CSSE463 Exam 1 Study Guide

The main ideas are feature extraction (image processing) and basic classifier concepts. The exam will be written, although some questions may ask you to write a few lines of Matlab code. Here are some sample questions. I will likely take some exam questions from these, although this list is by no means exhaustive.

1. Describe in detail how Matlab stores images as matrices.
2. Describe and explain the difference between various color spaces, such as RGB, HSV, and LST. Be able to sketch pictures and providing clear (non-circular) definitions of each of the three bands in the HSV space.
3. Understand 1D and 2D filters for smoothing (box and Gaussian filters) and edge finding.
    a. Describe basic mathematical properties of each (e.g., why smoothing filters must sum to 1).
    b. Be able to apply them to images manually.
4. Describe the process of computing the edge magnitude and direction in a grayscale image.
5. Compute each of the four morphological operations on simple image elements.
6. Use morphological operators to aid object recognition.
7. Describe appropriate times for a classifier to reject a sample.
8. Define and compute the various accuracy measures on test sets (e.g., recall).
9. Apply principles of classification: feature space, decision rules, decision surface. For example, draw a plot of tabulated feature data to represent a 2D feature space, and draw decision boundaries for a nearest neighbor classifier.
10. Create perceptrons to do simple classification.
11. Describe the basic formulation of support vector machines, including how an SVM can classify nonlinearly-separable data with 100% accuracy.
12. Compute shape features(e.g., area, perimeter, circularity, extent) for various binary shapes.
13. Sketch gray-level mapping functions that increase contrast, decrease contrast, and invert images.
14. Draw a radial representation of a shape.
15. Compute and describe the computation procedure for the covariance matrix of an image element, as used to determine principal axes and elongation, and plot major and minor axes given a set of eigenvectors.
16. Use Bayesian probability. For example, interpret an intensity histogram and compute an optimal threshold from probability density functions of the foreground and background.
17. Use the MAP principle to find the most likely class, given evidence.
18. Show how inner boundary tracing (Sonka, p 142-3) works on a given region.
19. Describe an algorithm to compute the area of a region without holes, given only its perimeter pixels, without regenerating the binary image.