Quantum Information and Computing

Assignment 1 (due in two weeks)

October 15, 2024

Slides template By the due date, please submit a report on the assignment in the form of a presentation including six slides at most. The presentation includes:

- First slide: header with your name, date, assignment number, course name and year.
- Different sections, such as (if applicable):
  - Theory: very briefly explanation of the theory your solution is based on.
  - Code development: strategies, tests, and debugging problems, compilations options.
  - Results: presentation of the data and results discussion.

Upload the report in Moodle under the correspondent assignment. File names must include your name, assignment number and codewords SLIDES, and CODE. Example: Ex1-Rossi-SLIDES.pdf

1. **Setup**
   (a) Create a working directory.
   (b) Open a code editor - i.e. emacs, Vim, Visual Studio editor, Atom - and write your first program in FORTRAN.
   (c) Submit a test job.
   (d) (Optional) Connect to CloudVeneto cluster via ssh and repeat the execution. (registration here)

2. **Number precision.** Integer and real numbers have a finite precision. Explore the limits of INTEGER and REAL in Fortran.
   (a) Sum 2.000.000 and 1 with INTEGER*2 and INTEGER*4.
   (b) Sum $\pi \cdot 10^{32}$ and $\sqrt{2} \cdot 10^{21}$ with single and double precision.

3. **Testing performance.** Matrix-matrix multiplication is many times the bottleneck of linear algebra computations.
   (a) Write explicitly the matrix-matrix multiplication loop in two different orders.
   (b) Use the FORTRAN intrinsic function.
   (c) Increase the matrix size and track the code performance using FORTRAN basic date and time routines (i.e. CPU_TIME).
   (d) Use different optimization flags available with the compiler and compare the performance with increasing matrix size.

Hands-on. The material explained for the hand-on will be uploaded weakly at this link