CMPEN/EE455: Digital Image Processing I
Fall 2019
Project #2

assigned: Friday 13 September 2019
due: Friday 27 September 2019

reading assignment: same as Written Homework #2

Connected-Component Labeling and Set Operations

As discussed in L5, this project considers the application of a sequence of simple image-processing operations to an image, such as connected-component labeling and logical (set) operations.

1. **Bright-Region Extraction**

   (a) Consider the gray-scale image, "lenna.gif." Experimentally choose a threshold so that > 5 distinct "bright" components obviously appear. Save this thresholded image, "fthresh," in a form that makes the thresholded objects visible on the screen. (Note: it is okay to have a thresholded image containing $>>5$ components.)

   (b) Find the connected components of the thresholded image "fthresh." You can use the MATLAB function `bwlabel` for this purpose. The following MATLAB call creates a labeled image called "flabel" from the input thresholded (binary valued!) image "fthresh":

   ```
   [flabel, num] = bwlabel(fthresh, 8)
   ```

   where 8-connectivity is assumed for the components and `num` is the number of connected components labeled in "fthresh". To display this labeled image with colored components, you can use

   ```
   fRGB = label2rgb(flabel);
   ```

   And then use `imshow(fRGB)` to see the colored labeled image.

   (c) Save the 3 largest components of your labeled image and delete the other components by setting their constituent pixels to 0. You must write a function to do this.

   (d) Be sure to give output images for all steps above.

2. **Logical (Set) Operations**
   Note: you are to write your own functions for the operations in this part of the project — you may NOT use built-in Matlab functions.

   (a) Write functions for the AND, OR and XOR binary-image operators and NOT unary-image operator, using **A** and **B** as input images. What are the quantities **A** AND **B** , **A** OR **B**, **A** XOR **B**, and NOT(**A**) in terms of set union, intersection, and complement?

   (b) Let **A** be the "match1" image and **B** be the "match2" image. Compute the following images: **A** AND **B** , **A** OR **B**, **A** XOR **B**, and NOT(**A**)

   (c) Build the minimum operator and compute $\mathbf{E} = \min(\mathbf{C}, \mathbf{D})$, where image **C** is "mandrill_gray" and image **D** is "cameraman." For each pair of pixels (x, y) in the two input images, the minimum operator assigns the minimum of the two values ($\mathbf{C}(x, y)$ and $\mathbf{D}(x, y)$) to the output $\mathbf{E}(x, y)$. As we will see later during our discussion of Morphological Image Processing (G&W Ch. 9), the minimum operator is a gray-scale analog of set intersection (AND) and is sometimes called "erosion."

3. Write a report in the standard format. Be sure to describe all of your methods, including 1(c) and other parts.