Answers to questions in

Lab 2: Edge detection & Hough transform

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**Instructions**: Complete the lab according to the instructions in the notes and respond to the questions stated below. Keep the answers short and focus on what is essential. Illustrate with figures only when explicitly requested.

Good luck!

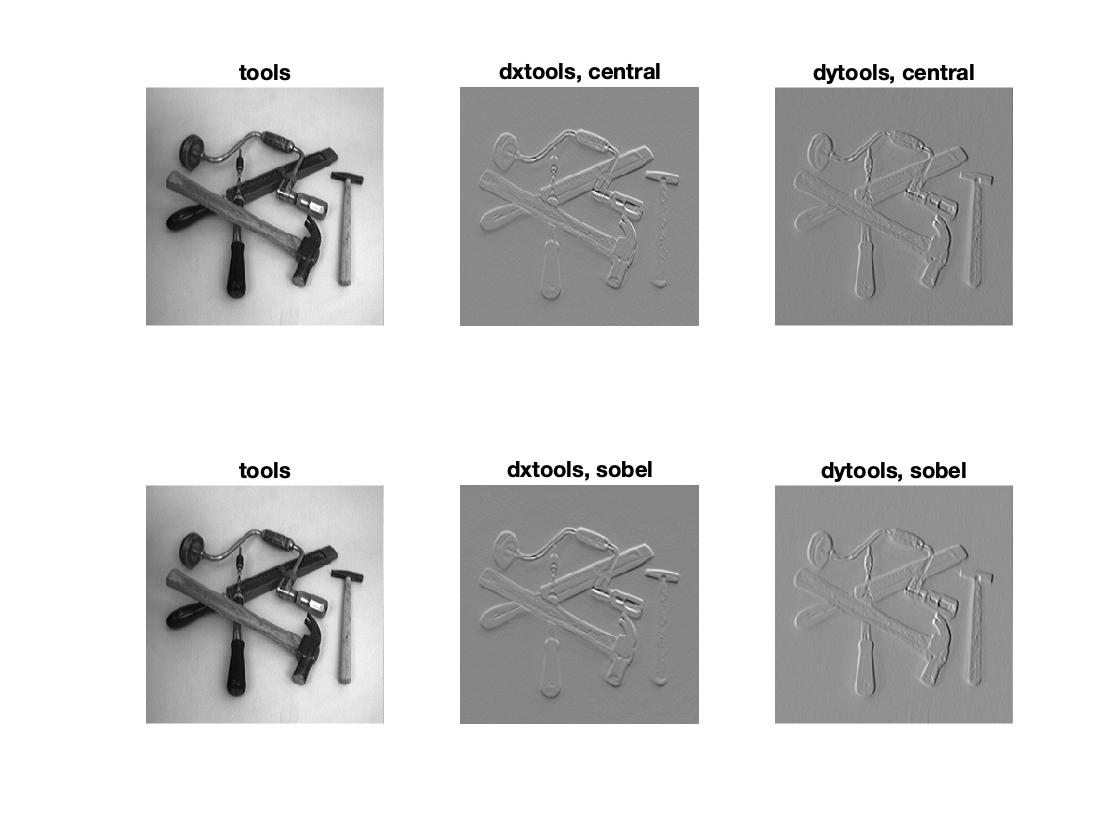
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**Question 1**: What do you expect the results to look like and why? Compare the size of *dxtools* with the size of *tools*. Why are these sizes different?

Answers:

Below are the horizontal and vertical derivatives of the ‘few256’ image, for both central differences and the Sobel operator. We expect the results to enhance only the edges in the image. The difference operators calculates the gradient in the vertical and horizontal direction. A change in magnitude will occur at the edges and thus these points will have increased or decreased gray values (depending on if it is an increase or decrease in the magnitude), as can be seen in the figure below.

Comparing the size of *tools* with either *dxtools* or *dytools* we find that *tools* has a size of and *dxtools*/*dytools* has a size of . The reduction in size has to do with the fact that we are using a convolution where we only save the parts that are computed without the zero-padded edges. This is specified by the ‘valid’ argument to conv2. In our case the difference operators are of size , meaning that the output of the convolution will shrink by 2 in both dimensions. Thus one can imagine this as, when the difference operator slides over the image, it will only perform calculations where the whole operator fits in the image. And the output for each position of the operator will be at the center of the mask.

