Workshop: Introduction to Image Processing using Open-Source Software

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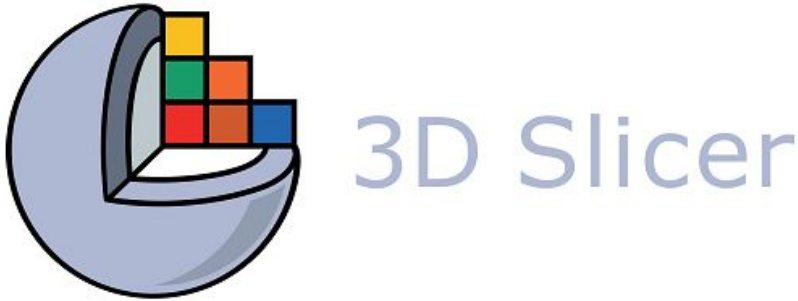
Agenda - Workshop

Day 1: Installation and use of software. Opening files.

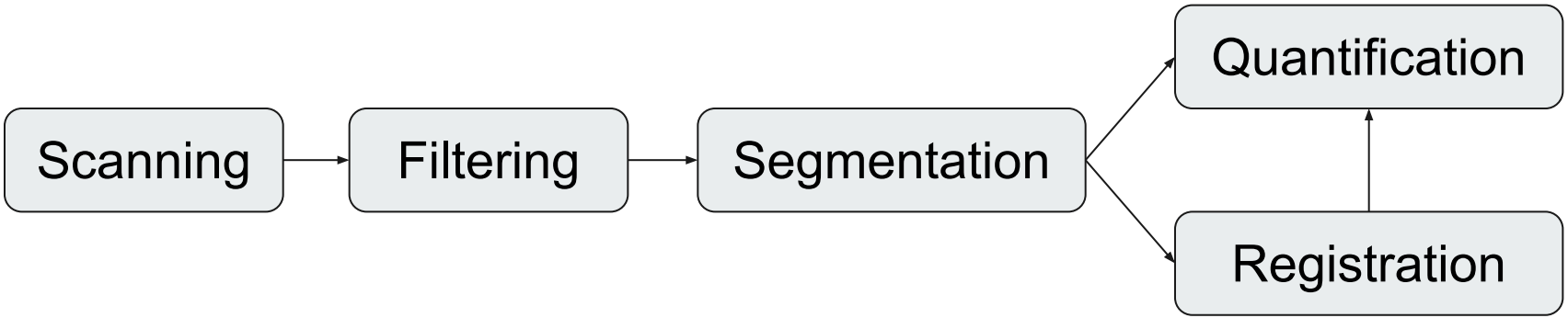
Day 2: Filtering

Day 3: Segmentation

Day 1



Day 2 - Filtering



An image processing pipeline

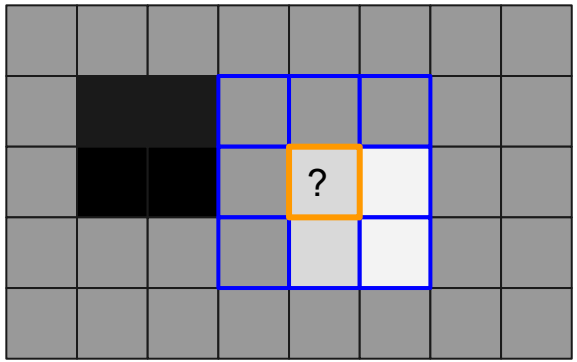
Filtering

Goals

- Noise reduction
- Enhance “important” characteristics of the image
  - And/or those required for further processing steps

Filters based on convolution

- They assign to the central pixel/voxel, the weighted average of it and the neighbourhood

