Simulation of Grover's algorithm on parallel computers with shared memory and using the Olib library

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The study presents the aspect of the quantum simulation of the Groover's algorithm using contemporary parallel processors with shared memory. Linux operating system, C programming language and Olib library, created by the author for wider set of numerical calculations, were used as a programming environment.

Olib (www.goldbach.pl/olib) is written primarily for Linux OS. In other systems (eg. Windows, BSD, Solaris) minor compatibility issues with the code may occur. Library implements efficient methods, which can be divided into following groups:

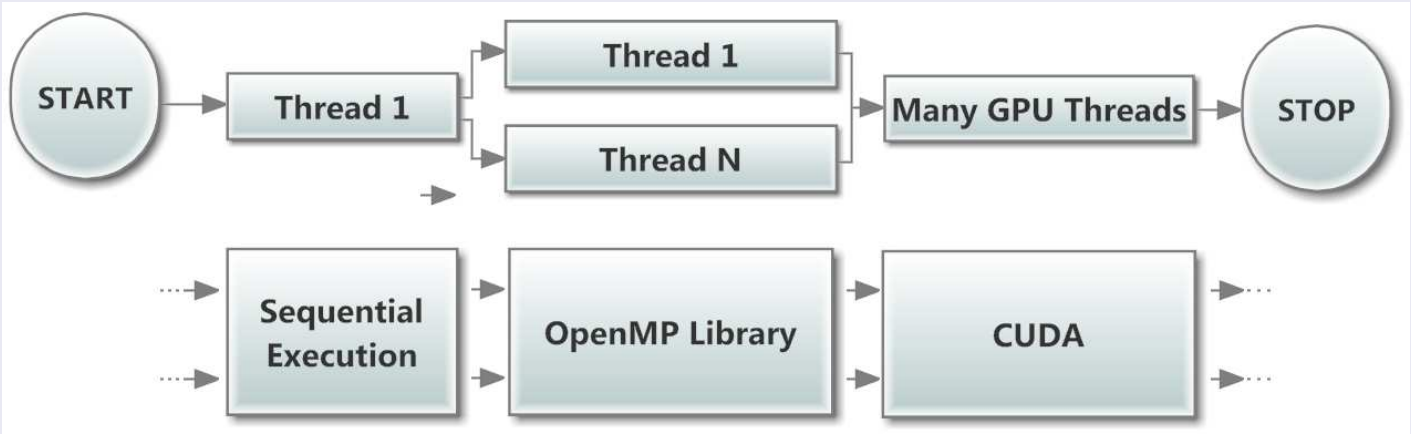
1. Linear algebra
2. Discrete Mathematics
3. Cryptography
4. Numerical methods
5. Artificial intelligence

Grover's algorithm is a quantum algorithm for searching an unsorted database with N entries in $O(\sqrt{N})$ time and using O(log N) storage space (see big O notation). It was discovered by Lov Grover in 1996.

