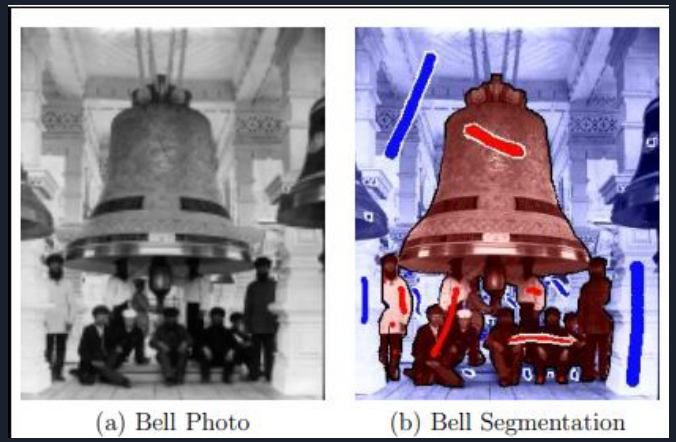
Image segmentation

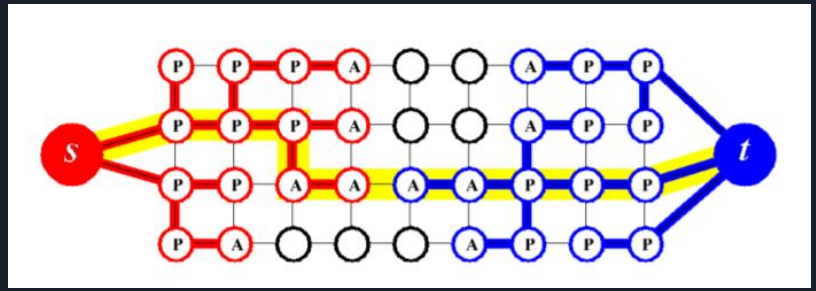
Hatim EL MALKI
Guillaume GHIENNE
Ilan KLEIMAN
Alexandre LEFEBVRE

Topic 3: Graph cut and image segmentation

Previously in “Graph cut and image segmentation”

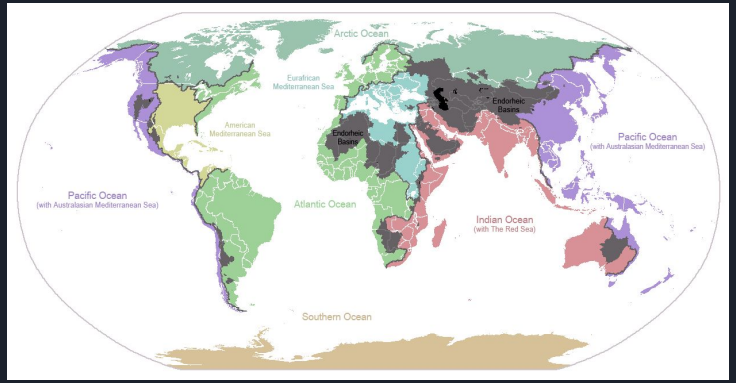


Purpose: divide a picture into two parts knowing the labels of a small subset of pixels.

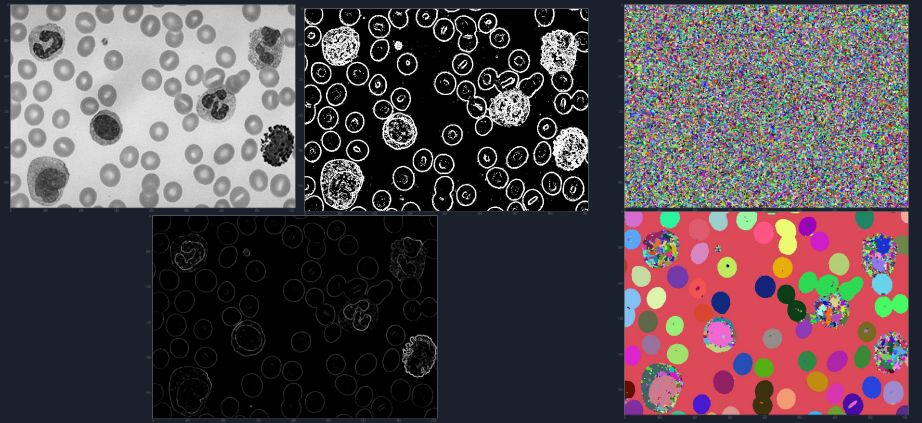


The algorithm of the article rely on paths exploration and edges weight.

I. Considered imaging problem and associated theoretical background: Watershed algorithm (steepest slope)



Drainage basins split a map of reliefs into areas along geological borders like mountains and hills.