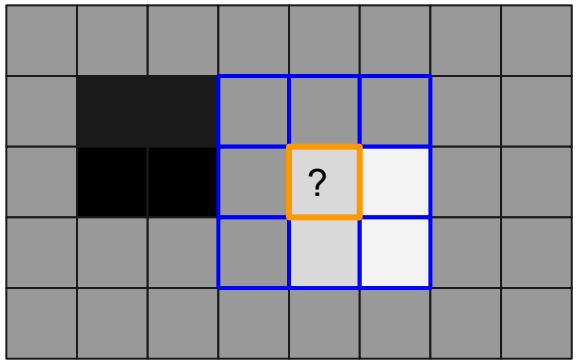


.11	.11	.11
.11	.11	.11
.11	.11	.11

.1	.1	.1
.1	.2	.1
.1	.1	.1

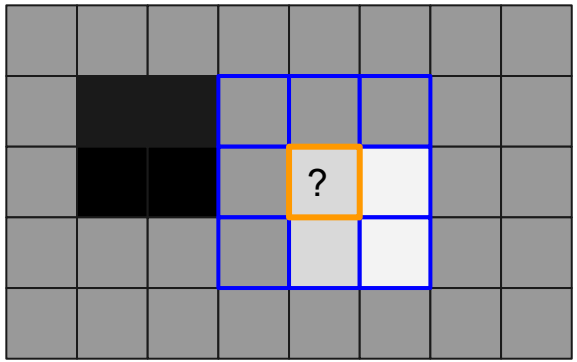
Median Filter

- They assign to the central pixel/voxel, the median value of the window
  - Good for punctual noise
  - Window size is the only parameter
  - It does not create new values in the image
  - Higher computational cost

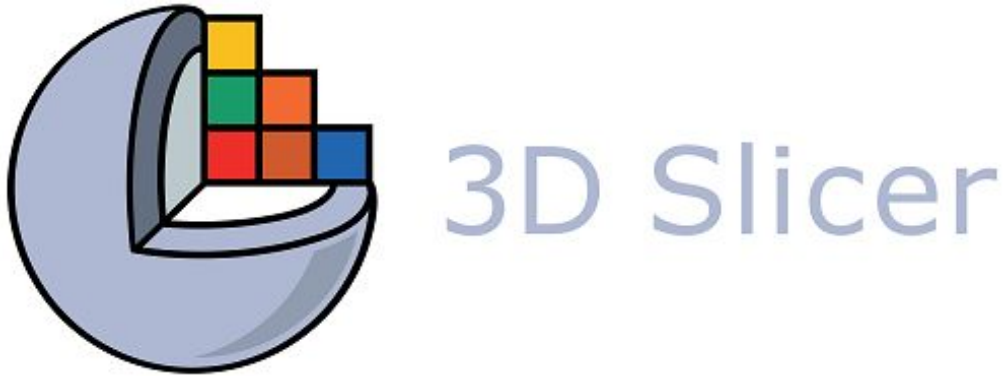


Anisotropic Diffusion Filter

- They assign to the central pixel/voxel, the weighted average of the window.
- The weights are determined using other characteristics of the image.
- I.e. Perona-Malik filter, SRAD



Filtering in 3D Slicer



Edge detectors based on Convolution

- They highlight gradients in the image
- Can be modified to detect edges in particular directions and signs

