AML Assignment 1 - report

March 22, 2020

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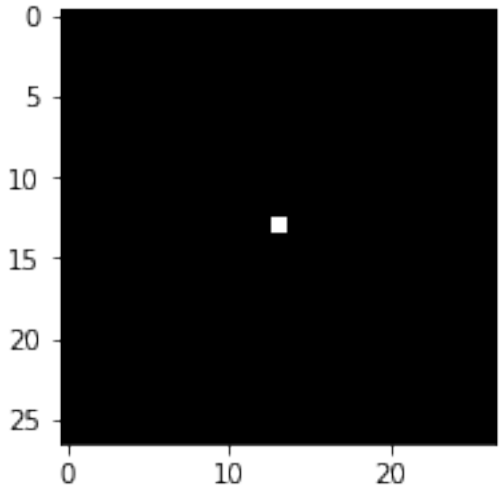
In this report we proceed to answer as requested the questions 1d, 1e, 3c and 4b. For each point we are going to write a brief description using figures and formulas whenever needed.

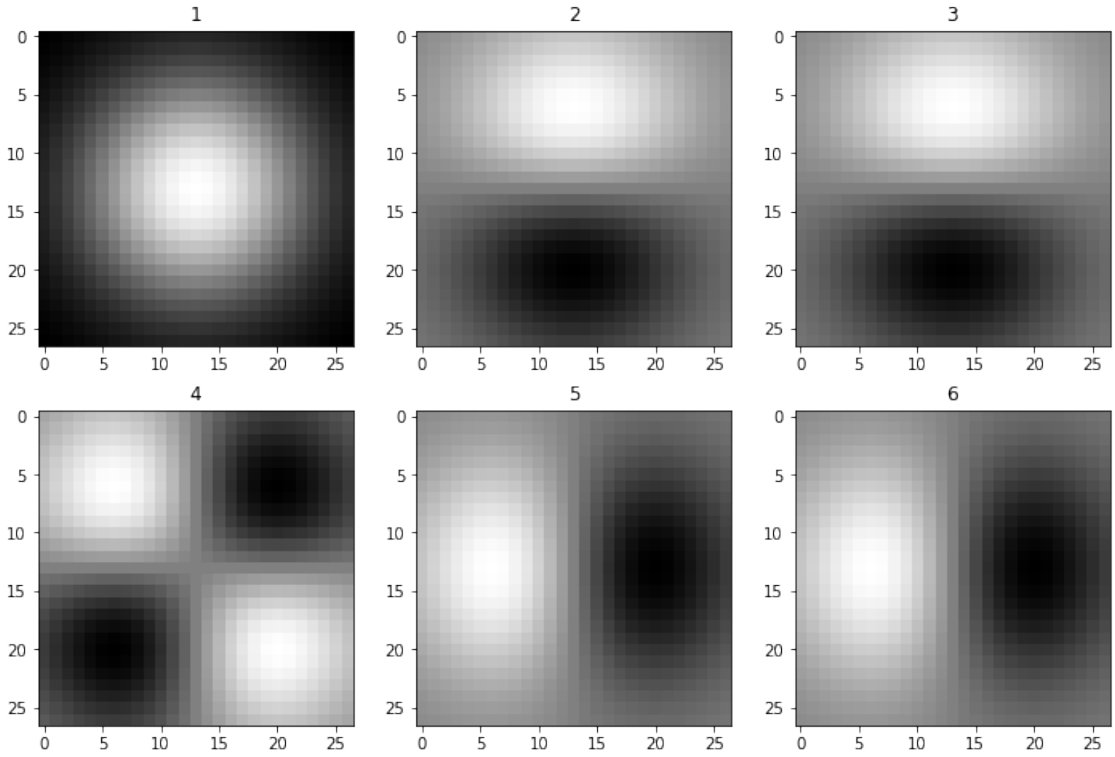
1 Question 1d

The effect of applying a filter can be studied by observing its impulse response. Execute the code in filter.py to create a test image in which only the central pixel has a non-zero value:



What happens when you apply the following filter combinations?

