CMPEN/EE455: Digital Image Processing I
Fall 2017
Project #5

assigned: 14 November 2017
due: Friday, 1 December 2017

reading assignment: G&W 9.1—9.3, 9.5 (up to page 711)), 9.6 (up to page 729), 10 (up to page 692), 10.3 (up to page 809).

Morphological Image Processing and Image Segmentation

For this project, you may **NOT** use MATLAB's built-in morphological functions.

1. MORPHOLOGICAL IMAGE PROCESSING — Consider the image "proj5" in the `Project 5` folder on CANVAS. This image contains some black text on a white background corrupted by two "line" streaks and by a thin grid.
   (a) Image "proj5" is not binary-valued. Thus, to begin, you must first threshold "proj5" appropriately, so that it becomes a true binary-valued image, where black ("0") constitutes the foreground and white ("255") constitutes the background.
   (b) Using the binary-valued image as input, devise a sequence of morphological and set operations that produce a new image with the following properties:
   (i) all corruptions are reduced;
   (ii) all letters are deleted except the tall letters in the set { D , P , l , I }.
   Give step-by-step results and explain the rationale for your method. Note: you will need to use morphological reconstruction to extract the letters — see the discussion for G&W Figure 9.31 to understand how to do this (G&W Sect. 9.6).
   (c) Edge Detection — Using morphological operations, find the edges of the detected letters in your processed image of (b).

2. MEDIAN FILTERING AND IMAGE SEGMENTATION — You will devise a "total system approach" for segmenting a noisy gray-scale image, as suggested in **L27.** Consider the image "wheelpepper" in the `Project 5` folder on CANVAS. This is the "wheel" image corrupted by pepper noise. As we saw in **L21-NonlinearFiltering,** the original "wheel" image contains 4 distinct components. Your task is to segment the wheel rim (third brightest component) in the corrupted image "wheelpepper." To solve this task, do the following:
   (a) Filter "wheelpepper" using a 3×3 median filter — use the MATLAB command below:
   ```
   fnew = medfilt2(f3,[3 3]);
   ```
   Give the original image and filtered image in your report, along with their histograms. Use your Project #4 histogram function!
   (b) Based on the filtered image's histogram, pick thresholds, T_1 and T_2, to threshold out the rim. Discuss your rationale for picking the thresholds.
   Next, apply your thresholds and connected-component labeling (as you did earlier in the semester) to segment the largest region in the thresholded image.
   Perform the operations above on both the original unfiltered image and the median-filtered image. (Use the same thresholds for both images!)
   (c) Give pictorial results for all steps for both images. What do you observe? Does median filtering help subsequent image segmentation?