

Class: Final Year (Computer Science and Engineering)

Year: 2022-23

Semester: 1

Course: High Performance Computing Lab

Practical No. 11

Exam Seat No : 2019BTECS00029

Name : Harshal Kodgire

Title of practical : Analysis of MPI Programs

Problem Statement 1:

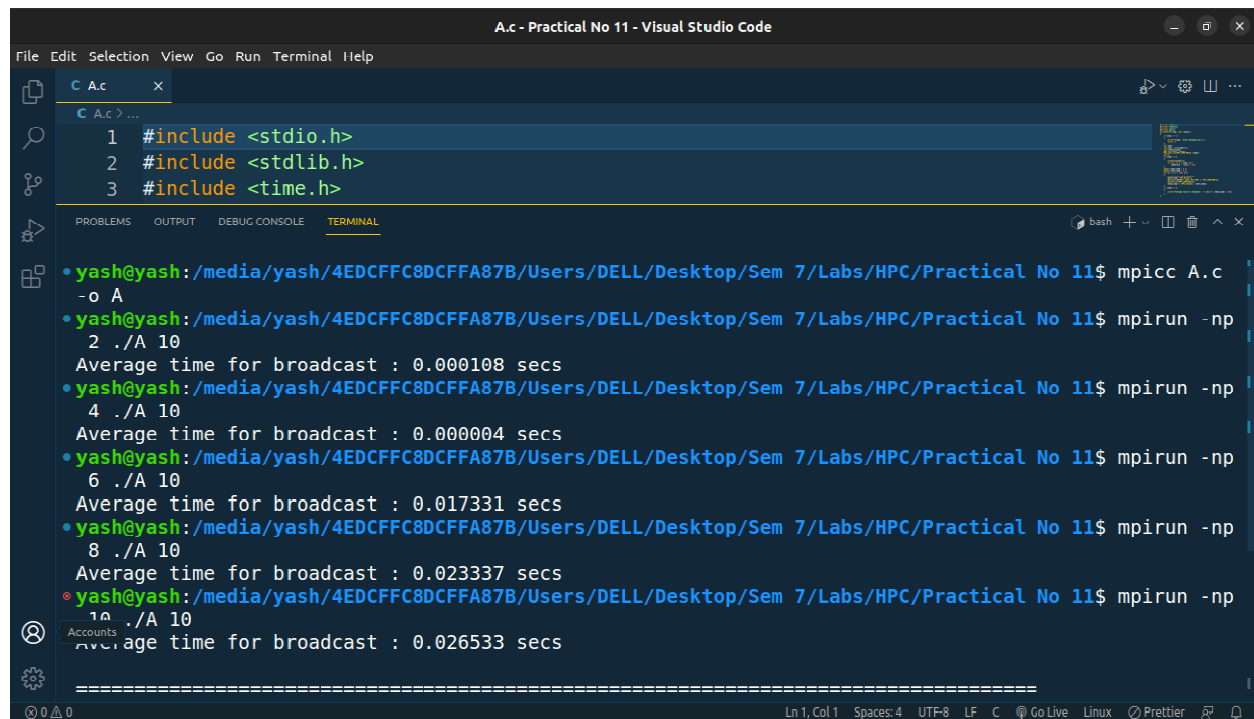
Execute the MPI program (Program A) with a fixed size broadcast. Plot the performance of the broadcast with varying numbers of processes (with constant messagesize). Explain the performance observed.

Screenshot 1:

```
#include<stdio.h>
#include<stdlib.h>
#include<time.h>
#include<mpi.h>
intmain(intargc,char*argv[])
{
    if(argc!=2)
    {
        printf("Usage : bcastmessage_size\n");
        return1;
    }
    int rank;
    int size =atoi(argv[1]);
    charbuffer[size];
```

```
MPI_Init(&argc,&argv);
MPI_Comm_rank(MPI_COMM_WORLD,&rank);
int i;
if(rank ==0)
{
    srand(time(NULL));
    for(i =0; i < size; i++)
        buffer[i]=rand()%256;
}
double total_time=0.0;
double start_time=0.0;
for(i =0; i <100; i++)
{
    MPI_Barrier(MPI_COMM_WORLD);
    start_time=MPI_Wtime();
    MPI_Bcast(buffer, size, MPI_CHAR,0, MPI_COMM_WORLD);
    MPI_Barrier(MPI_COMM_WORLD);
    total_time+=(MPI_Wtime()-start_time);
}
if(rank ==0)
{
    printf("Average time for broadcast :
%fsecs\n",total_time/100);
}
}
```

Screenshot 2:

