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PDP Final Project

Requirement

Take as input an image and apply a grayscale convolution filter on it.

Solution

To convert an image from color to grayscale one simple method is to set the intensity to the average of the RGB channels. But we will use a more sophisticated method that takes into account how the eye perceives color and weights the channels unequally.

The eye responds most strongly to green followed by red and then blue. The NTSC (National Television System Committee) recommends the following formula for color to grayscale conversion:

Img = 0.299 * R + 0.587 * G + 0.114 * B

1. Regular solution with threads
   Initialized 4 threads, each would get assigned an id and would process the rows that are modulo id.
2. Distributed solution using MPI
   The master computes the number of slaves and for each slave computes a chunk to be processed and sends the data corresponding to that chunk. It then receives the results of the slave computations and writes the final image to the file.
3. CUDA
   First, we preprocess the image by reading it as a RGB image. Before computing on GPU, initialize the size of the thread block with 512 and the number of blocks with WIDTH * HEIGHT / 512. Then, for each pointIndex we compute the value of the grayscale image in that point by the formula stated above. At the end, we postprocess the image by printing it and saving it.

Hardware

Processor: Intel(R) Core(™) i7-8750H CPU @ 2.20GHz 2.21 GHz
GPU: NVIDIA GeForce GTX 1050 Ti
RAM: 16 GB
System type: 64-bit OS
Platform: Windows 10

Tests

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Image size	Method	Time taken
1280 x 720	1	51 ms
1280 x 720	2	220 ms
1280 x 720	3	0.388096 ms