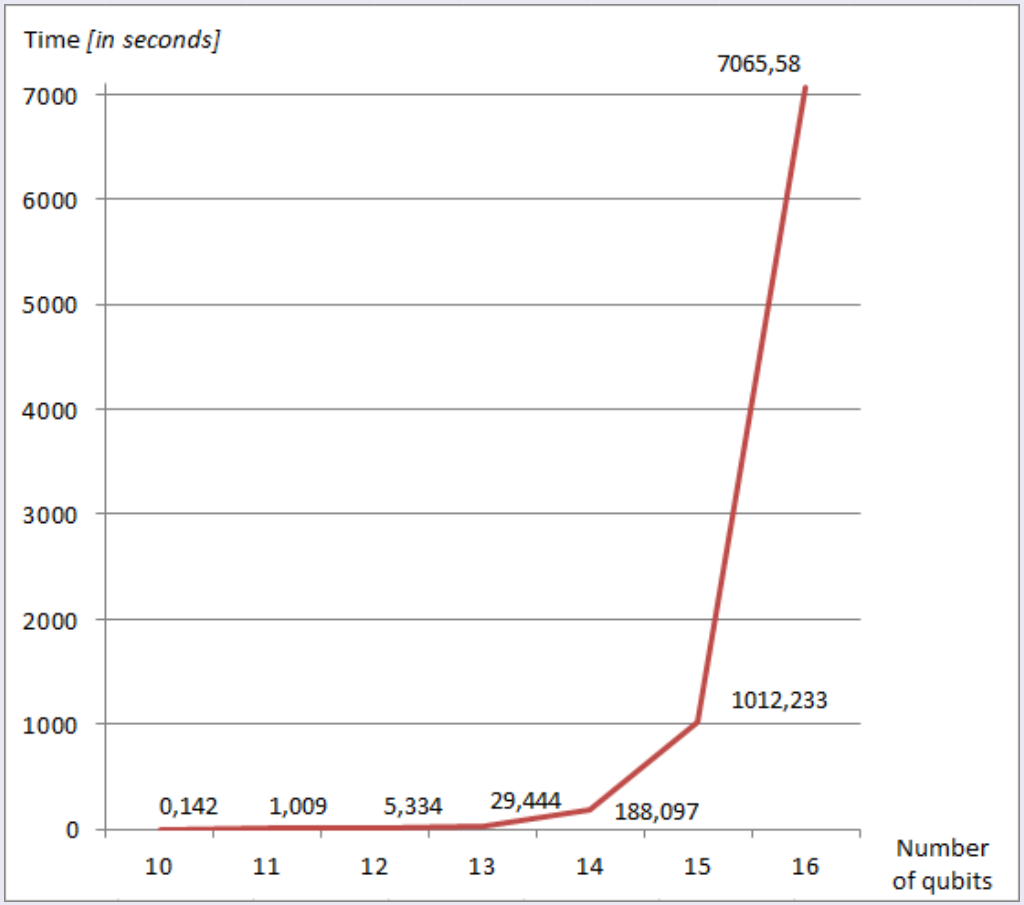
Complexity class: BQP (bounded error quantum polynomial time).

The best classical algorithm: O(N).

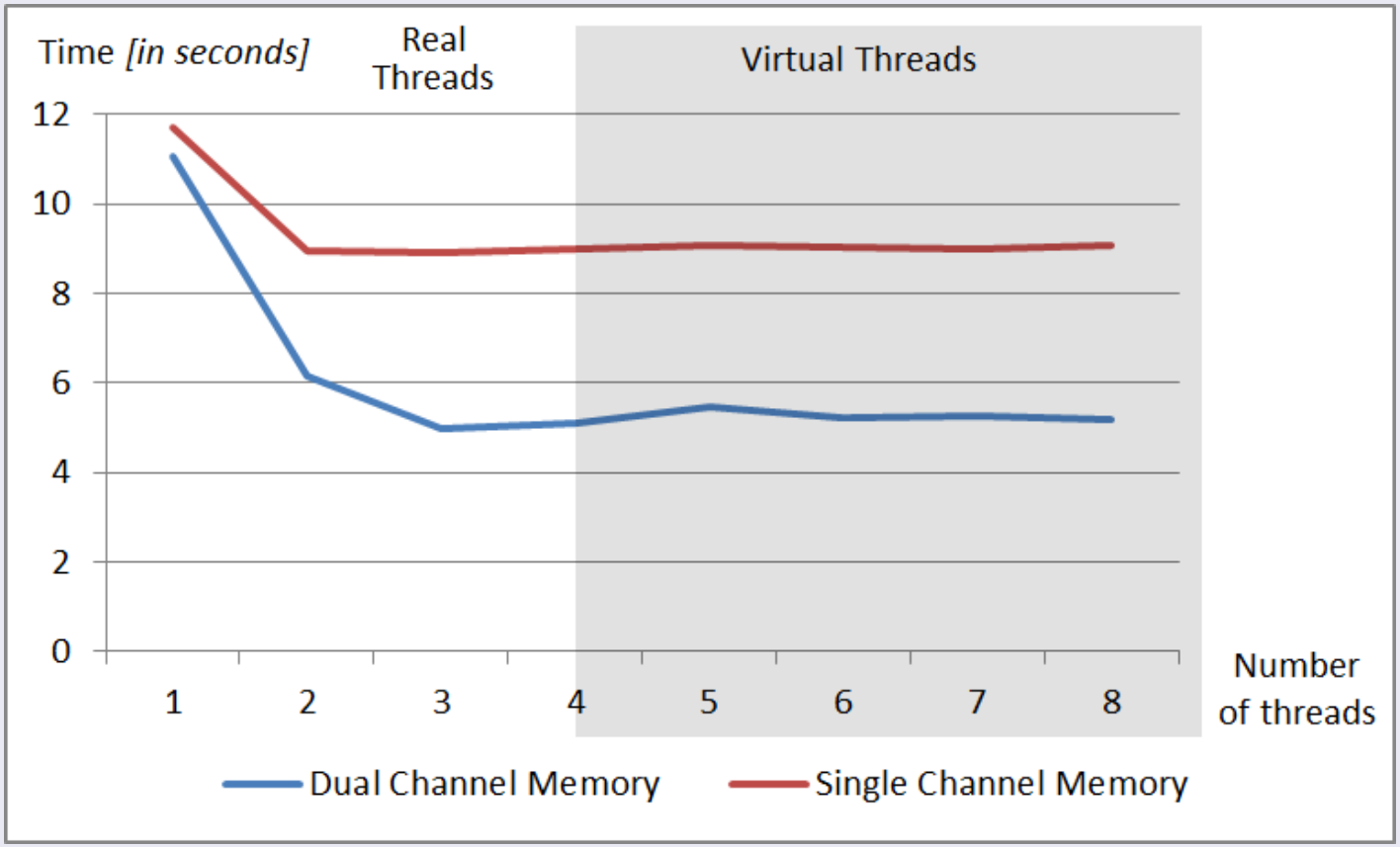
A sample flow of data streams in the program using Olib.



