

Low-Pass Filter Project

HIGH-
PERFORMANCE-
COMPUTING

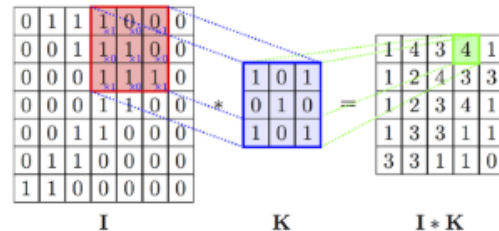
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Problem Definition:

Description:

It is used to make images appear smoother. Low pass filtering smooths out noise. It allows low frequency components of the image to pass through and blocks high frequencies. Low pass image filters work by convolution which is a process of making each pixel of an image by a fixed size kernel.



Imagine that the given image is I , the kernel is K . If we applied the filter on the red region at I , the result will be computed by aligning the kernel onto the image part then doing basic multiplication between the aligned elements as: $(1*1 + 0*0 + 0*1) + (0*1 + 1*1 + 0*0) + (1*1 + 1*0 + 1*1) = 4$. Every kernel based filter has its kernel, the low pass filter has this as a kernel:

| | | |
|-----|-----|-----|
| 1/9 | 1/9 | 1/9 |
| 1/9 | 1/9 | 1/9 |
| 1/9 | 1/9 | 1/9 |

For the border elements of the input image (e.g. pixel (0,0)), there are two ways to handle this either by zero padding or border replication. You can handle the case by any method of these. To see more on that check [this](#) video.

Input and Output:



*Bonus: make it work on a dynamic kernel filter size instead of fixed 3x3.

- render your results

- Test your code on 1, 25, 50, 100 pictures
- Record your Results

| | 1 pic | 25 | 50 | 100 |
|-----------------|-------|----|----|-----|
| Serial code | | | | |
| MPI Sol1 | | | | |
| MPI Sol (bonus) | | | | |

Deliverables

- The source code
- A report on the findings and enhancements made to performance.
- The project discussion will be individual

Core Idea to Parallelize

Input Image is $m \times n$

each core processor unit is responsible on an equally NO. of rows [subset of m] from the Original Image, But $n \sim$ The Width is Fixed and not Dividable

Except

The master Server, has a role of Distribute and Combine Results

and The Last Server takes whatever left after Division

Room for Improvements

- Convolution Operation as Dot Product in Parallel
no TIME

Code in Github:

<https://github.com/Ahmed-Khaled-1271999/High-Performance-Computing/blob/main/Low-Pass-Filter-Parallel.cpp>