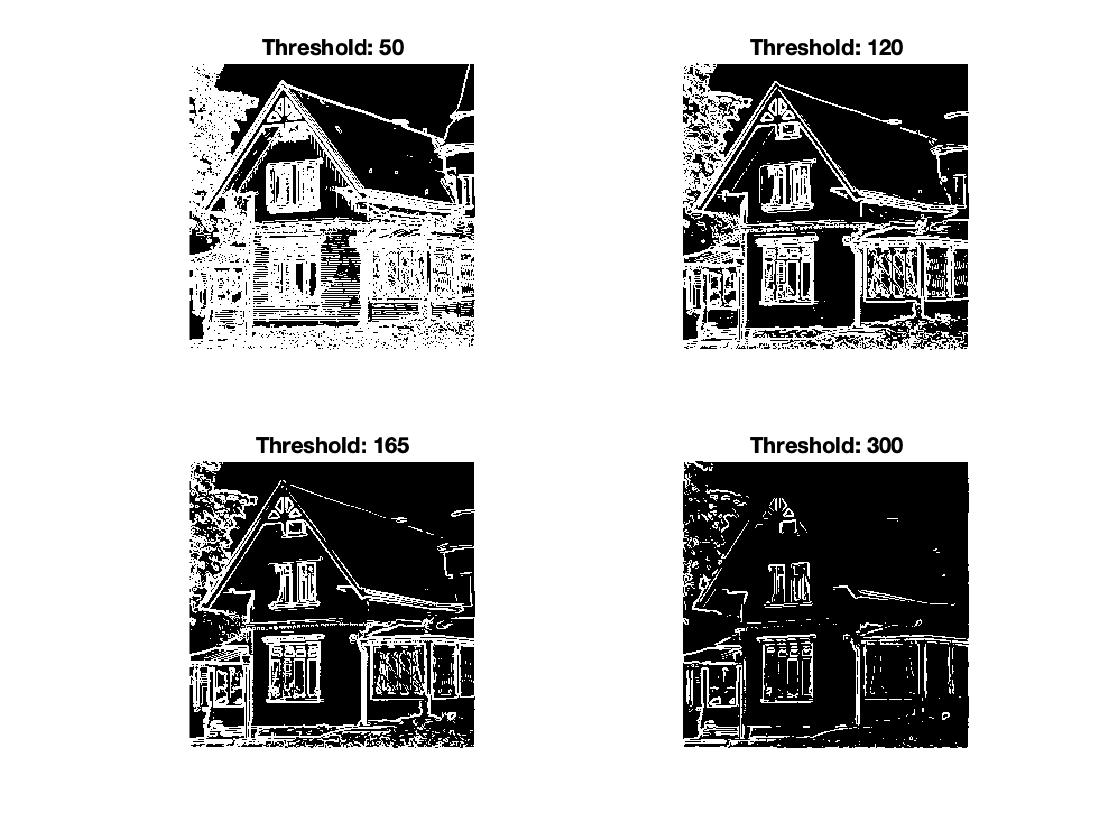


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**Question 2**: Is it easy to find a threshold that results in thin edges? Explain why or why not!

Answers:

The edges in the gradient magnitude image are of different width, intensity and shape. Thus a given threshold might result in thinner edges for some and may make others disappear or get fragmented. Due to this it is not easy to find a threshold that all edges benefit from. Most of them will get thinner, while others disappear. Below is an example of the ‘godthem256’ image for different thresholds. A lower threshold will allow wider edges, and therefore more edges. Thus the choice of the threshold will depend on the task and how much details one wish to have.