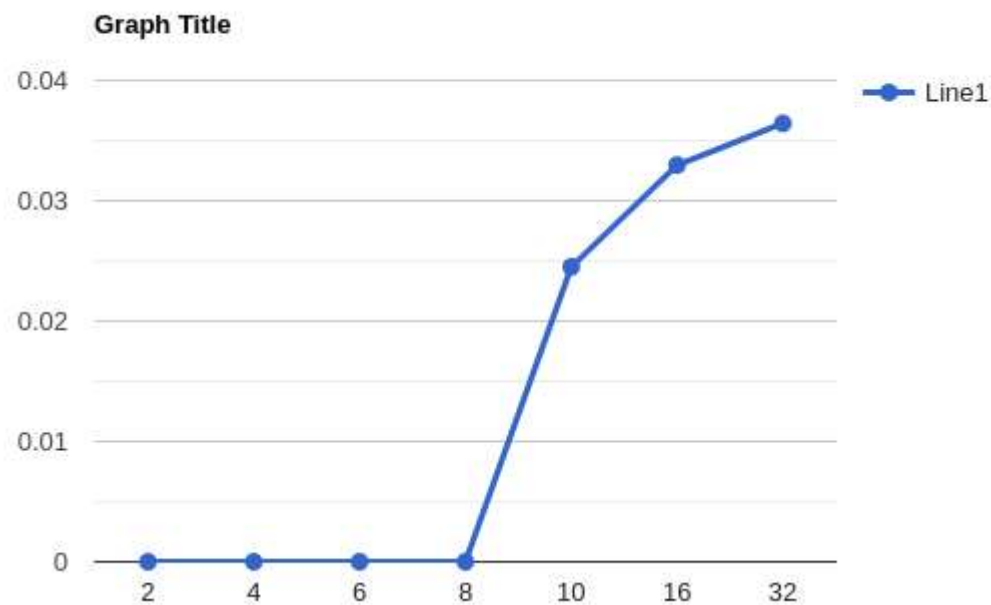


The screenshot shows a Visual Studio Code window titled "A.c - Practical No 11 - Visual Studio Code". The editor displays a C program with three include statements: `#include <stdio.h>`, `#include <stdlib.h>`, and `#include <time.h>`. The terminal window shows the compilation and execution of the program using `mpicc` and `mpirun`. The output shows the average time for broadcast for different numbers of processes (2, 4, 6, 8, 10, 16, 32). The time increases as the number of processes increases, starting from 0.000108 secs for 2 processes to 0.026533 secs for 32 processes.

```
1 #include <stdio.h>
2 #include <stdlib.h>
3 #include <time.h>

yash@yash:/media/yash/4EDCFFC8DCFFA87B/Users/DELL/Desktop/Sem 7/Labs/HPC/Practical No 11$ mpicc A.c
-o A
yash@yash:/media/yash/4EDCFFC8DCFFA87B/Users/DELL/Desktop/Sem 7/Labs/HPC/Practical No 11$ mpirun -np 2 ./A 10
Average time for broadcast : 0.000108 secs
yash@yash:/media/yash/4EDCFFC8DCFFA87B/Users/DELL/Desktop/Sem 7/Labs/HPC/Practical No 11$ mpirun -np 4 ./A 10
Average time for broadcast : 0.000004 secs
yash@yash:/media/yash/4EDCFFC8DCFFA87B/Users/DELL/Desktop/Sem 7/Labs/HPC/Practical No 11$ mpirun -np 6 ./A 10
Average time for broadcast : 0.017331 secs
yash@yash:/media/yash/4EDCFFC8DCFFA87B/Users/DELL/Desktop/Sem 7/Labs/HPC/Practical No 11$ mpirun -np 8 ./A 10
Average time for broadcast : 0.023337 secs
yash@yash:/media/yash/4EDCFFC8DCFFA87B/Users/DELL/Desktop/Sem 7/Labs/HPC/Practical No 11$ mpirun -np 10 ./A 10
Average time for broadcast : 0.026533 secs
```

Screenshot 3:



Problem Statement 2:

