

OLib - High Performance Library containing Mathematical Functions and Algorithms

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Abstract

This work presents a conception of the creation of a C/C++ language library having selected BLAS (Basic Linear Algebra Subprograms) functions and additional certain possibilities within numerical methods and discrete mathematics. The library has a back-up for graphic accelerators supporting CUDA, the computers with common memory (OpenMP standard), and also the computers with scattered memory (MPI standard). The project is based on the licence of the free and open GNU GPL software.

Key words: high performance library, CUDA, OpenMP, MPI

Motivation

The intention to gather within one library the efficient functions most often used in own researches, and making it fully available to the community of the users who use the calculations of high efficiency.

Implementation

The OLib is being developed mainly with the view of the Linux operating system. Nevertheless, it is possible to use it also in other operating systems (ex. Windows). The implementation is limited mainly to the specificity of the ANSI C language. However, it was necessary to use among other things also the templates and the function overloading features from the C++ language. That is why the support for the G++ compiler is required.

The modules which can be independently turned on have been segregated. The basic module is Primitives which contains the declaration of the structures required for the proper functioning of all other library sections.

Other modules are:

- Linear Algebra** - the functions related to the issues of the linear algebra domain (including multiplication of matrices, solving systems of equations).
- Discrete mathematics** - a set of the mathematic algorithms operating on the sets discrete by their nature. (including effective primality testing).
- Cryptography** - the algorithms related to the cryptography and the cryptanalysis. (historical ciphers, DES, 3DES, AES, SHA1, SHA2, MD5, Enigma)
- Numerical method** - a set of various numerical methods. (including the methods for calculating integrals, the Monte Carlo method, FFT, polynomial interpolation).

The division of the modules is presented in Fig. 2. The library modules have also been implemented from the point of view of various architectures (CUDA, CELL, OpenMP, MPI). This is presented in Fig. 3. Theoretically, from a single program level it is possible to use many other devices for data processing. One of the simplest possibilities of this type is presented in Fig. 4.

Summary

Thanks to the OLib one can obtain a very high increase of the efficiency in certain applications. Additionally, it should be kept in mind that the library is quite new and it is just being developed. An example of the time-drop when performing the algorithm of multiplication of matrices (for types: float, double, and complex_float) achieved due to the use of the implementation of the OLib for graphic accelerators is shown in Fig. 1.

