# Laboration 1 - TDDC78

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## 1 Program description

### 1.1 Threshold filter

This program calculates the average intensity of the image and makes all pixels with a higher-than-average value white, and all other pixels black.

The whole image is read on the root node. The root node also calculates the average intensity of the image. The calculated intensity is sent to all other nodes via MPI_Broadcast().

The image data array is split in as many parts as there are nodes, and each node gets its own part via MPI_Scatter(). Since each node needs to know the data length to receive, this is done in two steps where the total data length is first sent via MPI broadcast, and then the data is sent with MPI scatter. Each node then runs the threshold filter on its own part of the image. MPI_Gather() then reassembles the resulting image, which is written to disk by the root node.

### 1.2 Blur filter

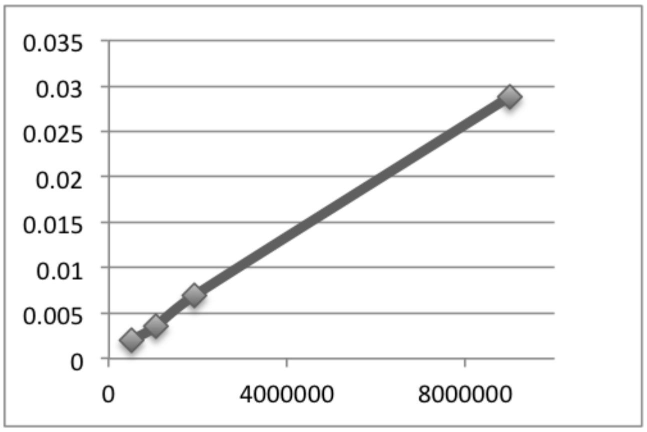
For each pixel this program calculates the average color of the neighbors with a given radius, of the pixel and sets the pixels color to the average. This gives a blurred effect over the whole image with a small radius giving almost the same image back, and a large radius gives a very blurry image.

The whole image is read at the root node. The intervals that each processor is going to work in is calculated. Since the algorithm is dependent on the value of the neighbours of each pixels, we have to send some more image information than we are actually blurring on each node, otherwise there will be some broken lines in the image. The data is distributed to the nodes using MPI_Scatterv(). Now each chunk is iterated by the blur filter and then transmitted to the root node with MPI_Gatherv(), the root node must take special care to get rid of some overhead created by the sending of extra data. This is done by pointing a bit forward in the array storing the image.

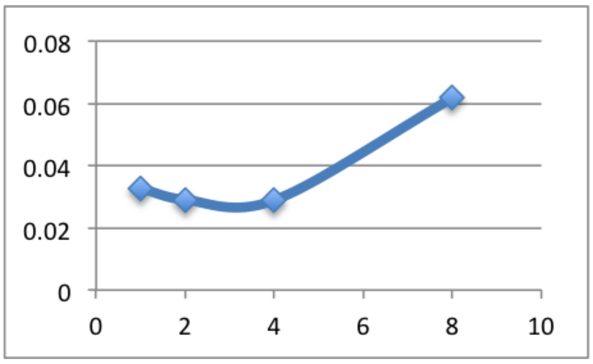
## 2 Execution times

In figure 1 and figure 4 the same number of nodes is used on different images and we see that the execution time is increased in a linear manor, for the thresh and blur filter. Figure 2 and figure

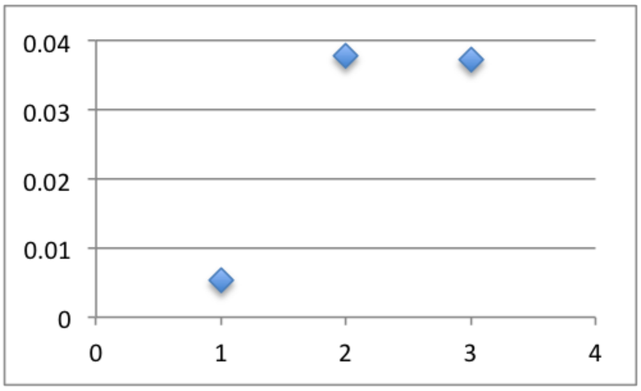
5 shows how the execution time decreases with increasing number of nodes for thresh and blur, in the thresh filter we get a bad scale since the problem size is so small that the communication overhead becomes too large. Figure 3 and figure 6 shows how the same increase in image size and number of nodes give the same execution time, for 6 we notice that the line isn't constant as soon as we use more than one processor (more than 16 nodes).



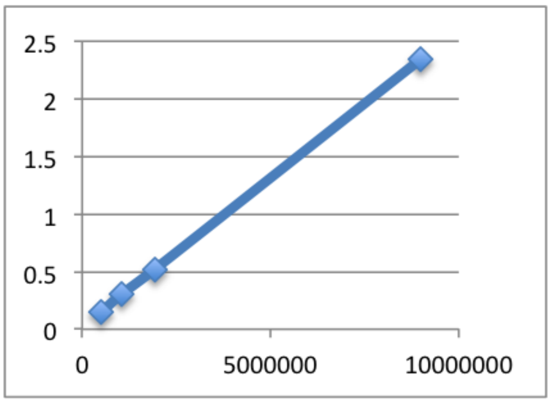
Figur 1: Using the same amount of nodes on different images. (Thresh)



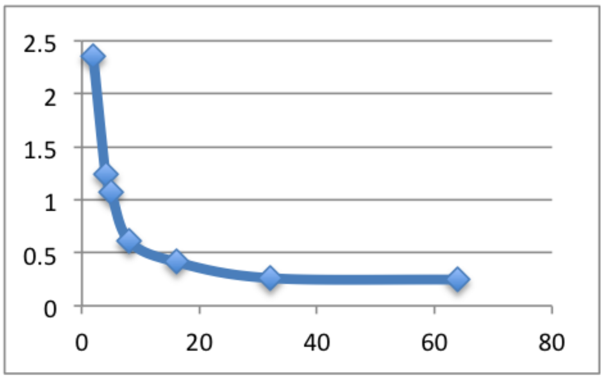
Figur 2: Using the same image with different number of nodes. (Thresh)



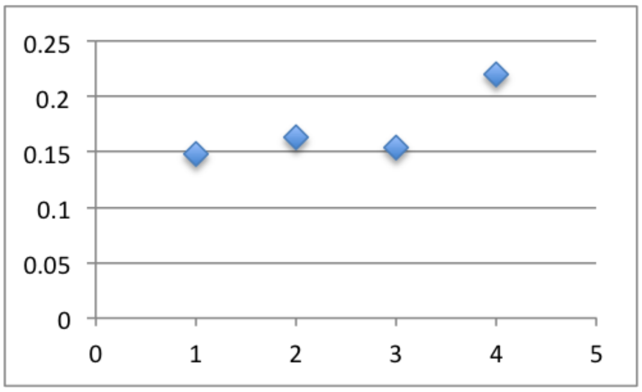
Figur 3: Scaling the image at the same rate as the number of nodes. Using 2, 4 and 8 nodes. (Thresh)



Figur 4: Using the same amount of nodes on different images. (Blur)



Figur 5: Using the same image with different number of nodes. (Blur)



Figur 6: Scaling the image at the same rate as the number of nodes. Using 2, 4, 8 and 38 nodes. (Blur)