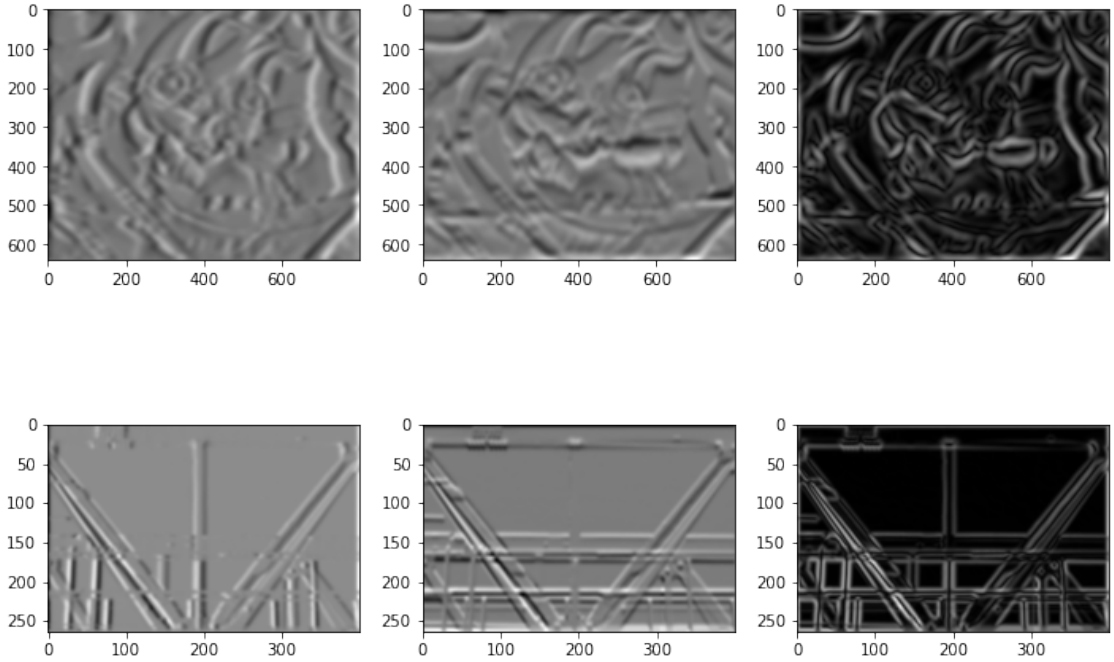
1. First Gx, then Gx^T
2. First Gx, then Dx^T
3. First Dx^T, then Gx
4. First Dx, then Dx^T
5. First Dx, then Gx^T
6. First Gx^T, then Dx



1. The result is given by applying the gaussian filter first horizontally and after vertically in two sequential 1D convolution, which is equivalent to a 2D convolution of a gaussian filter thanks to the separability property of such filter. The resulting image can be understood considering that the white spot has a higher weight when the convolutional patch is centered on pixels nearby it. The symmetry of the gaussian filter directly translates into the symmetry of the image.
2. In this case the gaussian filter slides over the x axis, affecting the smoothing process with respect to the y axis, consistent with what we would expect from such a filter. Then we apply the first derivative filter, with the effect of obtaining an edge detection along the vertical direction.
3. This image is the equivalent to the previous one due to the commutative property of the convolution.
4. In the original image we have 4 transitions from white to black, determining the edges. Applying the first derivative on both axis, we detect the four transitions by observing two minimum and two maximum. The edges are given by the transitions in between the minima and the maxima.
5. and 6. Similarly to the images 2 and 3 we are applying the filters of a gaussian and the first derivative, but with the inverted axis, obtaining the same result rotated and detecting the vertical edge

2 Question 1e

Apply the method gaussderiv to the provided example images graf.png and gantrycrane.png and comment on the output in your report. Consider also why smoothing an image is important before applying the derivative filter.



What we can observe from the images is that in the first image on the left we always identify the vertical edges while in the second we identify the horizontal edges. A combination of the two is obtained as $f(p_a, p_b) = \sqrt{{p_a}^2 + {p_b}^2}$ where p_a and p_b are corresponding pixels of the two filtered images so that the final result is an elementwise operation.

Smoothing an image is important before applying a derivative filter because it has the effect of blurring the input image by averaging locally, so that the derivative filter marks only the coarse traits of the image. One of the consequences of the gaussian filter is also to average out the noise in the image.

3 Question 3c

4 Question 4b