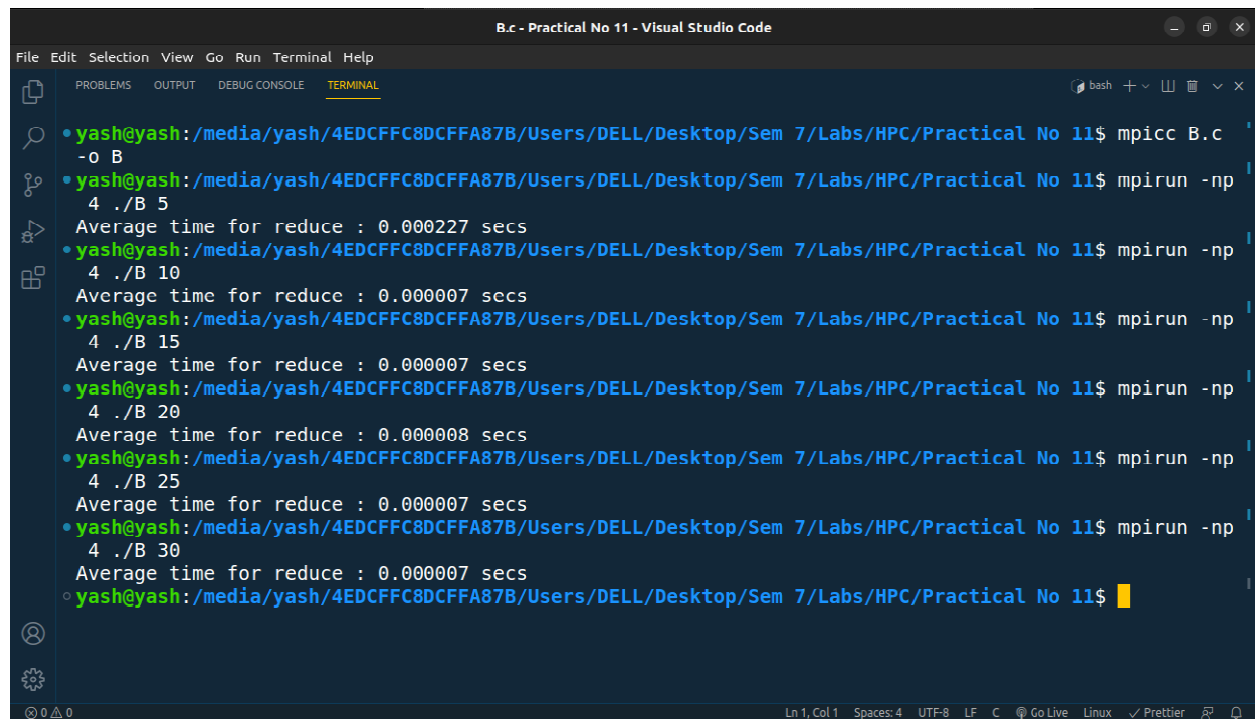
Repeat problem 2 above with varying message sizes for reduction (Program B). Explain the observed performance of the reduction operation.

Screenshot 4:

```
#include<stdio.h>
#include<stdlib.h>
#include<time.h>
#include<mpi.h>
intmain(intargc,char*argv[])
{
    if(argc!=2)
    {
        printf("Usage : reduce message_size\n");
        return1;
    }
    int rank;
    int size =atoi(argv[1]);
    charinput_buffer[size];
    charoutput_buffer[size];
    MPI_Init(&argc,&argv);
    MPI_Comm_rank(MPI_COMM_WORLD,&rank);
    int i;
    srand(time(NULL));
    for(i =0; i < size; i++)
        input_buffer[i]=rand()%256;
    doubletotal_time=0.0;
    doublestart_time=0.0;
```

```
for(i =0; i <100; i++)  
{  
    MPI_Barrier(MPI_COMM_WORLD);  
    start_time=MPI_Wtime();  
    MPI_Reduce(input_buffer,output_buffer, size, MPI_BYTE,  
MPI_BOR,0, MPI_COMM_WORLD);  
    MPI_Barrier(MPI_COMM_WORLD);  
    total_time+=(MPI_Wtime()-start_time);  
}  
if(rank ==0)  
{  
    printf("Average time for reduce : %fsecs\n",total_time/100);  
}  
}
```

Screenshot 5:



```
B.c - Practical No 11 - Visual Studio Code  
File Edit Selection View Go Run Terminal Help  
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL  
yash@yash:/media/yash/4EDCFFC8DCFFA87B/Users/DELL/Desktop/Sem 7/Labs/HPC/Practical No 11$ mpicc B.c -o B  
yash@yash:/media/yash/4EDCFFC8DCFFA87B/Users/DELL/Desktop/Sem 7/Labs/HPC/Practical No 11$ mpirun -np 4 ./B 5  
Average time for reduce : 0.000227 secs  
yash@yash:/media/yash/4EDCFFC8DCFFA87B/Users/DELL/Desktop/Sem 7/Labs/HPC/Practical No 11$ mpirun -np 4 ./B 10  
Average time for reduce : 0.000007 secs  
yash@yash:/media/yash/4EDCFFC8DCFFA87B/Users/DELL/Desktop/Sem 7/Labs/HPC/Practical No 11$ mpirun -np 4 ./B 15  
Average time for reduce : 0.000007 secs  
yash@yash:/media/yash/4EDCFFC8DCFFA87B/Users/DELL/Desktop/Sem 7/Labs/HPC/Practical No 11$ mpirun -np 4 ./B 20  
Average time for reduce : 0.000008 secs  
yash@yash:/media/yash/4EDCFFC8DCFFA87B/Users/DELL/Desktop/Sem 7/Labs/HPC/Practical No 11$ mpirun -np 4 ./B 25  
Average time for reduce : 0.000007 secs  
yash@yash:/media/yash/4EDCFFC8DCFFA87B/Users/DELL/Desktop/Sem 7/Labs/HPC/Practical No 11$ mpirun -np 4 ./B 30  
Average time for reduce : 0.000007 secs  
yash@yash:/media/yash/4EDCFFC8DCFFA87B/Users/DELL/Desktop/Sem 7/Labs/HPC/Practical No 11$
```

Screenshot 6:

