Industrial & Medical Image Processing Lab

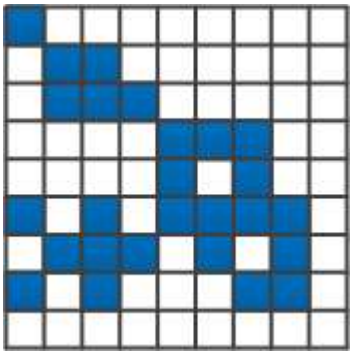
Session 04

Document the results of the exercises in a protocol. Upload both, protocol and source code in a zip-file.

Exercise 4.1

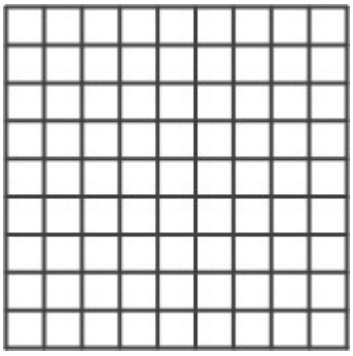
(a) Perform the following morphological operations. What are the operations about? If necessary use zero-padding, i.e. pixel outside of the image are considered as 0. 2P

$\boldsymbol{A}$

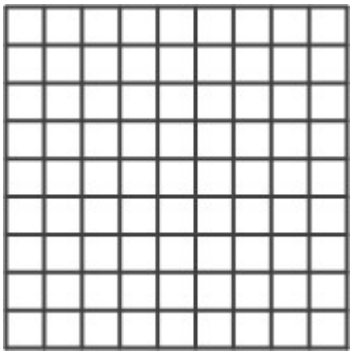


$\boldsymbol{B}$

$\mathbf{I} = \mathbf{A} \oplus \mathbf{B}$



$\mathbf{I} = (\mathbf{A} \oplus \mathbf{B}) \ominus \mathbf{B}$



(b) Use morphological operations in order to enhance the image in *„fingerprint*.png“ such, that possibly most noise is eliminated. Apply a thinning operation at the end to illustrate the resulting fingerprint. 3P

There are basically two ways of solution:

1. Binarisation through thresholding and afterwards morphological processing and thinning
2. First grey value morphology and then thresholding and thinning

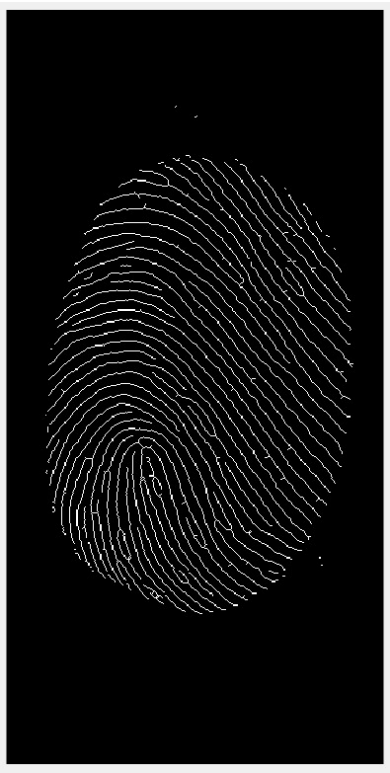
Execute both variants and compare the results (e.g. by simple subtraction of the resulting image.)
MatLab offers many functions for morphological operations. The most important ones are listed subsequently:

strel()	Generation of a structure element
imdilate()	Dilation
imerode()	Erosion
imopen()	Opening
imclose()	Closing
bwmorph()	Different morphological operations such as border extraction, Skeletonisation, thinning,…

Hint:

- Pay attention to fore- and background pixel (*imcomplement*)

Original Image



Thinned Image

c) Estimiate the number of balls in *‘balls.png’*. How could you easily analyse if the density distribution of the balls within the image is uniform? 2P

Exercise 4.2

(a) Segment the lungth in the image „*lungth_CT.jpg*“ using active contours. A simple implementation after Chan & Vese (2001, Active contours without edges. IEEE Transactions on Image Processing, 10(2), 266-277.) can be found in the sessions zip-file (“*act_cont_seg.m*”). 3P

An interactive selection (*“getrect”, “getpts”*) of an initial contour/region should be possible with your Matlab code. This contour/region serves as input for the active contour algorithm
Find out a parameter set in order to achieve an adequate segmentation result? Get to know the influence of the parameter α. Document your results.

