The Hong Kong University of Science and Technology
Department of Computer Science and Engineering
COMP4421 (Spring 2016)

Assignment 2

Total = 100 marks
Due: 11:55pm, April 12, 2016
Assignments must be submitted via Canvas
Late Policy: 10% reduction; only one day late is allowed, i.e., 11:55pm, April 13.

Overview

This assignment consists of two sections: programming section and written section. Both programming and written parts should be submitted via the Canvas system. If you would like to finish the written assignment with hand writing, you may scan and upload it.

In the programming section, you will use MATLAB to complete a routine that can be used for the segmentation of gray-level images (consisting of four intensity classes) with global thresholding. The thresholds are estimated with a mixture of four Gaussian distributions and the Expectation-maximization method. A set of M-files can be obtained from Canvas system and the code skeleton has been implemented. You need to complete the missing implementations in the programming section.

Programming assignment specifics (70%)

You need to complete the implementation of the routine that can be used to segment gray-level images (consisting of four intensity classes) with global thresholding in the *segment_panda.m* file. The routine estimates the hidden probability density function (PDF) of the intensity values parametrically with the Expectation-maximization method, under the assumption that the PDF can be modeled by a mixture of four Gaussian distributions. Once the parameters of the statistical mixture model are estimated, three minimum error thresholds can be calculated and used to segment a panda image into four classes: first, second, third and fourth intensity classes.

In this assignment, a code skeleton is given and you need to complete the implementation of the following tasks:

a) Estimate the expected posterior probabilities ($\frac{1}{N}\sum_n p^{old}(j|z^n)$);
b) Estimate the parameters of the statistical mixture model;

c) Calculate the three minimum error thresholds, i.e. the three intersections among the four Gaussian distributions.

Note: The stopping routine of this iterative process has been implemented in the skeleton code; you don't need to take care of this part. Please read the comments in the skeleton code carefully and follow the procedures mentioned in the comments.

Sample runs of the programming assignment

sample_run.fig is the sample output. You are supposed to obtain similar output on the screen when you run the following command in the MATLAB environment:

>> segment_panda;

Written assignment specifics (30%)

Part 1: Opening and Closing (15%)

Prove the validity of the duality expression of opening and closing.

$$(A \bullet B)^c = \left(A^c \circ \hat{B}\right).$$

Hint: You may use the duality relation of erosion and dilation without proof.

Part2: Dilation and Erosion (15%)

For the following given image A

0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	0
0	0	0	1	1	1	1	0
0	1	1	1	1	1	1	0
0	1	1	1	1	1	1	0
0	1	1	1	1	0	0	0
0	1	1	1	1	0	0	0
0	0	0	0	0	0	0	0

and structuring elements B:

<1> B=

1	1	1
1	1	1
1	1	1

<2> B=

0	1	0
1	1	1
0	1	0

Calculate the dilation $A \oplus B$ and the erosion $A \Theta B$ using the structuring element <1> and <2> above.