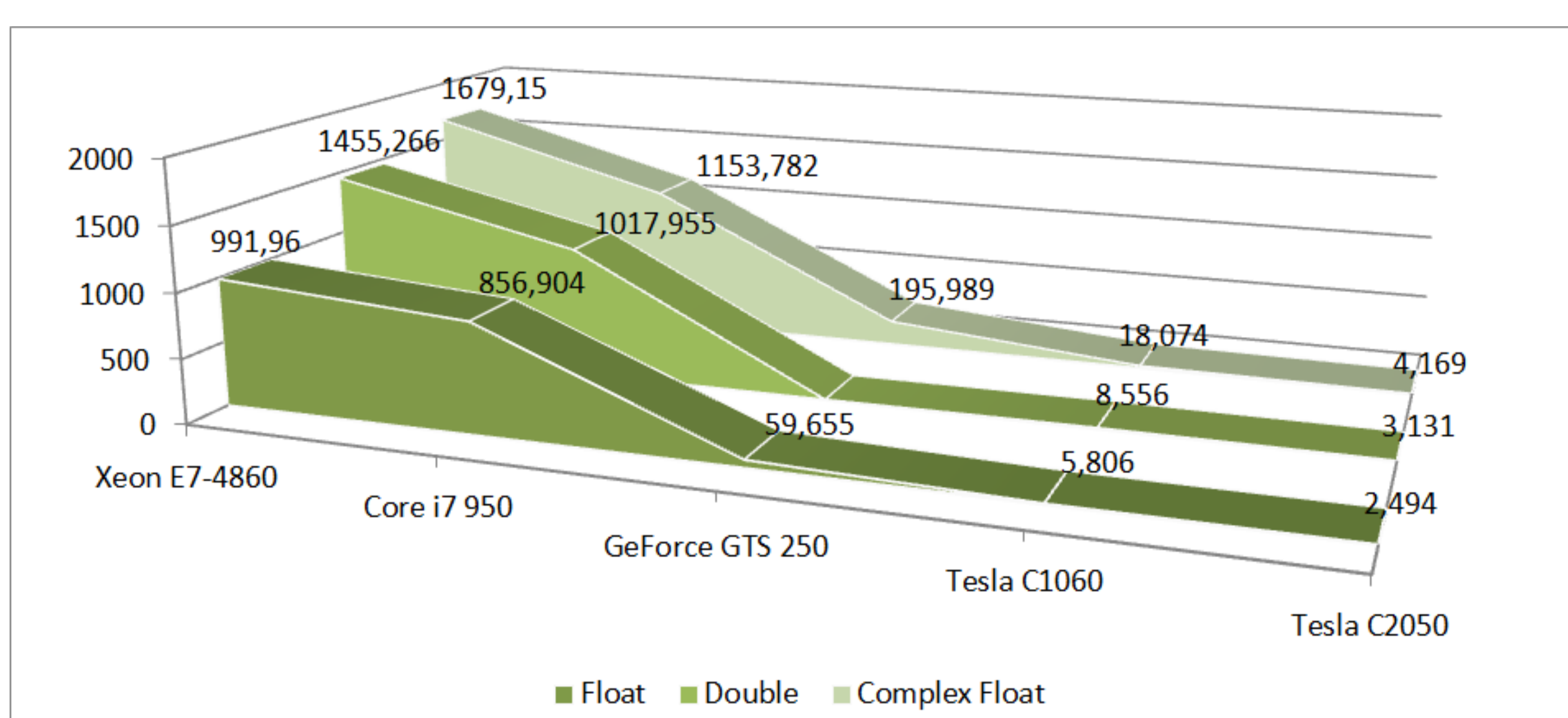


Figure 1: The time-drop when multiplying the matrices of 4096 x 4096 size achieved with the use of the OLib and various graphic accelerators.

The homepage of the library: www.goldbach.pl/olib. More information can be found there and the current source code version can also be downloaded.

