SYCL-BLAS: Combining expression trees and kernel fusion on heterogeneous systems

José I. ALIAGA*, Ruyman REYES* and Mehdi GOLI*

* Dpto. Ingeniería y Ciencia de Computadores, Universitat Jaume I, Castellón, Spain.
* Codeplay Software Ltd., Edinburgh, United Kingdom.

Abstract. The support for heterogeneous platforms requires multiple specialised devices collaborate to execute an application. The SYCL standard publishes by Khronos, providing a C++ abstraction layer on top of OpenCL that provides single-source programming for a large number of heterogeneous devices. Single-source programming and task data-flow approach enable SYCL developers to leverage modern programming techniques on heterogeneous platforms. In this paper, we present how SYCL combines expression tree templates and kernel fusion to develop SYCL-BLAS, an efficient BLAS implementation for heterogeneous platforms. The use of templates permits to generate BLAS kernels related to each BLAS routine. whereas kernel fusion describes how to merge the expression trees, enlarging the BLAS kernels. These features prove that SYCL can be used to quickly develop libraries for heterogeneous systems by providing sufficient levels of abstraction. Our experiments compare the performances of clBLAS and SYCL-BLAS on a server equipped with an Intel Core i7-6700K CPU and an AMD R9 GPU.

Keywords. Parallel programming, Graphics processing units (GPUs), SYCL, expression trees, kernel fusion

1. Introduction

Many of the numerical scientific and engineering applications (image and signal processing, telecommunication, computational finance, material science simulations, structural biology, data mining, bio-informatics, fluid dynamics, . . . ) can be decomposed into a collection of simple kernels, or “dwarfs” [3]. The crucial role, that these kernels played over the past decades, has motivated the development of highly tuned implementations of BLAS [2] (Basic Linear Algebra Subprograms) and LAPACK [3] (Linear Algebra Package) as, e.g., those included in Intel’s MKL [4] (Math Kernel Libraries) and IBM’s ESSL [5] (Engineering and Scientific Subroutine Library).

1 Corresponding Author: Dpto. de Ingeniería y Ciencia de Computadores, Universitat Jaume I, 12,071–Castellón (Spain); E-mail: aliaga@icc.uji.es.
http://www.netlib.org/blas
http://www.netlib.org/lapack
https://software.intel.com/intel-mkl
http://www-03.ibm.com/systems/power/software/essl