COMPUTAÇÃO DE ALTO DESEMPENHO

2022/2023
Project 2 – MPI
Deadline: 18 December 2022

Review the heat diffusion problem from Project 1. Now consider the design, implementation, optimization and evaluation of a solution using MPI for a cluster of computers.

Again, the main objective is to achieve the best performance, particularly for bigger resolutions and simulated time spans. For convenience, this work can be divided in several stages (number 5 is mandatory):

1. (30%) Implement a MPI solution that
    a. Parallelizes the heat diffusion computation.
    b. Experiment with different parallel strategies for data distribution and communication patterns.
    c. Allow, as before, two types of results: getting just the final state at the end of simulation; and getting the surface state at each number of interactions as defined by parameter *outputEvery*.

2. (30%) Evaluate these solutions
    a. against the original sequential version
    b. evaluate your solution scalability with a fixed workload for 1, 2, 4… 32 cpu.
    c. try with output image every 10000 steps or just at the end.

    Note: use a relevant workload. Try computing with parameters: *nx=ny=200, h=0.005, numSteps=100000*. If relevant, use different parameters

3. (10%) Try to complement your solution with the ability to overlap computation with communication, when the intermediate images are requested.

4. (10%) Evaluate the previous solution against the others as in stage 2.

5. (20%) Write a report (max of 5 pages A4 11pt font) that presents
    a. Tested approaches and final (best) solution
    b. Relevant implementation details
    c. Your evaluation results (include times and/or graphs to compare and justify your solution)
    d. An analysis and interpretation of all these results

The report, in pdf format, and final solution source code, should also be delivered in a zip file by email.

Other relevant optimizations may also be accounted in the final grade.

Bibliography:

Chapter 3, Distributed memory programming with MPI, from “An Introduction to Parallel Programming”, Pacheco and Malensek, 2nd Ed.

Open-MPI documentation, https://www.open-mpi.org/doc/current/

MPI Tutorial, https://hpc-tutorials.llnl.gov/mpi/