Hint: You can use down-sampling of the image or mask with *imresize(xxx, 0.5)* to achieve a faster computation of the iterations.

(b) Extend the implementation in (a) in such way that two or more initial contours can be chosen. Is it possible to segment the butterfly as well as the flower in the image „*butterfly.jpg*“. 1P
Discuss and document the results, problems and insights.

For all those how are further interested: here you’ll find an excellent paper on conventional and GVF active contours
http://www.iacl.ece.jhu.edu/pubs/p084j.pdf

Exercise 4.3

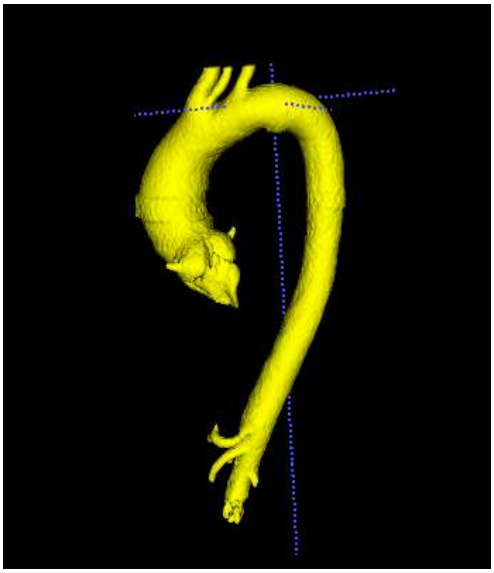
Install ITK-Snap and perform the segmentation tasks using the active contour tool.

(a) Follow the tutorial in ITK-SNAP_Tutorial.pdf in order to segment the spleen. 2P

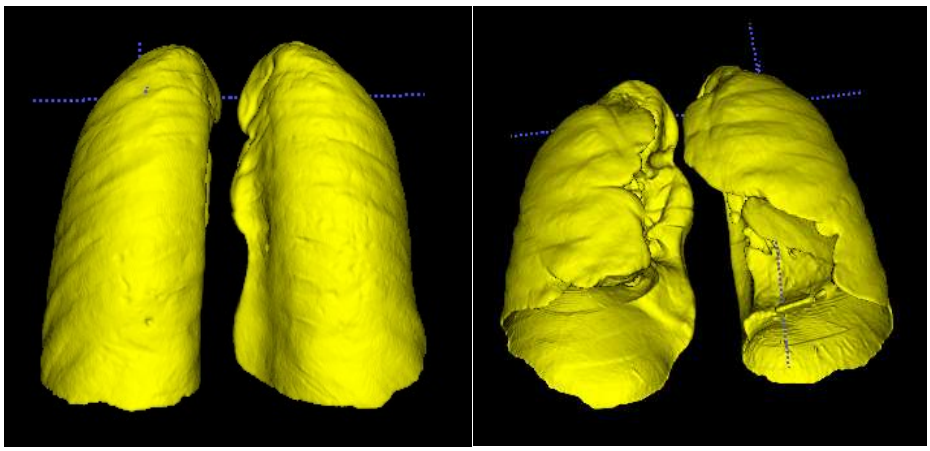
(b) Segment the aorta from the image data provided in the folder *CT_Aorta,* so the final 3D model looks similar to the image below (choose another active layer than the one used in the tutorial) 2P

(c+) Segment the lung so the final 3D model looks similar to the image below (This might take some time. Expect around 2500-3000 iterations, depending on the amount and placement of the bubbles) 2P

(d+) Feel free to segment any structures of your choice



3D model of the aorta



3D model of the lungth