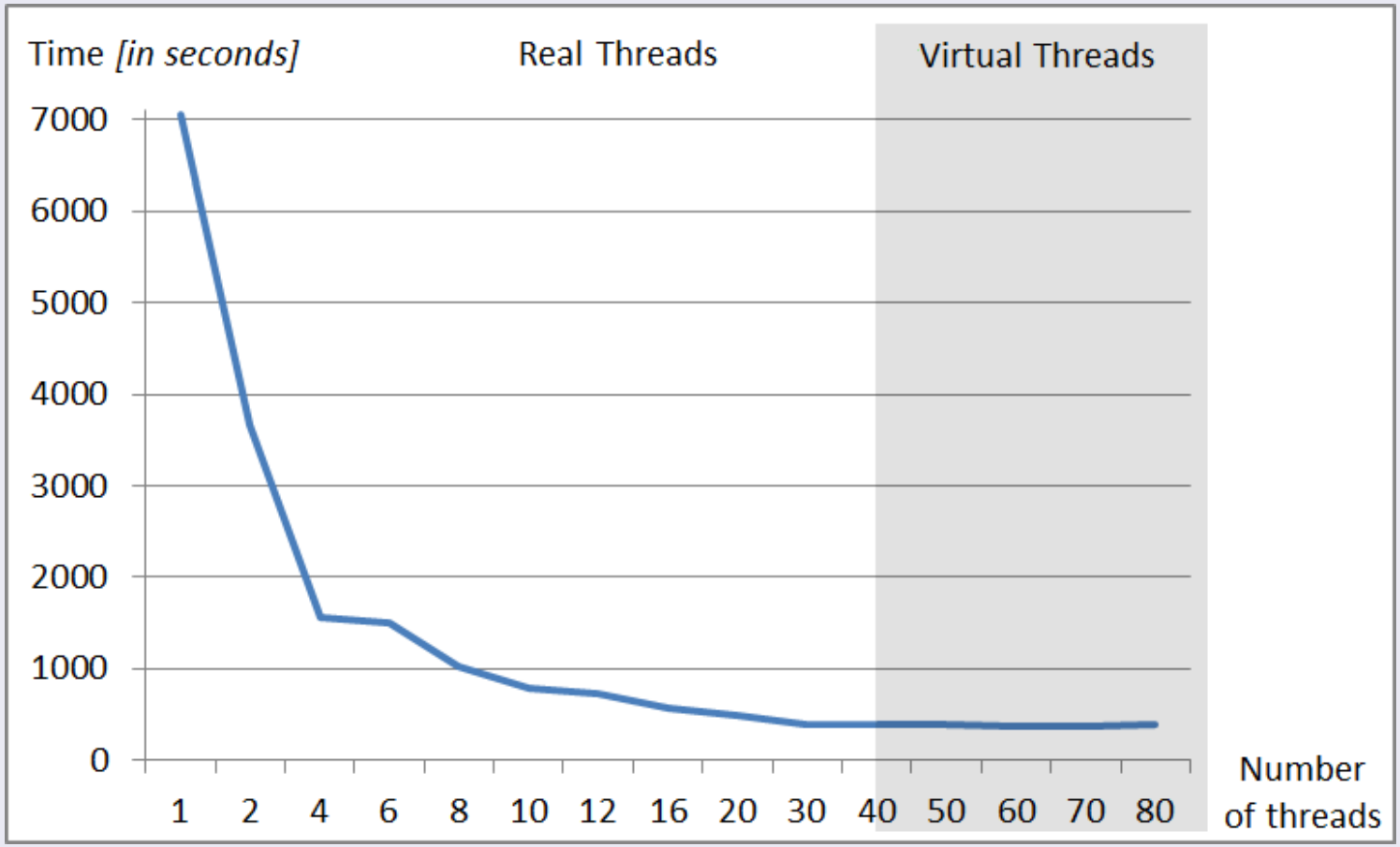
Increase of processing time of sequential algorithm on the Intel Xeon E7-4860 processor during the simulation of the quantum computer with deferent size of quantum register.



