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Massively Parallel Computing
Assignment 2

Submission deadline for the exercises: 2. März 2018

Hints

Download the framework `exercise02.tar.gz` from the Ilias course web page.
Present your results to the exercise instructors to get a grading on this exercise sheet.

2.1 Asynchronous Memory Transfer (30)

- Start with the `upload` template.

- You might have noticed that the upload in the testDotProduct.cu was slowing down the overall performance, here comes the solution:

- Transfer data to the GPU in three different modes

  - Using simple memcpy
  - Using memcpy from non-pageable memory
  - Using asynchronous memcpy with two streams

- Use the provided skeleton and fill in the missing gaps

2.2 Reverse Array (30)

- Given an input array $\{a_0, a_1, ..., a_{n-1}\}$ in pointer d_a, store the reversed array $\{a_{n-1}, a_{n-2}, ..., a_0\}$ in pointer d_b

- Start from the `reverseArray` template

- Part 1: Compute the number of blocks to launch

- Part 2: Implement the kernel reverseArrayBlock()

2.3 Cross Correlation (40)

- Start from the `crossCorrelation` framework.

- Compute the normalized cross correlation between two images $f, g : \mathbb{R}^2 \to \mathbb{R}$, component-wise for RGB

$$
\begin{aligned}
\bar{f} &:= \sum_{x,y} f(x,y)/(M \cdot N) \\
\bar{g} &:= \sum_{x,y} g(x,y)/(M \cdot N) \\
f'(x,y) &:= f(x,y) - \bar{f} \\
g'(x,y) &:= g(x,y) - \bar{g} \\
(f' * g')(X,Y) &= \sum_{x,y} f'(x,y) \cdot g'(X+x, Y+y)
\end{aligned}
$$

- Use the provided skeleton and fill in the missing gaps

- In folder `images/` you will find example input images

- In folder `referenceImages/` we have pre-computed the solution for different combinations of input images

- Use these pre-computed solutions to check that your code works correctly!