Objective

The objective of this homework is to gain experience with 2D object extraction from an image that can be thresholded into a binary image. A secondary objective is for the student to become familiar with working with image files and simple programs that process them. Before handing in your work, reread these specs to make sure that your tests are done on the required images. Final test data will be selected by Tuesday of the week of the due date.

Problem 1

Write a connected components extraction program (or function) to perform the operations listed below. Some resources are discussed further below. You may obtain an existing image class or code for storing and operating on an image, but you must code your own components and feature extraction operations.

1. The program should read one input image file. X.pgm files, as described in Ch 2 (Fig. 2.12), will be available so you can read ASCII text if you want. You may assume that no image will be larger than 512 x 512. You may convert the X.pgm images to another format if you want, being aware that the conversion may result in image changes.

2. The program should threshold the input image into background (0) and objects (1). You may find an appropriate threshold by trial and error using your own program, or by using an image tool (gimp, etc.); it is not necessary to do thresholding automatically.

3. The program should detect and summarize each separate object (blob) by giving its (a) area, (b) centroid, (c) three second moments ($\mu_{rr}$, $\mu_{cc}$, $\mu_{rc}$), (d) and min inertia and max inertia about an axis through the centroid. Clean output should be produced for the report as well as some discussion about why it is correct or interesting. Make sure you discuss/sketch which image coordinate system is being used.

4. Report the results for the images hw2-1A and hw2-2B and for one image of your own choosing.

5. 1 or 2 points of extra credit for computing the circularity of the blobs according to formula 3.11 or 3.12 of the text.
**Problem 2**

Match up two blobs from image 2A to similar objects in image 2B. Compute the rotation and translation that maps the coordinates of the centroids in image 2A to the corresponding centroids in image 2B. You can find an example of how to do this at the bottom of page 335 of the text. (You may do this by hand, calculator, or tiny program.) Then, map all of the centroids for regions that have correspondences and note the error for each (difference between the extracted centroid in image B and the result of mapping the centroid from image A). For error, use Euclidean distance in the R-C-plane (pixel units). Discuss the results.

**Resources**

Students may use the following resources.

1. Students may use any of the C++ code referenced from the course web pages, but should not search for code anywhere else, except that an image class may be obtained. Those using MATLAB should not use the image processing library, but can use MATLAB image I/O. Cite your acquisitions.

2. Students may use image tools to change the format of the test images supplied, including the thresholding operation, (but not connected components (coloring)).

**Notes**

1. Program code or tools used that are developed by others should be documented. This is not a programming project; the objective is not to produce a beautiful program, but rather to learn to use an algorithm and to get correct results. But, you may use this code again in a future homework, so take care not to put it together too badly.

2. Your report must show the use of the program, the results, and some discussion of the results. Review the report format given in the syllabus.

3. Partial credit will be given for partial completion of the tasks.

4. Intermediate output beyond the requirements is allowed/encouraged, but please do not submit verbose output in your report.

**Remember: Academic Integrity**

The critical language from the MSU code is as follows. “...all academic work will be done by the student to whom it is assigned, without unauthorized aid of any kind. ... If any instance of academic dishonesty is discovered by an instructor, it
is his or her responsibility to take appropriate action.” Possible actions include assigning a failing grade for the assignment or course.

CSE 803 assignments are NOT to be done in groups. Discussion of course material relating to an assignment with fellow students is a valuable learning technique and is encouraged. Discussion of computer tools and clarification of assigned problems is also encouraged. However, group writing of programs or group solutions of assigned problems is NOT ACCEPTABLE. Reviewing a fellow student’s work AFTER submission is encouraged as a learning experience for both students.