Computer Science & Engineering

CSE4001

Parallel and Distributed Computing

LAB ASSIGNMENT 10

Submitted to **Prof. DEEBAK B.D.**

TOPIC: PROBLEMS USING MPI

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QUESTION – I

Assume the variable rank contains the process rank and root is 3. What will be stored in array b [ ] on each of four processes if each executes the following code fragment?

int b [4] = {0 , 0 , 0 , 0};

MPI_Gather (& rank , 1 , MPI_INT , b , 1 , MPI_INT , root ,MPI_COMM_WORLD);

Hint. The function prototype is as follows:

```
int MPI_Gather (
void * sendbuf ,              // pointer to send buffer

int sendcount ,               // number of items to send

MPI_Datatype sendtype ,       // type of send buffer data

void * recvbuf ,              // pointer to receive buffer

int recvcount ,               // items to receive per process

MPI_Datatype recvtype ,       // type of receive buffer data

int root ,                    // rank of receiving process

MPI_Comm comm )               // MPI communicator to use
```

SOURCE CODE:

```
#include <mpi.h>
#include <stdio.h>
#include <stdlib.h>

int main(int argc, char** argv) {

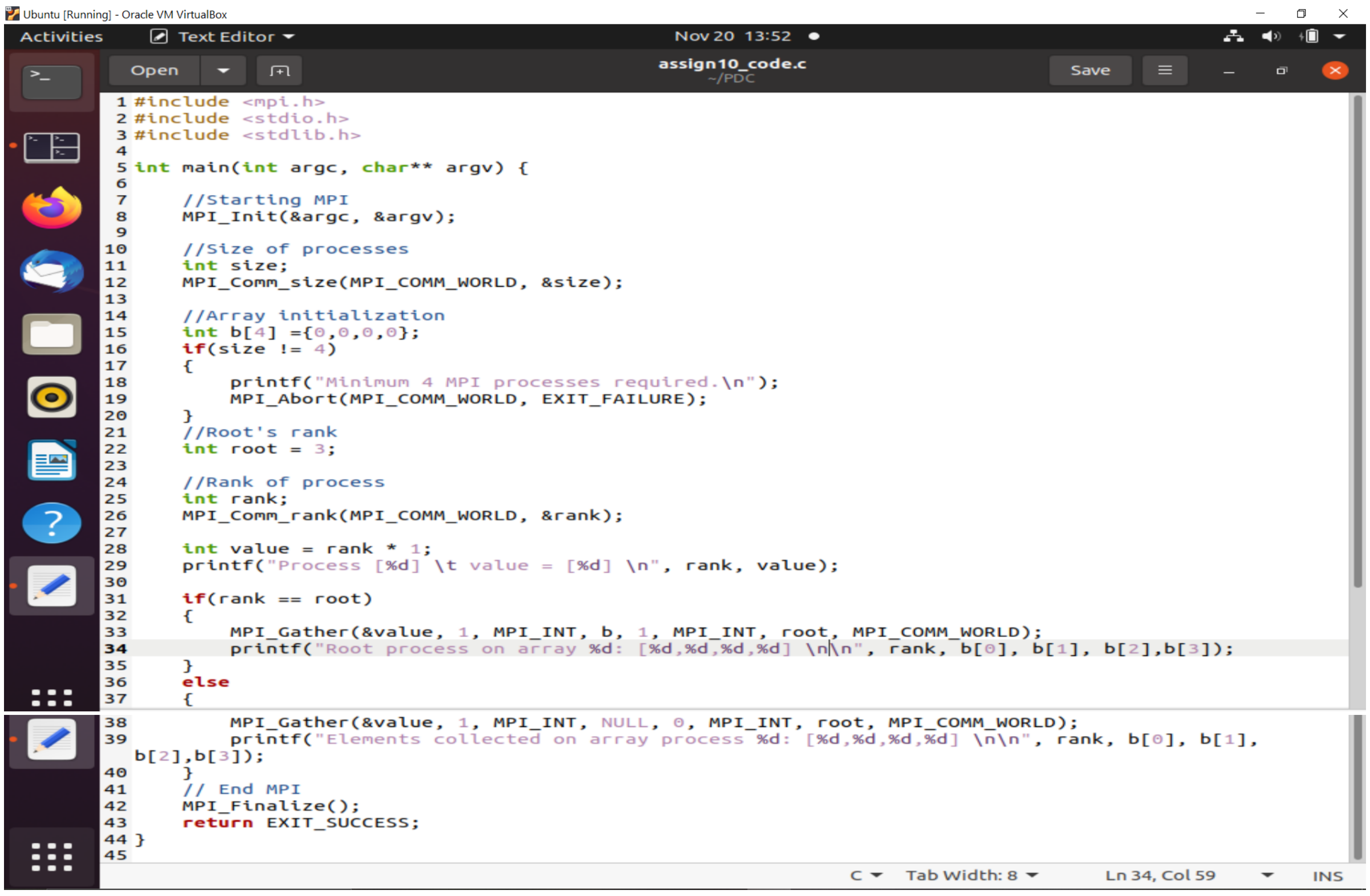
    //Starting MPI
    MPI_Init(&argc, &argv);

    //Size of processes
    int size;
    MPI_Comm_size(MPI_COMM_WORLD, &size);

    //Array initialization
    int b[4] ={0,0,0,0};
    if(size != 4)
    {
        printf("Minimum 4 MPI processes required.\n");
        MPI_Abort(MPI_COMM_WORLD, EXIT_FAILURE);
    }
    //Root's rank
    int root = 3;
    //Rank of process
    int rank;
    MPI_Comm_rank(MPI_COMM_WORLD, &rank);

    int value = rank * 1;
    printf("Process [%d] \t value = [%d] \n", rank, value);

    if(rank == root)
    {
        MPI_Gather(&value, 1, MPI_INT, b, 1, MPI_INT, root, MPI_COMM_WORLD);
        printf("Root process on array %d: [%d,%d,%d,%d] \n\n", rank, b[0],
b[1], b[2],b[3]);
    }
    else
    {
        MPI_Gather(&value, 1, MPI_INT, NULL, 0, MPI_INT, root,
MPI_COMM_WORLD);
        printf("Elements collected on array process %d: [%d,%d,%d,%d] \n\n",
rank, b[0], b[1], b[2],b[3]);
    }
    // End MPI
    MPI_Finalize();
    return EXIT_SUCCESS;
}
```



