_time = MPI_Wtime();
29         MPI_Allreduce(input_buffer, recv_buffer, size, MPI_BYTE, MPI_BOR, MPI_COMM_WORLD);
30         MPI_Barrier(MPI_COMM_WORLD);
31         total_time += (MPI_Wtime() - start_time);
32     }
33     if (rank == 0)
34     {
35         printf("Average time for allreduce : %f secs\n", total_time / 100);
36     }
37     MPI_Finalize();
38 }
```

Output:

```

PROBLEMS 4 OUTPUT DEBUG CONSOLE TERMINAL JUPYTER
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpicc d.c -o d
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 1 ./d 10000
Average time for allreduce : 0.000000 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 2 ./d 10000
Average time for allreduce : 0.000139 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 3 ./d 10000
Average time for allreduce : 0.000107 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 4 ./d 10000
Average time for allreduce : 0.000025 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 6 ./d 10000
Average time for allreduce : 0.000035 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 8 ./d 10000
Average time for allreduce : 0.000030 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 10 ./d 10000
Average time for allreduce : 0.057176 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 12 ./d 10000
Average time for allreduce : 0.083971 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 14 ./d 10000
Average time for allreduce : 0.096794 secs
● abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ mpirun -np 16 ./d 10000
Average time for allreduce : 0.113726 secs
○ abhi@kingsman:~/Documents/Sem7/Assignment/HPC/Assignment11$ █

```



Github Link: <https://github.com/SavaliDesai4/HPC-Practicals>