EECS101: HOMEWORK #3

Due: February 3, 2017

Written Problem

Consider a region growing method that uses the homogeneity measure

$$\mathrm{H}(R_i) = \mathrm{TRUE} \quad \text{if} \quad \sigma_i^2 \leq 1$$
$$\mathrm{H}(R_i) = \mathrm{FALSE} \quad \text{if} \quad \sigma_i^2 > 1$$

where σ_i^2 is the sample variance of the pixels in region R_i. Assume that the method starts with the upper left pixel and always attempts to grow to a new connected pixel (assuming eight neighbors) whose gray level is closest to the average of the gray levels of the current region. For the grayscale image below, find the first region that will be generated using this algorithm (grow from the upper left pixel until $H(R_1)$ is FALSE). Circle this region in the image and compute the mean and sample variance of the region. For each step in the region growing process, write down the pixel values in the current region and their mean and variance.

Assume that the sample variance σ_i^2 of a region R_i is defined by

$$\sigma_i^2 = \frac{1}{N} \sum_j (I_j - \mu)^2$$

where N is the number of pixels in R_i, I_j are the pixel values in R_i, and μ is the mean of the pixel values in R_i. The sum is over the pixels in R_i. The gray-level image is

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 8   8  14  10  11
12   9  12  10  10
12  10  12  12   8
14  11   8   9  11
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Computer Problem

In this problem you will

1) segment a gray level image into a binary image by thresholding using a gray level histogram

2) find the area of the object in the binary image

3) find the center of area of the object in the binary image

Tasks

For each of three supplied 512×512 gray level images

1) Display the gray level image

2) Use provided software to display a gray level histogram of the image.

3) Choose a threshold that will separate object from background

4) Write a program to threshold the gray level image to obtain a binary image. For display purposes, let gray level 0 indicate background and let gray level 255 indicate object in the binary image. Your program should print out the area and center of area of the object and output the binary image with the center of area indicated by a small cross with gray level 128. You may assume for all calculations that there is only one connected object in the binary image. You do not need to find connected components.

5) Display the binary image that your program generates and check that your center of area appears correct.

You are required to demonstrate the operation of your program for your TA. In addition, for each of the three images, submit your generated binary image and the values for your threshold, the object area, and the object center of area (x, y). Assume that the origin of the (x, y) coordinate system is at the bottom left corner of the image.