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    //Root's rank
    int root = 3;

    //Rank of process
    int rank;
    MPI_Comm_rank(MPI_COMM_WORLD, &rank);

    int value = rank * 1;
    printf("Process [%d] \t value = [%d] \n", rank, value);

    if(rank == root)
    {
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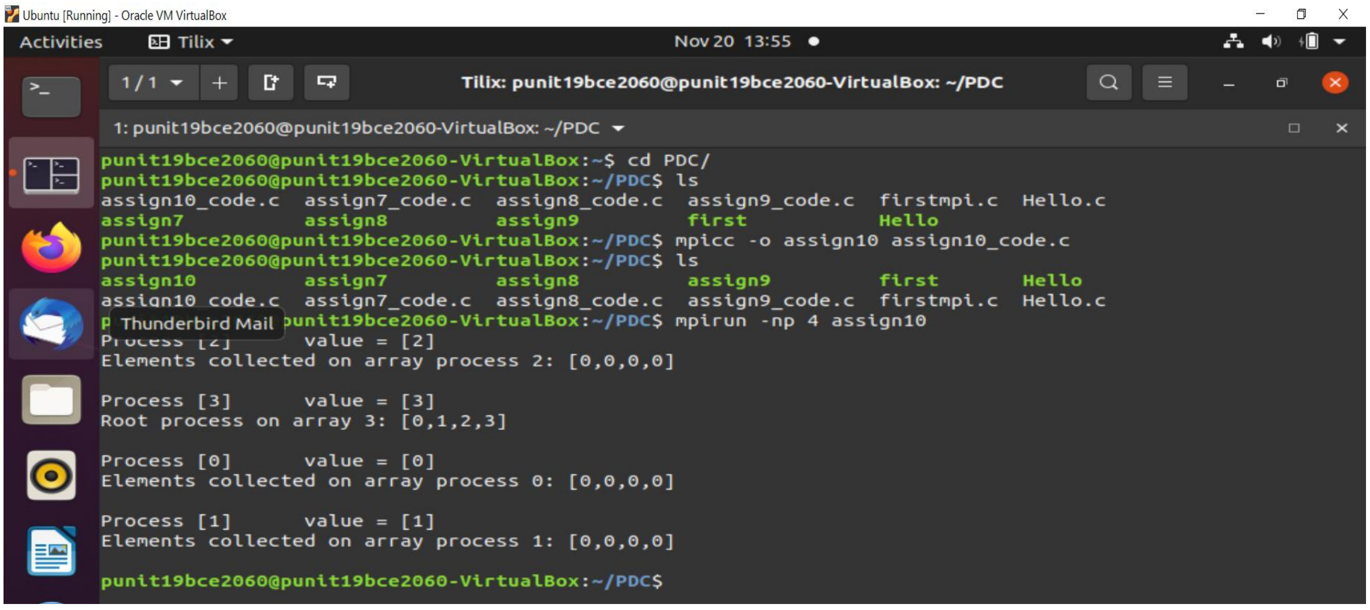
        printf("Root process on array %d: [%d,%d,%d,%d] \n\n", rank, b[0], b[1], b[2],b[3]);
    }
    else
    {
        MPI_Gather(&value, 1, MPI_INT, NULL, 0, MPI_INT, root, MPI_COMM_WORLD);
        printf("Elements collected on array process %d: [%d,%d,%d,%d] \n\n", rank, b[0], b[1],
b[2],b[3]);
    }
    // End MPI
    MPI_Finalize();
    return EXIT_SUCCESS;
}
```

EXECUTION:


Ubuntu [Running] - Oracle VM VirtualBox
Activities
Tilix
Nov 20 13:55
1 / 1
Tilix: punit19bce2060@punit19bce2060-VirtualBox: ~/PDC
1: punit19bce2060@punit19bce2060-VirtualBox: ~/PDC
Thunderbird Mail

```
punit19bce2060@punit19bce2060-VirtualBox:~$ cd PDC/
punit19bce2060@punit19bce2060-VirtualBox:~/PDC$ ls
assign10_code.c  assign7_code.c  assign8_code.c  assign9_code.c  firstmpi.c  Hello.c
assign7          assign8         assign9         first           Hello
punit19bce2060@punit19bce2060-VirtualBox:~/PDC$ mpicc -o assign10 assign10_code.c
punit19bce2060@punit19bce2060-VirtualBox:~/PDC$ ls
assign10         assign7         assign8         assign9         first       Hello
assign10_code.c  assign7_code.c  assign8_code.c  assign9_code.c  firstmpi.c  Hello.c
punit19bce2060@punit19bce2060-VirtualBox:~/PDC$ mpirun -np 4 assign10
Process [2]      value = [2]
Elements collected on array process 2: [0,0,0,0]

Process [3]      value = [3]
Root process on array 3: [0,1,2,3]

Process [0]      value = [0]
Elements collected on array process 0: [0,0,0,0]

Process [1]      value = [1]
Elements collected on array process 1: [0,0,0,0]

punit19bce2060@punit19bce2060-VirtualBox:~/PDC$
```

REMARKS:

- ✓ b [0, 0, 0, 0] is an array.
- ✓ The minimal number of processes necessary for the execution of program is equal to the number of array items, which is 4, in this case.
- ✓ The software will provide an error if the number of processes is fewer than 4.
- ✓ Process 3 is assigned as the root.
- ✓ We may use the MPI Gather function to find the array items stored in the supplied array on each of four processes.
- ✓ It Assembles data from all members of a group and distributes it to a single individual.
- ✓ As a result of this, we can see that the array items are shown on all processes except the root one. The process numbers are presented in the root process.