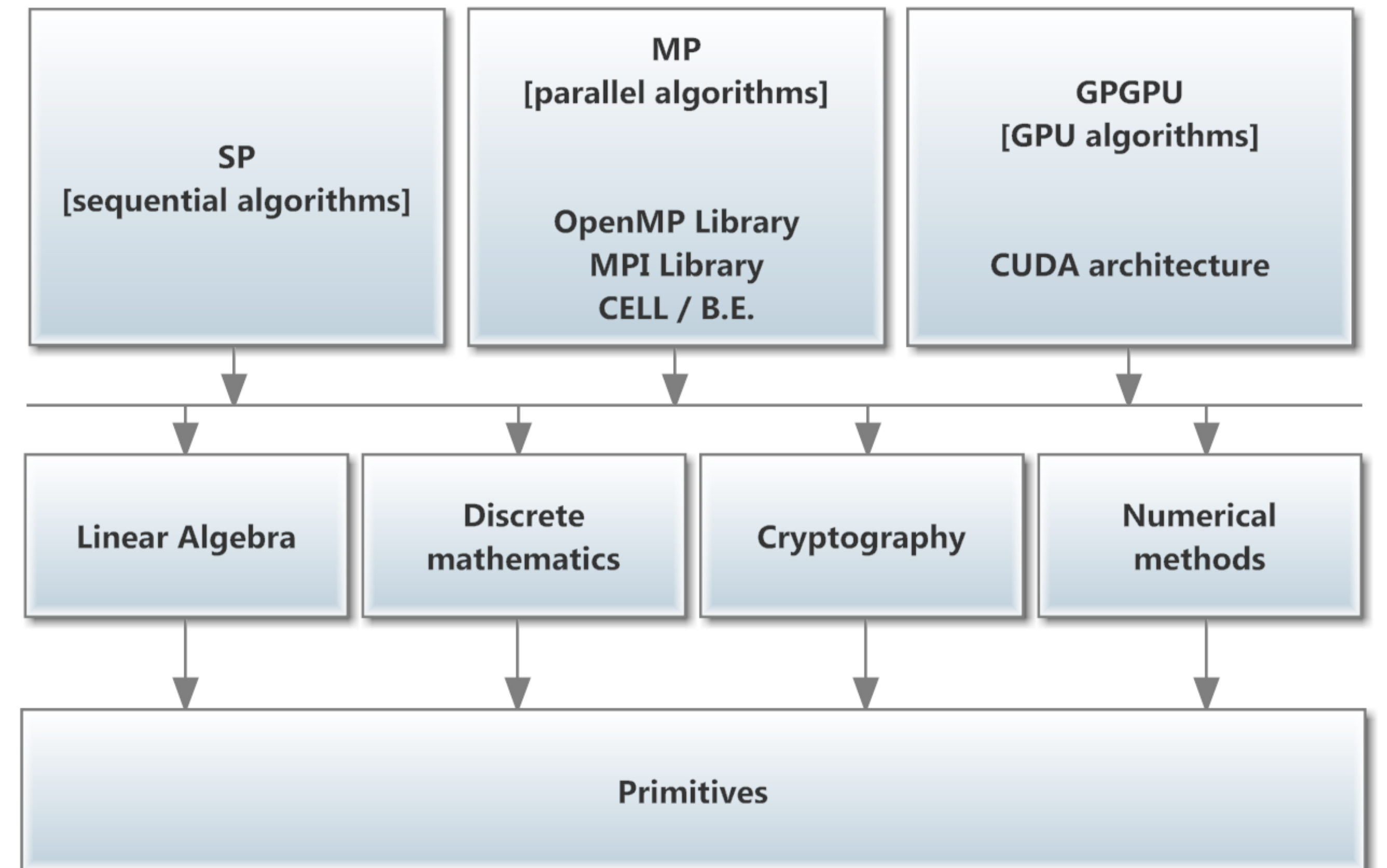


Figure 2: Modular structure Olib Library.

