AN INTRODUCTION TO PARALLEL PROGRAMMING

A course for PhD students, Alma Mater Studiorum, Università di Bologna, January/February 2019

Instructor

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About the course

Multi- and many-core processors, once found on expensive supercomputers, are now ubiquitous; however, parallel programming paradigms must be used to benefit from the processing power of multi- and many-core processors, but those paradigms are little known to the majority of programmers. In this course we introduce the basic techniques for programming shared-memory multi-core processors (CPUs) and graphics processing units (GPUs). For the former we will use OpenMP/C, i.e., the OpenMP extensions to the C programming language. For the latter, we will introduce programming general-purpose graphics processing units (GPGPUs) using CUDA/C, a proprietary extension of the C programming language developed by NVidia corp. for GPGPU programming.

Topics

1. Introduction to parallel programming
   - Parallel architectures; Flynn's taxonomy
   - Programming models for parallel applications
   - Speedup and scalability of parallel programs
2. OpenMP programming
   - Basic concepts
   - The `#pragma omp parallel` and `#pragma omp for` directives
   - Variables scoping
   - OpenMP constructs for reduction and synchronization
3. CUDA/C programming
   - Basic concepts: kernels, threads, thread blocks
   - CUDA memory hierarchy

Teaching material

All teaching material is in English and will be provided by the instructor through the Web site
https://www.moreno.marzolla.name/

Schedule

- Fri, Jan 25 2019, 11:00–13:30 aula seminari 2 *
- Wed, Jan 30 2019, 11:00–13:30 aula Busi *
- Wed, Feb 6 2019, 11:00–13:30 aula Busi *
- Wed, Feb 13 2019, 11:00–13:30 aula Busi *

* DISI, Mura Anteo Zamboni 7, Bologna

Final assessment

Each student will prepare a written report and/or a small programming project on a topic of his/her choice (possibly, but not necessarily, connected with his/her research interests). The instructor might request revisions of the software/report. Acceptance of both means that the exam has been successfully passed.