CSE585/EE555: Digital Image Processing II
Spring 2019
Project #2 — The Morphological Skeleton and Shape Analysis

assigned: 6 February 2019
due: Friday, 22 February 2019 on CANVAS
reading assignment: Sections 6.7-6.12 of P&V (PitasCh6.pdf),
Maragos and Schafer paper (Maragos-Schafer.pdf),

1. *Morphological Skeleton* — Implement the morphological skeleton algorithm, as given by P&V Sect.6.8, eq. (6.8.2) (and in class). For the procedures below, try the following three structuring elements B, as on page L6-6:

   (a) 3×3 SQUARE
   (b) RHOMBUS
   (c) VEC045

   Apply the 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.

2. *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 with this.

   (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 objects 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.

3. 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.