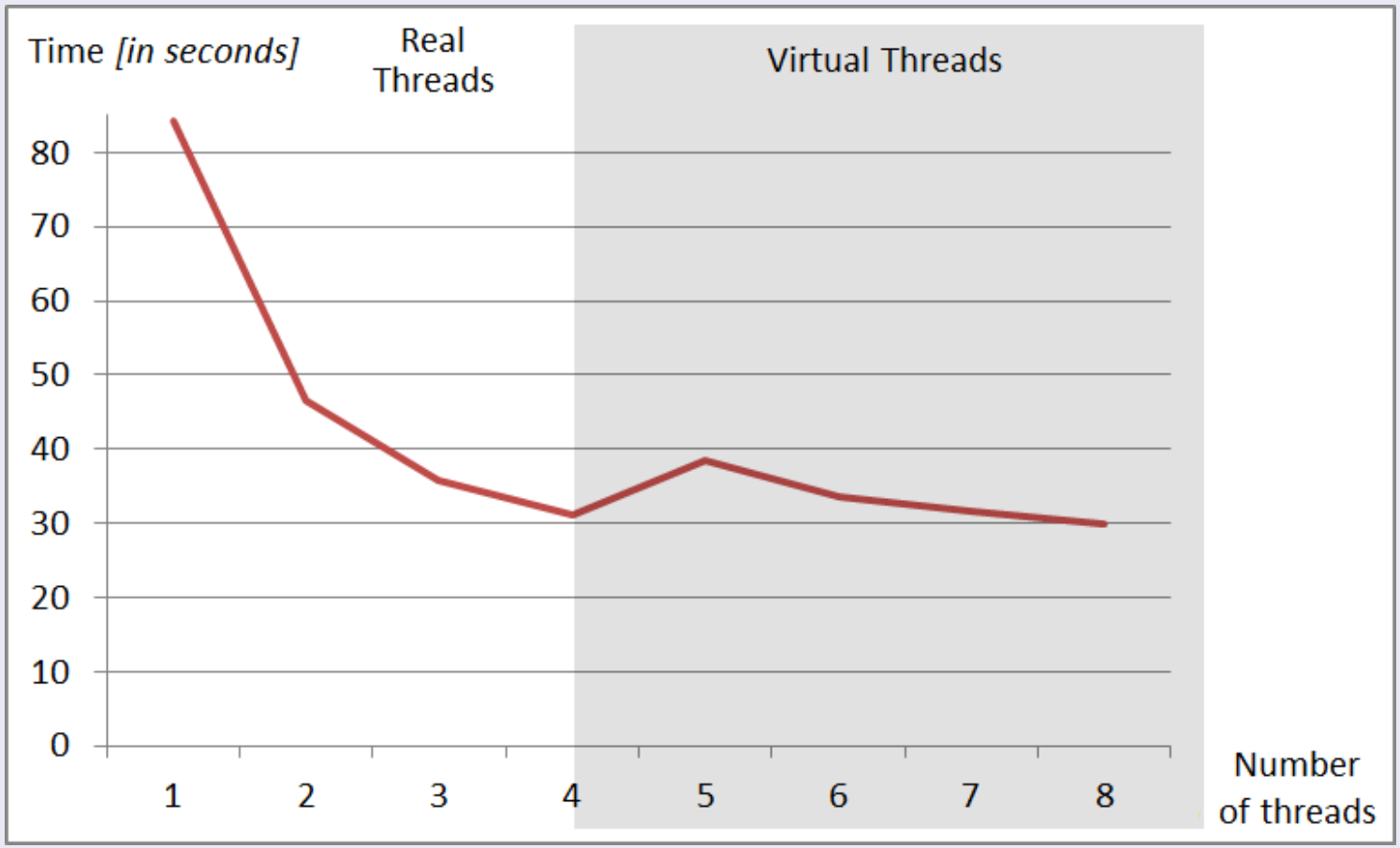
Decrease of time of register simulation which consists of 13 qubits when different threads on the processor Intel Core i5-2400 and single channel memory and dual-channel memory DDR3 are used.