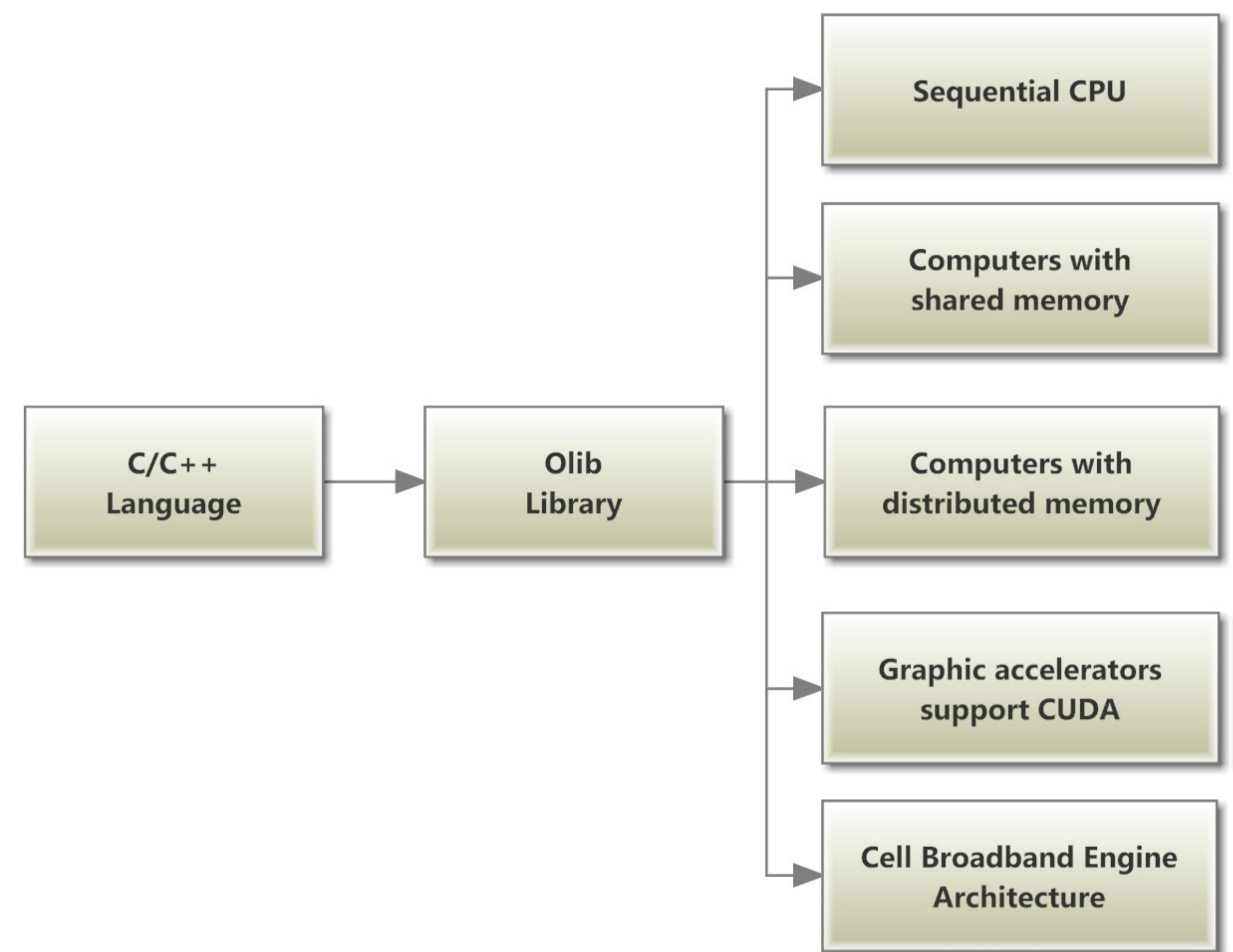


Figure 3: The architectures supported by the OLib library.

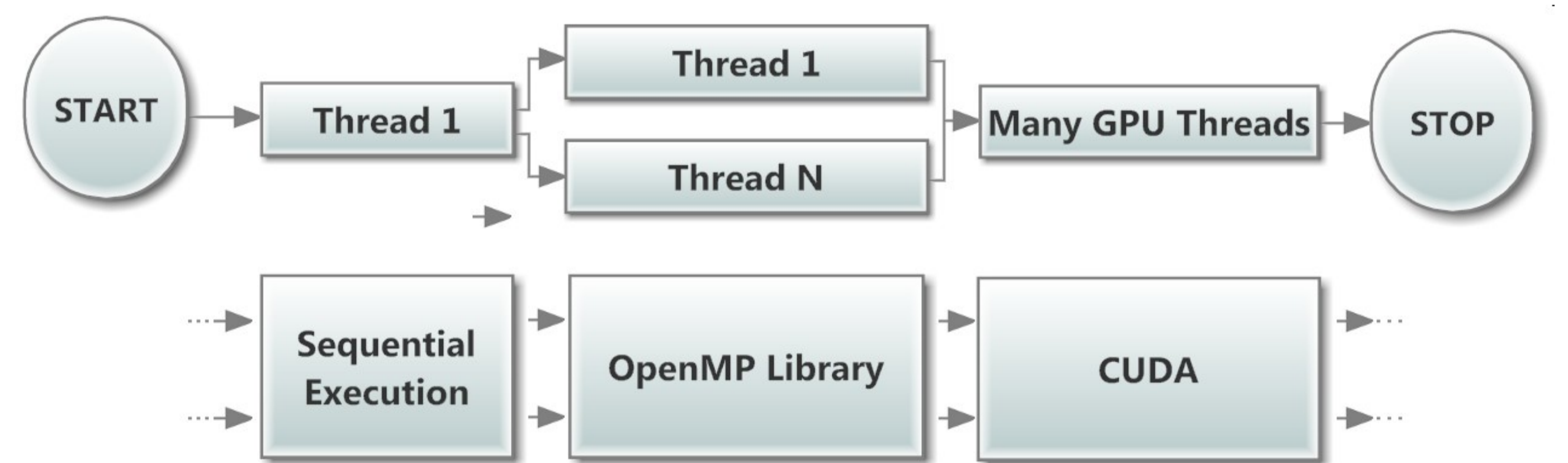


Figure 4: An exemplary flow of the data stream in the program using the OLib library and various technologies.

Literature

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Note

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