

# Implementation and Performance Analysis of the following algorithms

## *CPAR exercise 2*

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To be develop by groups of 3 students, which aims to implement and evaluate the following algorithms.

### 1. LU factorization

The LU factorization is a modified form of Gaussian elimination algorithm and is used to solve systems of linear equation, of the form  $Ax=b$ .

1. Implement a sequential version.
2. Implement a block oriented sequential version.
3. Implement a shared memory version using OpenMP with tasks, a data parallel OpenMP, and a SYCL version.
4. Performance analysis of the implementations.

The time complexity of the algorithm for a matrix of size  $(n,n)$  is  $\Theta(2/3.n^3)$ .

Data range to consider  $(n)$ : from 1024 to 8192, with a step of 1024.

### 2. Matrix multiplication

Implement using SYCL, a memory aware block matrix multiplication algorithm that can run in a GPU as well as in the CPU. The algorithm should copy to local memory the blocks used in each step. Compare its performance to the sequential and OpenMP parallel versions.

Data range to consider  $(n)$ : from 1024 to 8192, with a step of 1024.

## REPORT

The report should consider the following topics:

- Problem description;
- Sequential solutions and performance measures;
- Parallel algorithms and their characterization;

- Time measures of the parallel version;
- Performance evaluation and scalability analysis;
- Results analysis.
- Annex: Characterization of the platform used and a user's manual for running the SYCL code.

**NOTES:**

For each problem, the SYCL version should identify the platforms available and ask the user which one to use.

Performance evaluation consists in analyzing single processor performance and, speedup, efficiency and scalability from 1 to P processors for the parallel versions. A discussion on the obtained results is also expected.

The report should not have more than 10 pages.

**To be delivered up to: 18/05/2020**