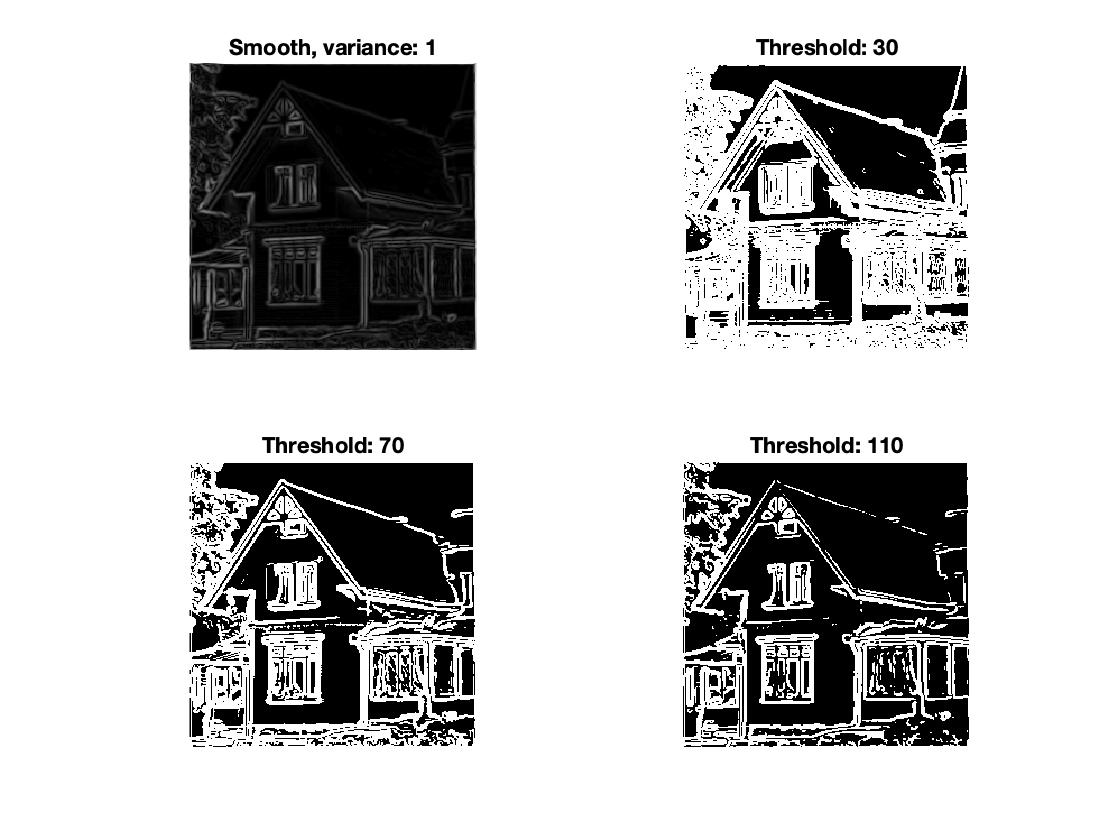


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**Question 3**: Does smoothing the image help to find edges?

Answers:

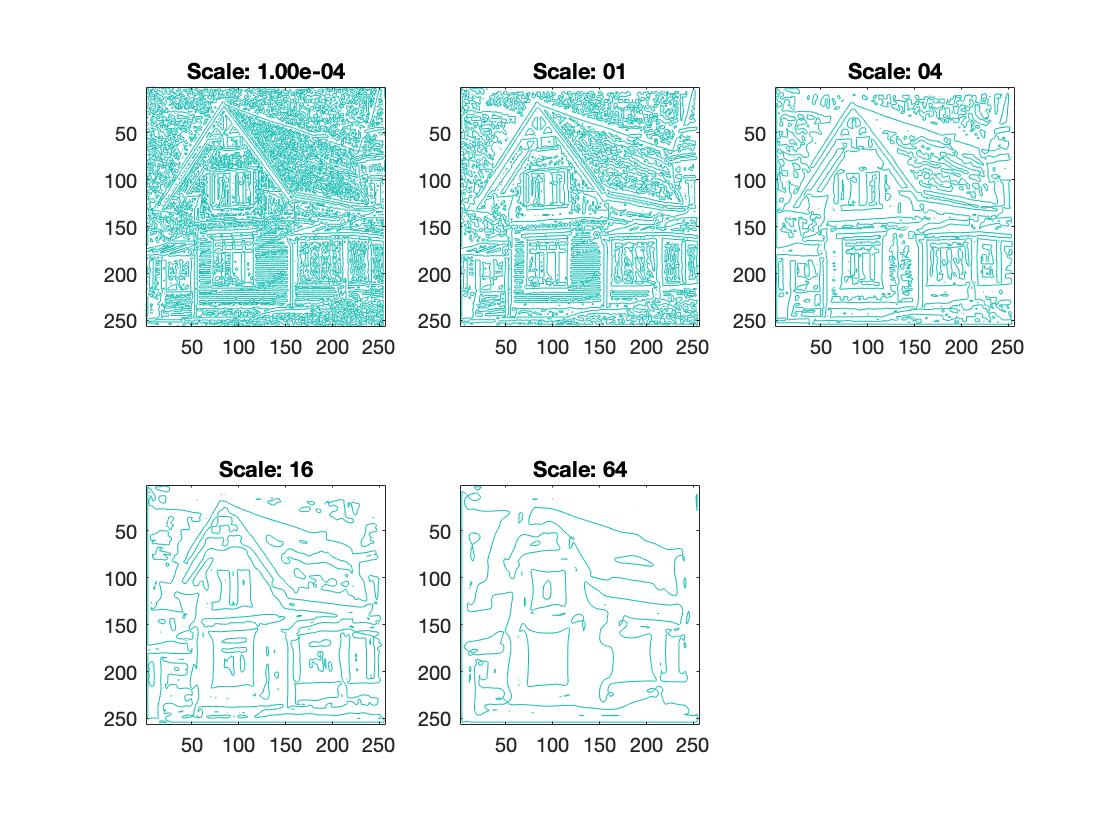
The Gaussian filter is a low pass filter, that suppresses noise and also details that lives in the high frequencies, but relatively well preserves boundaries and edges. Preceding the differentiation by smoothing will help reduce noise and “false positives”. But there is a trade-off problem, increasing the amount of smoothing will suppress noise but also give rise to higher distortions of “true” structures. With a decreased amount of smoothing, more accurate feature detection will be possible, but a higher number of “false positives” may be present. Smoothing can thus suppress details and one must adjust the amount of smoothing depending on what one wish to achieve. To find edges, smoothing may help to promote wider and more intense edges, but thin edges might fade away. Therefor smoothing is a good thing if one only wish to highlight the main structures in the image. When pre-smoothing the image, the threshold for thinning out the edges should be lower, since smoothing will decrease the intensity and sometimes also the width of features and therefore a lower threshold will be needed.



