Pattern Analysis Joint Meeting
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Worksheet 11: Monday July 6 / Friday July 9 2021

Please watch the video prior to the lecture, and think about the questions below. In the joint meeting, you will have 20 minutes time to discuss the questions with your group. Afterwards, we will jointly discuss your solution proposals.

You can print this sheet and use the space below for your notes.

Task 1: Graph Cut-Solvable Potentials

Check whether each of the MRF setups below can be solved with our min cut transformation. As usual x_i, x_j denote hidden variables, and y_i denotes an observation associated with x_i.

(a) Setup 1:

Task:	Image Smoothing
Labels:	256 grayscale values, scaled between 0 and 1
Input:	256 grayscale values, scaled between 0 and 1
Connection structure:	grid-like 4-neighborhood (horizontal and vertical neighbors)
unary potentials:	$\exp\left(-3\sqrt{\lvert x_i - y_i \rvert}\right)$
pairwise potentials:	$\exp\left(-8\lvert x_i - x_j \rvert\right)$

(b) Setup 2:

Task:	Depth Estimation
Labels:	256 depth values in meters, ranging between 0 and 10
Input:	Calculations of disparity: Correlations between pairs of shifted input patches
Connection structure:	grid-like 4-neighborhood (horizontal and vertical neighbors)
unary potentials:	$\exp\left(-2\lVert x_i - \mathrm{disparity}(\mathrm{y}_\mathrm{i}^1, \mathrm{y}_\mathrm{i}^2) \rVert_2^2\right)$
pairwise potentials:	$\exp\left(-2\lVert x_i - x_j \rVert_2^2\right)$

(c) Setup 3:

Task:	Image Sharpening
Labels:	256 grayscale values, scaled between 0 and 1
Input:	256 grayscale values, scaled between 0 and 1
Connection structure:	grid-like 4-neighborhood (horizontal and vertical neighbors)
unary potentials:	$\exp\left(-(x_i - y_i)\right)$
pairwise potentials:	$\exp\left(-\frac{1}{\lVert x_i - x_j \rVert_2^2}\right)$

(d) Setup 4:

Task:	Image Smoothing
Labels:	256 grayscale values, scaled between 0 and 1
Input:	256 grayscale values, scaled between 0 and 1
Connection structure:	grid-like 8-neighborhood (horizontal, vertical, diagonal neighbors)
unary potentials:	$\exp\left(-3\sqrt{\lvert x_i - y_i \rvert}\right)$
pairwise potentials:	$\exp\left(-8\lvert x_i - x_j \rvert\right)$

Remarks on setup 2 (not super-necessary for solving this exercise, but probably good to know): our eyes triangulate depth by looking at the disparity of a point in the scene: the disparity is the lateral shift of a point when seen in the left eye versus seen in the right eye. The closer a point is, the larger is this shift (a finger in front of your nose creates a huge disparity between the left and right eye). Stereo camera systems calculate the disparity by sliding small image patches from the left camera over the image of the right camera. For each position, the correlation of the patches is calculated. The disparity is the shift with the maximum correlation.

Task 2: Discussion of the Programming Exercises

Let us have a look at the solution to the programming exercise 4!