Chapter 3

Pitfalls, Software and Benchmarks

3.1 Introduction

After presenting the rules of HPC and the hardware that compose the cluster we need to introduice ways to target this supercomputer. Several options are present in the language, the multi-processing API, the distribution and the accelerators code. This chapter details the most important software options for HPC programming and include the choices we made for our applications.

Then it presents the software used to benchmark the supercomputers called Benchmarks. We present here the most famous, the TOP500, GRAPH500 and GREEN500 to give their advantages and weaknesses.

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3.2 Sofware/API

In this section we present the main runtimes, API and programming language use in HPC and in this study in particular. The considered language will be C/C++, the most present in HPC world.

3.2.1 Parallel programming

PThreads

The POSIX threads API is an execution model available in most of the languages. It allows the user to define threads that will execute concurrently on the processor ressources using shared/private memory. PThreads is the low level handling of threads and the user need to handle concurrency with mutex, conditions variables and synchronization "by hand". This makes the PThreads hard to use in complex applications and used only for very fine-grained control over the threads management.

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OpenMP

Open Multi-Processing, OpenMP, is an API for multi-processing shared memory. It is based on the fork-join model.[Cha08]

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3.2.2 Distributed

In the cluster once the code have been developped locally and using the multiple cores available, the new step is to distribute it all over the nodes of the cluster. This step requires the processes to access NoRMA memory from a node to another. Several runtime are possible for this purpose.

MPI

The Message Passing Interface, MPI, is the most and widely spread runtime for distributed computing.[Gro15, Gro14]

Charm++

Legion

3.2.3   Accelerators

CUDA

OpenCL

3.3   Benchmark

3.3.1   TOP500

The most famous benchmark is certainly the TOP500[1]. It gives the ranking of the 500 most powerful, known, supercomputers of the world as its name indicates. Since 1993 the organization assembles and maintains this list updated twice a year in June and November.

This benchmark is based on the LINPACK.

3.3.2   GRAPH500

3.3.3   GRENN500

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[1]http://www.top500.org

Bibliography

[Cha08] Barbara Chapman. *Using OpenMP : portable shared memory parallel programming.* MIT Press, Cambridge, Mass, 2008.

[Gro14] William Gropp. *Using MPI : portable parallel programming with the Message-Passing-Interface.* The MIT Press, Cambridge, MA, 2014.

[Gro15] William Gropp. *Using advanced MPI : modern features of the Message-Passing-Interface.* The MIT Press, Cambridge, MA, 2015.