



Universidade de Aveiro
Mestrado Integrado em Engenharia Computacional
Computação Paralela

Project 1: Contrast Stretching with CUDA

Academic year: 2019/2020

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1. Introduction

In this assignment gray scale images will be processed in order to enhance the image by using contrast stretching. An image will be modeled as an array of integers which values range from 0 to 255. The values in the image specify the pixel luminance, hence a value of 0 indicates a black pixel and a value of 255 indicates a white pixel. An image will be stored in memory as an array (or matrix) of integer values where each element of the array/matrix corresponds to a pixel in the image.

The image will be processed for image enhancement using the Contrast Stretching technique. This technique finds the minimum and maximum luminance of all pixels in the image and then expands the range of used luminance values to the maximum allowed range using a linear scaling.

2. Work description

The objective of this work is to start from the source code package **cp_contrast.tgz** (available at elearning), which includes a C implementation of the Contrast Stretching technique, and develop improved versions of the Contrast Stretching using the CUDA platform. Images may be of any size. The function **contrastDevice()** should encapsulate all the operations of preparation, execution and result retrieval of the CUDA kernel(s). The assignment should be tested using the **banana.ua.pt** computer that includes a GPU with compute capability 7.5. The function **contrastHost()** and functions called from **contrastHost()** should not be changed.

You may develop (and compare) several versions of your code that use different functionalities of the CUDA device (global memory, shared memory, texture memory, etc.). If you do test the use of different CUDA memory resources, please deliver all developed versions and use an archive file with an additional suffix in its name (ex: **proj1_nm_shared.tgz**¹) for the different memory types that were used.

3. Important notes

Each group must deliver:

- the source code of the developed program;
- a report that presents: a) the general architecture of the developed solutions; b) the main data structures and algorithms that have been used; c) the results that have been attained; d) basic instructions for compilation and execution of your program.

¹ "nm" is to be replaced by your UA id number.

During the development of this assignment you should follow an ethical conduct that prohibits plagiarism, in any form, as well as the participation of external elements in the assignment development. Any initiative that, judged by the teaching team, might be considered as a plagiarism situation will have real consequences on the student(s) evaluation and may lead to disciplinary sanctions.

4. Due dates

- **May 1, 2020**

Submitting your work after the due date will be penalized with 1 point less for each day of delay.

Bibliography:

- [1] *NVIDIA CUDA C Programming Guide*, PG-02829-001_v10.2, NVIDIA (available at elearning)
- [2] *CUDA C++ BEST PRACTICES GUIDE*, DG-05603-001_v10.2, NVIDIA (available at elearning)