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**Question 4**: What can you observe? Provide explanation based on the generated images.

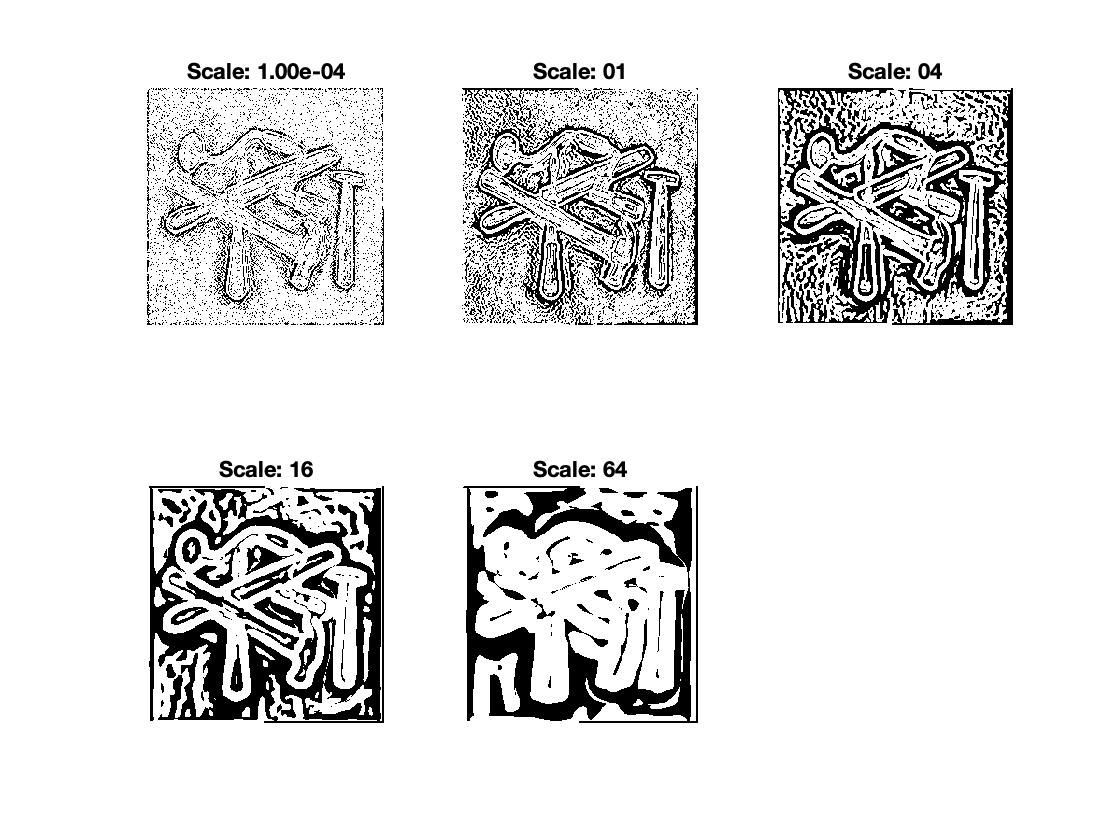
Answers:



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**Question 5**: Assemble the results of the experiment above into an illustrative collage with the *subplot* command. Which are your observations and conclusions?

Answers:



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**Question 6**: How can you use the response from *Lvv* to detect edges, and how can you improve the result by using *Lvvv*?

Answers:

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**Question 7**: Present your best results obtained with *extractedge* for *house* and *tools*.

Answers:

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**Question 8**: Identify the correspondences between the strongest peaks in the accu-mulator and line segments in the output image. Doing so convince yourself that the implementation is correct. Summarize the results of in one or more figures.

Answers:

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**Question 9**: How do the results and computational time depend on the number of cells in the accumulator?

Answers:

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**Question 10**: How do you propose to do this? Try out a function that you would suggest and see if it improves the results. Does it?

Answers:

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