CSE585/EE555: Digital Image Processing II
Spring 2014
Project #2 — Shape Analysis and the Skeleton

assigned: 5 February 2014
due: Friday, midnight, 21 February 2014 in ANGEL project drop box
reading assignment: Sections 6.7-6.12 of P&V (PitasCh6.pdf), Maragos and Schafer paper (Maragos-Schafer.pdf),

1. *Tall-Character Recognition* — Perform the appropriate operations to extract the "tall" (elongated) characters in the image "TextExcerpt.gif" — this was briefly suggested by page L5-4 of the lecture notes. The tall characters (e.g., " H ", " p ", and " l ") roughly have height $\geq$18 pixels, whereas the "short" characters (e.g., " e ") roughly have height $\leq$ 14 pixels. Also, note that this image isn't quite a binary image. As in Project #1, you will have to threshold it first before applying morphological operations. Furthermore, the background is *bright,* while the characters are *dark.* Your operations will require an appropriate opening followed by a conditional dilation to reconstruct/restore the tall characters.

2. *Morphological Skeleton* — Implement the morphological skeleton algorithm, as given by P&V Sect.6.8, eq. (6.8.2) (and in class). Let B be a 3×3 square. Apply this algorithm to the "penn256" and "bear" images. In addition, give the partial reconstructions, X_{2B}, X_{3B}, and X_{4B}. For all results, give figures that show the corresponding skeletons superimposed either on X or on the partial reconstructions.

3. *Shape Analysis* — For both parts below, let B be the 3×3 square. Also, for each considered image, you will need to isolate distinct objects and find the minimum bounding rectangle (MBR) [also referred to as the bounding box] enclosing each distinct object — feel free to use the MatLab connected-component labeling function to help derive an MBR.

   (a) Consider the "match1" image, which contains 4 objects (clover, spade, steer, and airplane).

      i. Compute the size distribution, pectrum, and complexity of each object. Give well-labeled plots and/or tables, as appropriate, for your results. Which object is the most complex? You must give quantitative results to back up your answer.

      ii. Now, consider image "match3," which contains rotated versions of the objects in "match1." Use pecstral analysis, as discussed in P&V Section 6.11 and the Lecture 6 notes, to determine which object in "match3" best matches the "spade" (upper right object) in "match1." Be sure to give all necessary pecstral and distance calculations in your report, in addition to the specific algorithm you use.

   (b) Consider the image "shadow1," which has four solid objects; the objects are characters from the "Peanuts" comic strip. Quantitatively (and automatically) match them to the proper objects depicted in the complementary image "shadow1rotated." Give sufficient results to make it perfectly clear how you arrived at your results.

4. Write a detailed report describing your results and implementations. Also, give a well-commented listing of your MATLAB code, abiding by the code specifications of the class project protocol.