Introduction to
High-Performance Computing

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CAVEAT & instructions

✓ This is only introductory stuff
✓ There's much more under the hood
✓ These 8 lessons can only help you introduce some basic ideas
✓ More experience is needed (and so many mistakes) to manage HPC
✓ Almost all examples are in Fortran but the reasons behind performance are (almost) language independent (we are boomers)
✓ Please write to g.amaticode@gmail.com and alessandro.ceci@uniroma1.it to have your email
✓ material downloadable from: https://github.com/gamati01/HPCLessons

These are the HPC topics covered in this course:

- ✓ HPC description
- ✓ Memory subsystem
- ✓ Floating point structure
- ✓ Algorithm vs. Implementation
- ✓ Compiler
- ✓ Parallel paradigm for CPU
- ✓ Parallel paradigm per GPU

Topics not covered in here:

✓ OS

✓ Virtual Memory

✓ I/O

✓ ….

Example/exercises

Some examples/exercises that will be presented here

✓ Matrix-Matrix Multiplication

✓ Matrix-Matrix Multiplication

✓ Matrix-Matrix Multiplication (again…)

✓ Laplace equation

✓ Travel Salesman problem

✓ Sieve of eratosthenes

✓ ….

Note: some exercises will be performed remotely through CoCalc infrastructure

What is requested:

✓ A Laptop/PC to perform some tests/exercises

✓ A basic knowledge of a programming language

- ■ Fortran/C/matlab/python….

✓ Register for CoCalc (it will be used for some exercises)

- ■ https://cocalc.com/

Just to know where we come from…

✓ G. Amati
✓ A. Ceci

Some books….

✓ Charles Severance; Kevin Dowd "High Performance Computing", O'Reilly, ISBN 13:9781565923126

✓ John L. Hennessy, David A. Patterson , "Computer Architecture: A Quantitative Approach" Morgan Kaufmann; ISBN-10 : 0128119055

✓ John L. Hennessy, David A. Patterson , "Computer Organization and Design: The Hardware/Software Interface", Morgan Kaufmann;

✓ D. Goldberg, "What Every Computer Scientist Should Know About Floating-Point Arithmetic"

✓ U. Drepper: "What Every Programmer Should Know About Memory"

Material

https://github.com/gamati01/HPCLessons

You'll have access to

✓ PDF of the various presentations

✓ Code in fortran/C
- to complete
- to modify
- to simply run

✓ `git clone https://github.com/gamati01/HPCLessons.git`