

Assignment 03:

To develop a distributed system, to find the sum of N elements in an array by distributing N/n elements to n number of processors MPI or OpenMP. Demonstrate by displaying the intermediate sums calculated at different processors.

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

int main(int argc, char **argv) {
    int rank, size;
    int N = 10; // total number of elements
    int n = 4; // number of processors
    int* arr = malloc(sizeof(int) * N); // allocate memory for the array
    int i, local_sum = 0, global_sum = 0;

    // initialize the array with sequential values
    for (i = 0; i < N; i++) {
        arr[i] = i + 1;
    }

    MPI_Init(&argc, &argv);
    MPI_Comm_rank(MPI_COMM_WORLD, &rank);
    MPI_Comm_size(MPI_COMM_WORLD, &size);

    if (size != n) {
        printf("Error: must run with %d processes\n", n);
        MPI_Finalize();
        return 1;
    }

    // calculate the local sum
    int start = rank * N / size;
    int end = (rank + 1) * N / size;
    for (i = start; i < end; i++) {
        local_sum += arr[i];
    }

    // reduce the local sums to get the global sum
    MPI_Reduce(&local_sum, &global_sum, 1, MPI_INT, MPI_SUM, 0, MPI_COMM_WORLD);

    // send the local sum to process 0
    if (rank != 0) {
        MPI_Send(&local_sum, 1, MPI_INT, 0, 0, MPI_COMM_WORLD);
    } else {
        // process 0 receives the local sums and prints the intermediate and final results
        printf("Rank %d local sum: %d\n", rank, local_sum);
        for (i = 1; i < size; i++) {
```

```

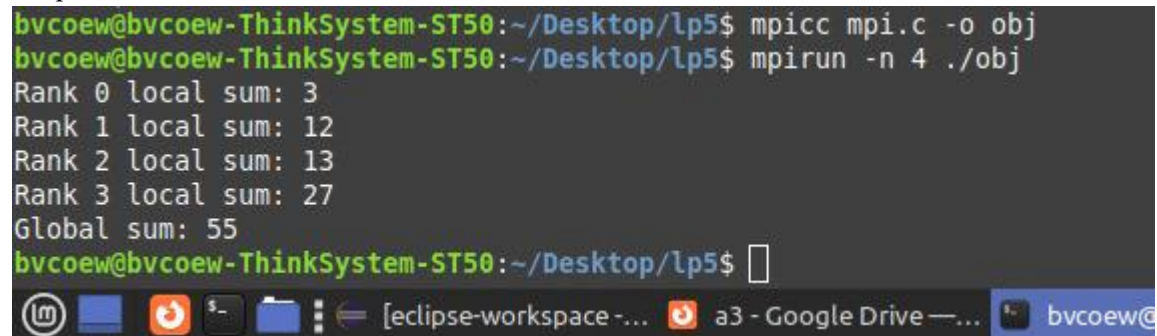
        MPI_Recv(&local_sum, 1, MPI_INT, i, 0, MPI_COMM_WORLD,
MPI_STATUS_IGNORE);
        printf("Rank %d local sum: %d\n", i, local_sum);
    }
    printf("Global sum: %d\n", global_sum);
    fflush(stdout);
}

MPI_Finalize();
free(arr);

return 0;
}

```

Output:



A terminal window screenshot showing the execution of an MPI program. The user is at a prompt on a system named 'bvcoew@bvcoew-ThinkSystem-ST50'. They compile the program 'mpi.c' using 'mpicc' and then run it with 'mpirun -n 4 ./obj'. The output shows four ranks reporting their local sums: Rank 0 (3), Rank 1 (12), Rank 2 (13), and Rank 3 (27). The final line shows the 'Global sum: 55'. The terminal window has a taskbar at the bottom with icons for a terminal, a folder, and a web browser, along with the text '[eclipse-workspace -... a3 - Google Drive —... bvcoew@'.

```

bvcoew@bvcoew-ThinkSystem-ST50:~/Desktop/lp5$ mpicc mpi.c -o obj
bvcoew@bvcoew-ThinkSystem-ST50:~/Desktop/lp5$ mpirun -n 4 ./obj
Rank 0 local sum: 3
Rank 1 local sum: 12
Rank 2 local sum: 13
Rank 3 local sum: 27
Global sum: 55
bvcoew@bvcoew-ThinkSystem-ST50:~/Desktop/lp5$

```