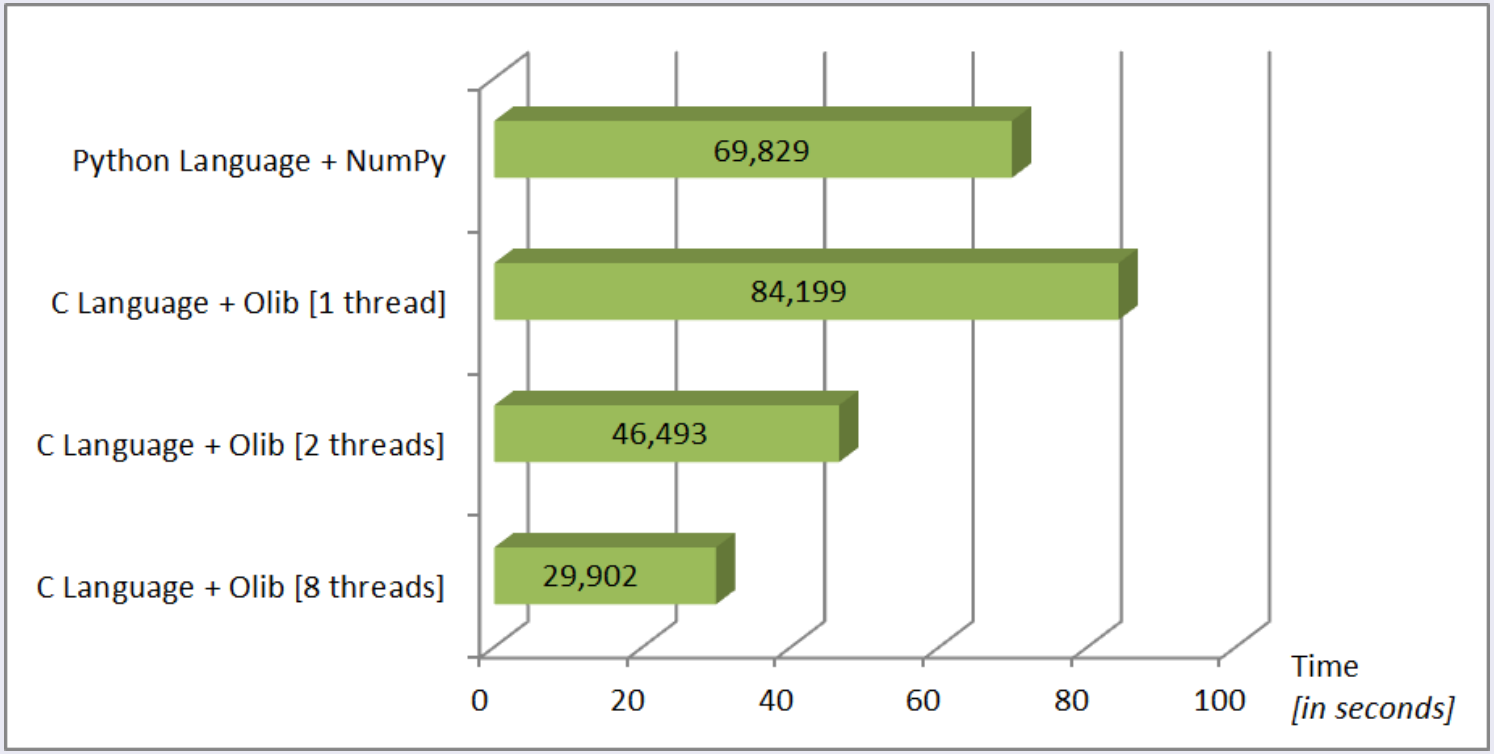
Decrease of time of register simulation consisting of 16 qubits during using different quantity of threads on the platform which consists of four Intel Xeon E7-4860 processors.



