

Mini-project 2015 Instructions

1. - A brief description of the serial application and its serial computational complexity: $O(n)$, $O(n \log n)$..
 - Complexity of ratio “computation to communication time” for the parallel application
 - Amdahl’s law giving a theoretical upper bound (without accounting for the data transfers)
 - Amdahl’s law giving a more accurate upper bound by accounting for the data transfers, especially during the initialization phase.
2. – Select a parallelization strategy and justify it
 - Select one or several parallelization frameworks: DPS multi-node, MPI multi-node, OpenMP multi-core, CUDA multi-core (OpenMP alone is not enough)
 - Establish the flowgraph (DPS), the sequence of message passing (MPI) & processing operations, the sequence of processing operations (OpenMP) or the sequence of memory transfers and processing operations (CUDA)
 - Establish an approximative timing diagram of the parallel application by performing a few measurements and/or calculations (execution times, network transfer times, memory transfer times, etc..).
 - Derive the critical path and establish a theoretical speedup formula as a function of the number of processors (DPS & MPI: nodes, OpenMP: cores, CUDA: multiples of 32 cores)
3. Implement the selected parallelization scheme
4. - Evaluate the performance of the application on at least 1, 2, 4, 8, 16 distributed memory nodes (DPS, MPI), with OpenMP on 1, 2, 4, 8, 16, 32 cores or with CUDA, with 32, 64, 96, 128, 160, 192 data threads (cores), for different sizes of the dataset.
 - Draw a speedup graph combining the practical absolute (in respect to a serial execution), relative (in respect to a parallel execution on a single node (or warp)) and the theoretical speedup, as well as the upper bound speedup derived from Amdahl’s law. Mention the reference serial execution time.
 - Draw a speedup graph for different data sizes
 - Explain the difference between predicted and measured speedups.

The *theoretical prediction report* must contain parts 1 to 2. The final report comprises the improved theoretical prediction report as well as parts 3 to 4.

The report should be fairly brief and include figures and graphs. Please deliver the printed report together with a CD-ROM/DVD containing the report files, all the program sources, binaries and result files and instructions about how to recompile and launch the program.