Università della Svizzera italiana

Institute of Computational Science ICS

High Performance Computing **2019**

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Solution for Assignment 5

Due date: 29 November 2019, 23:55

Parallel Programming with MPI

This assignment will introduce you to parallel programming using MPI. You will implement simple message exchange, compute a process topology and parallelize computation of the Mandelbrot set.

1. Exchange of the ghost cells *(40 Points)*

- The cartesian 2D communicator was created with periodic boundaries as such:

```
MPI_Cart_create(MPI_COMM_WORLD, 2, dims, periods, 0, &cart_comm);
```

Figure 1. Creation of the cartesian communicator

- Follows now the declaration of the *ghost_ data* type:

```
MPI_Type_vector(SUBDOMAIN, 1, 0, MPI_DOUBLE, &data_ghost);
MPI_Type_commit(&data_ghost);
```

Figure 2. Creation of the *ghost_ data*

2. Parallelizing the Mandelbrot Set with MPI *(60 Points)*

```
usi@usis-MacBook-Pro ~/I/H/M/ghost> mpirun -np 16 --oversubscribe ./ghost
data of rank 9 after communication
9.0 5.0 5.0 5.0 5.0 5.0 5.0 9.0
8.0 9.0 9.0 9.0 9.0 9.0 9.0 10.0
8.0 9.0 9.0 9.0 9.0 9.0 9.0 10.0
8.0 9.0 9.0 9.0 9.0 9.0 9.0 10.0
8.0 9.0 9.0 9.0 9.0 9.0 9.0 10.0
8.0 9.0 9.0 9.0 9.0 9.0 9.0 10.0
8.0 9.0 9.0 9.0 9.0 9.0 9.0 10.0
9.0 13.0 13.0 13.0 13.0 13.0 13.0 9.0
```

Figure 3. Result after finishing the implementation