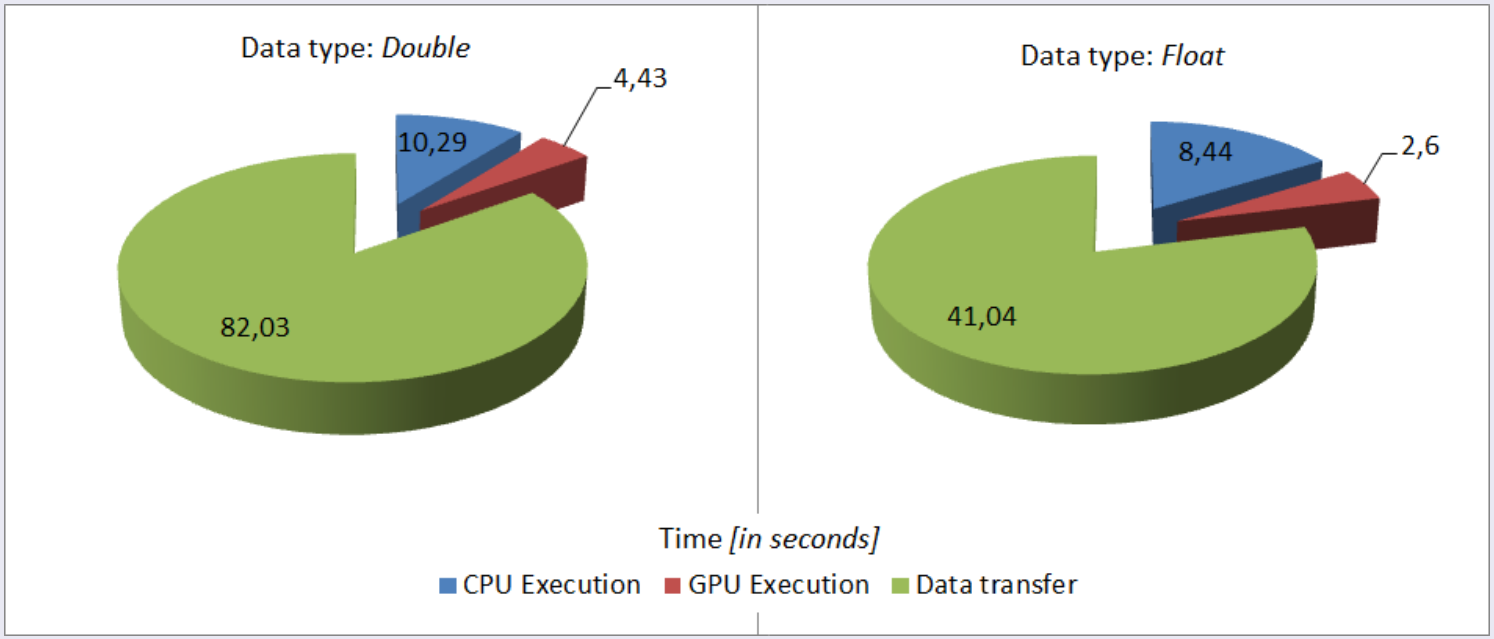
Decrease of time of register simulation which consists of 14 qubits when used different threads on the processor Intel Core i7 920.



