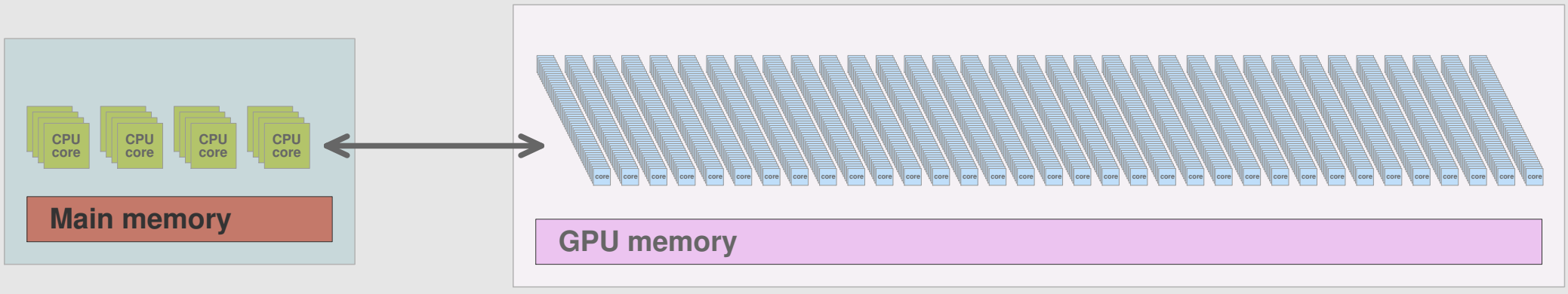
Institut de Physique Théorique

Theoretical physics courses



Introduction to CUDA programming for physicists

François Gelis (IPhT)

On Mondays 16, 23, 30 September and 7 October 2024, 14:15 to 16:30. In person at IPhT and online.

Many numerical computations in physics require applying repetitively the same operations on large arrays, a type of task likely to receive a substantial gain in speed when parallelized. Traditionally, parallelism has been achieved by increasing the number of CPUs in a computer, or the number of computing cores in each CPU.

Graphical Processing Units (GPU) may be viewed as a specialized type of processor with thousands of computing cores. Thanks to a combination of hardware and software developments, their use has expanded from the domain of computer graphics into that of general purpose computing. Besides commercial softwares written to take advantage of the computing power of GPUs, several tools exist to develop computer programs that offload parts of a computation to one or more GPUs.

Among these programming frameworks, CUDA (Compute Unified Device Architecture) is one of the most widely employed. CUDA is an extension of the C++ language, but can be used also in C, FORTRAN, Python and many other programming languages. The goal of this course is to expose the concepts of CUDA programming from the ground up, in order to write simple programs that use GPUs to accelerate critical sections of code.

Outline of the course:

- Architecture of a GPU (computing units, memory, interplay with the host computer). What type of tasks are GPUs good for?
- Memory operations (allocation, data transfer to and from a GPU). GPU shared memory.
- CUDA kernels. Streams, synchronization between dependent tasks.
- Reduction operations on a GPU. Available libraries: cuFFT, cuBLAS, cuSPARSE, cuRAND.

To receive the latest news on this course and the video-conference links, please subscribe to its newsletter, as explained at the website `courses.ipht.fr`. An open, non-interactive livestream will also be available at `youtube.com/ipht-tv`.

IPhT, CEA/Saclay
Orme des Merisiers bât. 774
F-91191 Gif-sur-Yvette

courses.ipht.fr

poster version: 2024-06-31