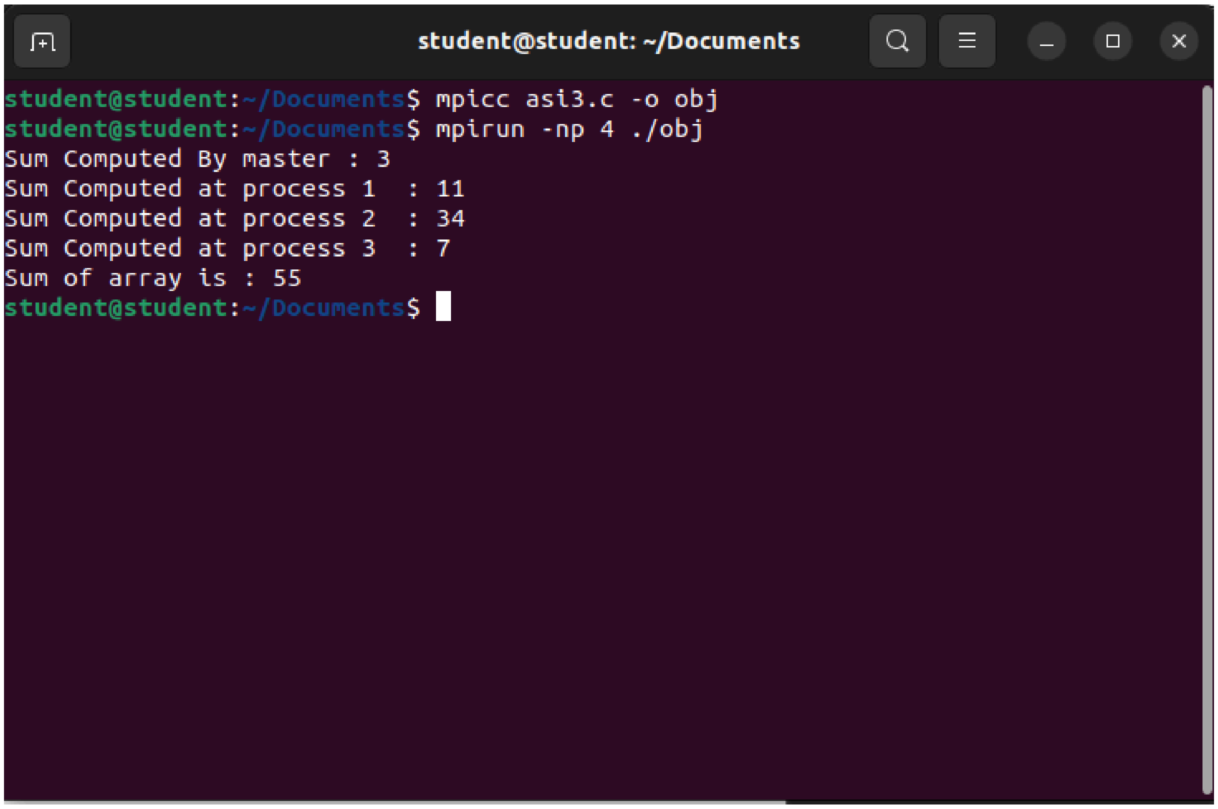
Assignment No.: 3

Code:

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

// size of array
#define n 10

int a[] = { 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 };

// Temporary array for slave process
int a2[1000];

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

    int pid, np,
        elements_per_process,
        n_elements_recieved;
    // np -> no. of processes
    // pid -> process id

    MPI_Status status;

    // Creation of parallel processes
    MPI_Init(&argc, &argv);

    // find out process ID,
    // and how many processes were started
    MPI_Comm_rank(MPI_COMM_WORLD, &pid);
    MPI_Comm_size(MPI_COMM_WORLD, &np);

    // master process
    if (pid == 0) {
        int index, i;
        elements_per_process = n / np;

        // check if more than 1 processes are run
        if (np > 1) {
            // distributes the portion of array
            // to child processes to calculate
            // their partial sums
            for (i = 1; i < np - 1; i++) {
                index = i * elements_per_process;

                MPI_Send(&elements_per_process,
                                        1, MPI_INT, i, 0,
                                        MPI_COMM_WORLD);
                        MPI_Send(&a[index],
                                        elements_per_process,
                                        MPI_INT, i, 0,
                                        MPI_COMM_WORLD);
                }

                // last process adds remaining elements
                index = i * elements_per_process;
                int elements_left = n - index;

                MPI_Send(&elements_left,
                                1, MPI_INT,
                                i, 0,
                                MPI_COMM_WORLD);
                MPI_Send(&a[index],
                                elements_left,
                                MPI_INT, i, 0,
                                MPI_COMM_WORLD);
        }

        // master process add its own sub array
        int sum = 0;
        for (i = 0; i < elements_per_process; i++)
                sum += a[i];
                printf("Sum Computed By master : %d",sum);

        // collects partial sums from other processes
        int tmp;
        for (i = 1; i < np; i++) {
                MPI_Recv(&tmp, 1, MPI_INT,
                                MPI_ANY_SOURCE, 0,
                                MPI_COMM_WORLD,
                                &status);
                int sender = status.MPI_SOURCE;
                printf("\nSum Computed at process %d  : %d",i,tmp);
                sum += tmp;
        }

        // prints the final sum of array
        printf("\nSum of array is : %d\n", sum);
    }
    // slave processes
    else {
        MPI_Recv(&n_elements_recieved,
                        1, MPI_INT, 0, 0,
                        MPI_COMM_WORLD,
                        &status);
```

```
            // stores the received array segment
            // in local array a2
            MPI_Recv(&a2, n_elements_recieved,
                            MPI_INT, 0, 0,
                            MPI_COMM_WORLD,
                            &status);

            // calculates its partial sum
            int partial_sum = 0;
            for (int i = 0; i < n_elements_recieved; i++)
                partial_sum += a2[i];

            // sends the partial sum to the root process
            MPI_Send(&partial_sum, 1, MPI_INT,
                            0, 0, MPI_COMM_WORLD);
        }

        // cleans up all MPI state before exit of process
        MPI_Finalize();

        return 0;
    }
```

Output:



```
student@student:~/Documents$ mpicc asi3.c -o obj
student@student:~/Documents$ mpirun -np 4 ./obj
Sum Computed By master : 3
Sum Computed at process 1  : 11
Sum Computed at process 2  : 34
Sum Computed at process 3  : 7
Sum of array is : 55
student@student:~/Documents$
```