Graphs for image processing, analysis, vision and pattern recognition

Aims of the course: introduce image processing methods based on graphs for low-level applications like segmentation and higher level applications like pattern recognition.

• What is a graph? Which kind of graphs do you know for image processing?

• What is a Region Adjacency Graph? Do you know how to define the Voronoï diagram and Delaunay triangulation from a set of points?

• Which algorithms from graph theory have you already seen?

• Here is a toy image:

Propose a segmentation method of this image based on the minimum spanning tree.

Propose a segmentation method based on a minimum cut.

• Here is a toy image. Compute the cost of the cuts and normalized cuts.
• Doing a binary classification can be done by computing a min-cut. What is the graph to build for the following toy image - line and the energy: \( U(x|y) = \sum_s (y_s - \mu_{x_s})^2 + \beta \sum_{s,t} \Delta(x_s, x_t) \) (\( y_s \) is the grey-level of pixel \( s \), \( x_s \) is the class 0 or 1, \( \beta \) a penalization constant). \( \mu_0 = 5 \) and \( \mu_1 = 10 \).

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5 & 6 & 11 & 9 & 4
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• The decision tree allows to compute the maximal cliques of a graph. What is the decision tree for the following graph:

• To find sub-graph isomorphisms, an association graph can be computed. Determine the one associated to the two following graphs: