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Introductory School on Parallel Programming and Parallel Architecture for High-Performance Computing

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Think Parallel!

- In this two week activity, we learned a lot about the parallel programming.
- We were lucky to have great teachers and experts, who taught us the key concepts of parallel programming and guided us in the daily lab work.
- Some of the basic approaches regarding the parallel programming that I learned in this school includes:

➢ The modern High Performance Computing Architecture

➢ Sequential vs pipelining data processing

➢ The cache memory, cache miss and cache hit

➢ Multi-language programming and code optimization

➢ The OMP programming and MPI

➢ Use of built-in libraries for problem-solving

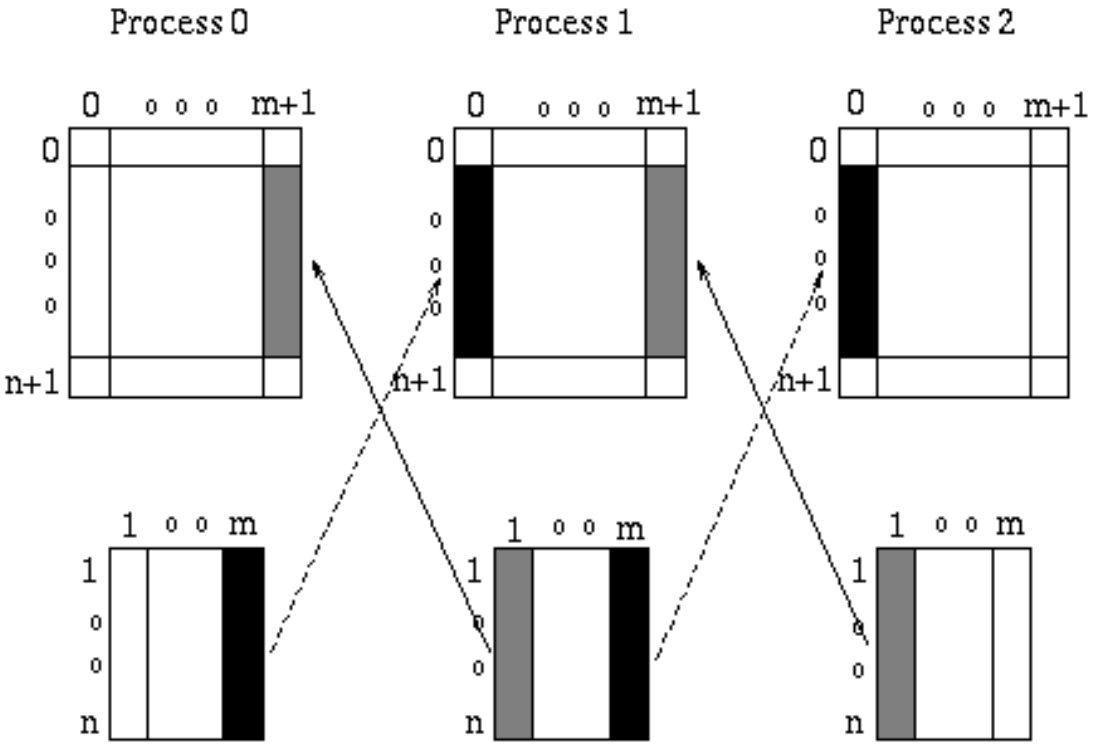
Jacobi Iteration Project

➢ I have been working on the Jacobi iteration problem (in FORTRAN);
I compiled and run the 1D-MPI program (still some errors in the output matrix).

➢ Methodology:

- I divided the domain as; block_size=DIM/SIZE
- Allocate the matrix to each block and initialized it.
- I used ghost cell through Non-Blocking ISend and IRecv for sharing border data.

1D partition



Potential Applications of Parallel Computation in My Research

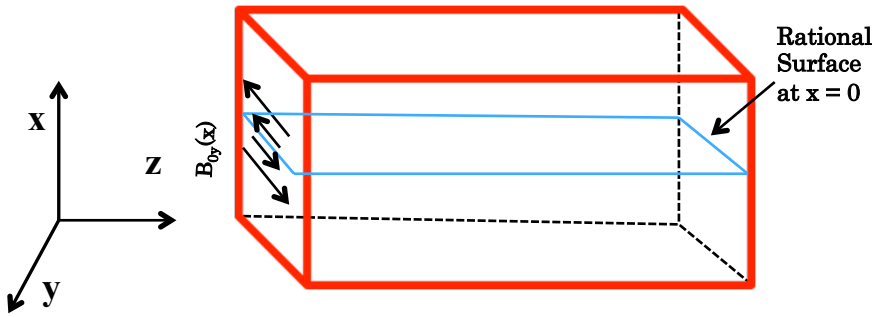
➢ The reduced Magneto-Hydro-Dynamic (MHD) model

Flux equation: $$\frac{\partial \psi}{\partial t} = -[\phi, \psi] + \eta \nabla^2 \psi$$

Vorticity equation: $$\frac{\partial \nabla^2 \phi}{\partial t} = -[\phi, \nabla^2 \varphi] + [\psi, \nabla^2 \psi] + \mu \nabla^2 (\nabla^2 \phi)$$

➢ Numerical scheme

- Radial finite difference with fixed boundary;
- Spectral (pseudo) decomposition in y direction
- x-direction : 2048 mesh numbers, $\Delta x = 0.0048$
- y-direction : up to 100 Fourier modes



➢ Implementation of MPI in the Code:

➢ I hope to parallelize the existing code first with the OMP, for the heavy-calculation parts.

➢ Then, I will try with MPI

➢ This course will be of great help for me to understand and use the parallelized MHD and PIC codes for plasma simulations in near future!

Thank You Very Much For Your Attention!