M2-BigData : GPGPU
Chapter 8 – Exercice 1

Objectives

Implement a convolution filter for constant squared boxed filters.
The convolution formula is given by :

$$P_{i,j,c} = \sum_{x=-k}^{k} \sum_{y=-k}^{k} I_{i+x,j+y,c} M_{x,y}$$

where c is image channel, M is the filter mask of size $2k+1$ the parameter k is called filter radius.

Instructions

Complete your code from exercice 3, Chapter 3 (blur image filter) to implement the convolution of size $w = 2k + 1$, with the following filters :

— $k = 1$ and $M = \begin{pmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{pmatrix}$

— $k = 2$ and $M = (\frac{1}{25})$

— $k = 2$ and $M = \frac{-1}{256} \begin{pmatrix} 1 & 4 & 6 & 4 & 1 \\ 4 & 16 & 24 & 16 & 4 \\ 6 & 24 & -476 & 24 & 6 \\ 4 & 16 & 24 & 16 & 4 \\ 1 & 4 & 6 & 4 & 1 \end{pmatrix}$

Once the program is working with all filters, improve the code with a constant memory mask.

Question

1. How many floating operations are being performed in your convolution kernel ? explain.
2. How many global memory reads are being performed by your kernel ? explain.
3. How many global memory writes are being performed by your kernel ? explain.
4. Compute the arithmetic intensity of the kernel.
5. Measure the kernel computational time of the kernel, using the profiler. Then, compute the computational power of the kernel (in GFLOPS). Compare with the CPU version given.
6. Compare the computational power evolution using different images sizes.