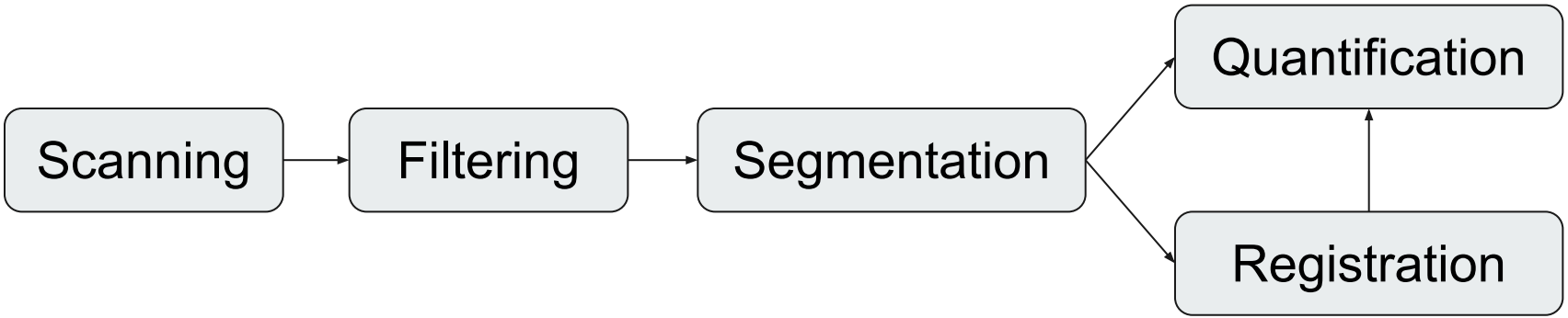
-1	0	1
-2	0	2
-1	0	1

Sobel Filter X

1	2	1
0	0	0
-1	-2	-1

Sobel Filter X

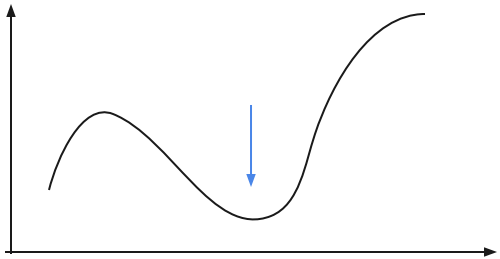
Day 3 - Segmentation



An image processing pipeline

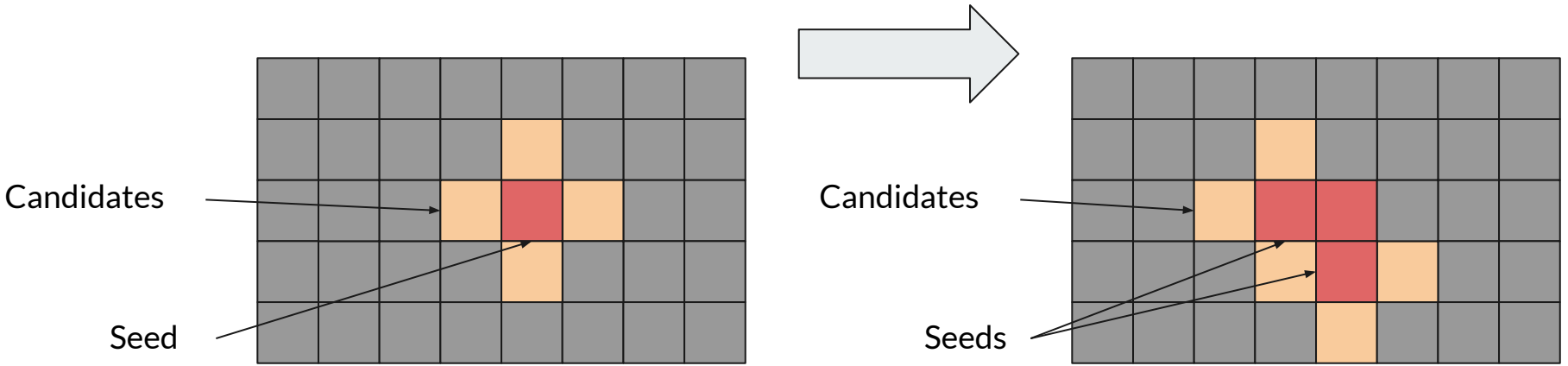
Thresholding

- Intensity values that are inside a range are supposed to be part of the object of interest.
- Different ways to establish the range:
  - Visual inspection
  - Histogram analysis
  - Automatic histogram analysis (i.e. Otsu's method)



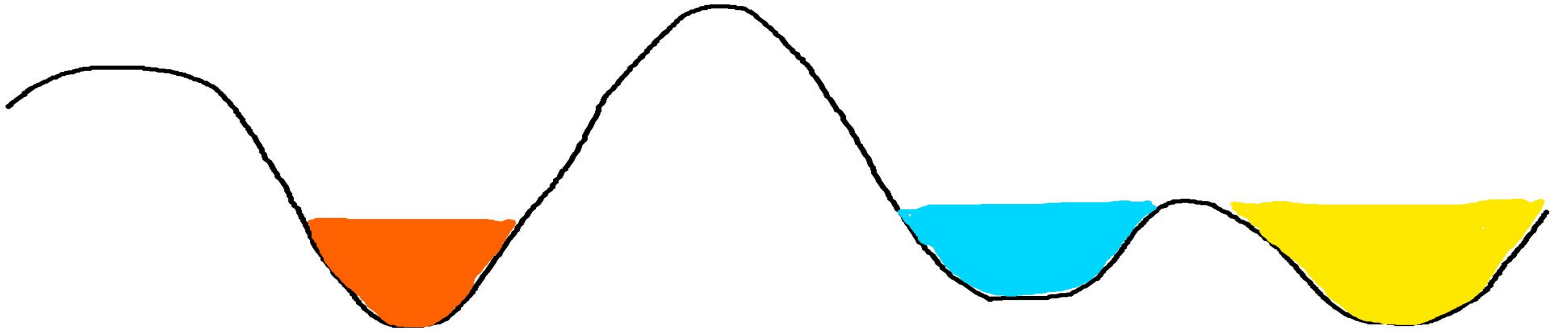
Region Growing

- Starting from a seed, it iteratively adds pixels/voxels if they comply with a certain criteria



Watershed algorithm

- A “flooding” is simulated in the image, with different starting points.
- The algorithm stops the evolution of a flooding before it encounters a different flooding.



Active contours or *snakes*

- The goal is to make an initial contour to evolve to the real edge of the object
- The evolution of the contour is guided by:
  - Internal forces: Stretching and bending of the curve
  - External forces: Intensities and edges of the image, among others