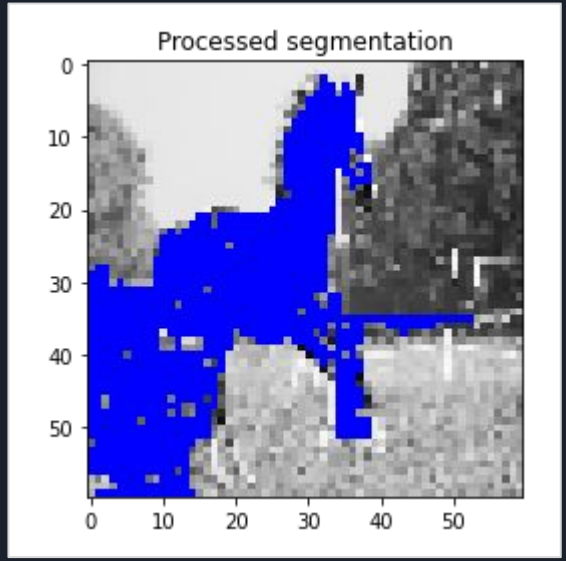


The gradient norm image is the equivalent of the relief map for the drainage basins. Here are the results with and without a threshold for the minimum value of the gradient

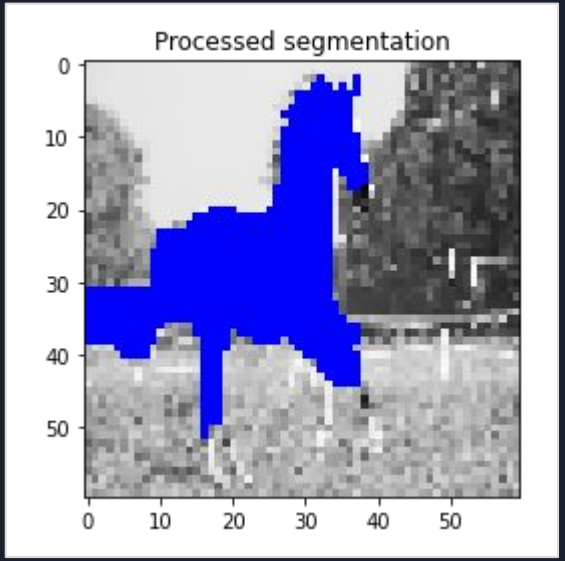
Principle of the algorithm: in which minimum would go a drop of water moving on the gradient norm image ?

II. Bolkov-Kolmogorov and Push Relabel Algorithms

- Usage of gaussian regularization cost. $e^{-(\|\nabla I\|/K)^2}$



Low K



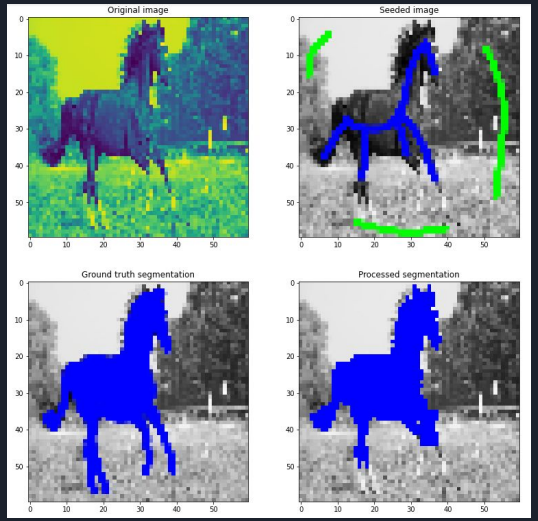
High K

III. Considered experimental setting

We evaluated 2 metrics for several images and sizes

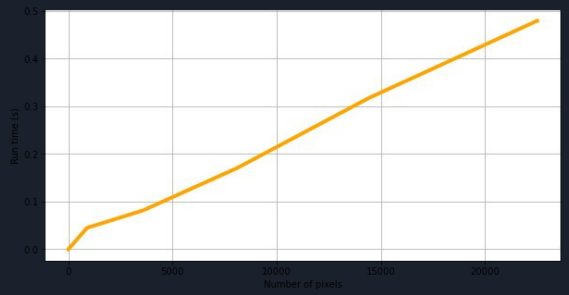
- Runtime in seconds as a function of the number of pixels.
- The Dice metric is a measure of the similarity between 2 sets (here the sets of labeled pixels)

$$s = \frac{2|X \cap Y|}{|X| + |Y|}$$

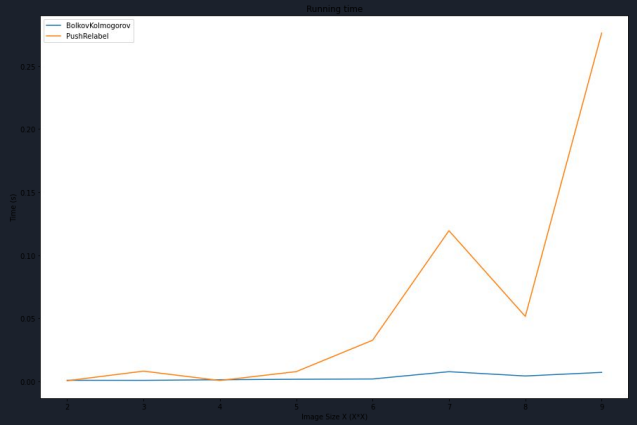


Ground truth and max flow/min cut result

III. Results



Watershed:
Linear with the number of pixels



Graph-cut:
Runtime as a function of the square root of the number of pixels.

- orange: push-relabel
- blue: Kolmogorov

100x100pxls	Horse	Baby	Football
Bolkov-Kolmogorov	259s	427s	218s
Watershed	0.23s	0.22s	0.22s

Run time

100x100pxls	Horse	Baby	Football
Bolkov-Kolmogorov	88%	96%	87%
Watershed (without erosion)	82%	96%	89%

Segmentation quality (Sørensen-Dice metric)