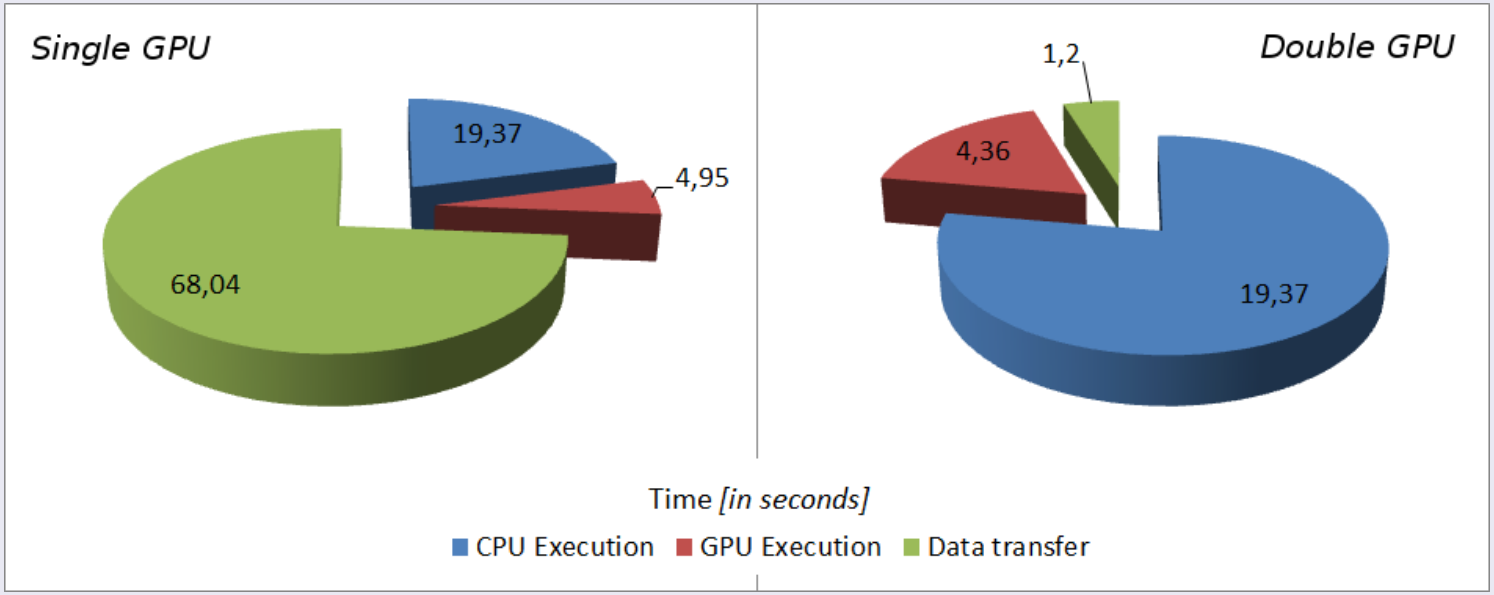
Comparison of Olib library performance with parallel processing and the NumPy (test for 14 qubits and processor Intel Core i7 920).



Intel Core i7 920 + nVidia Tesla C2050 [The division of time]



Intel Xeon E5520 + nVidia Tesla C1070 [The division of time]



Thank you for your attention!