CMSC 426

Mid term Examination

April 16, 1996

1. Define the following terms [25 points]

a. Simple point

b. End point

c. Accommodation

d. Connected component

e. Chromatic abberation

f. Image gradient

g. Background

2. Sub-template/template matching. Suppose you are trying to correlate a 15x15 template against a 500x500 image. [25 points]

a. About how many arithmetic operations are required for the brute force correlation, using the sum of squared difference measure, to correlate the template against the image? Assume that the correlation is not performed for the top and bottom 8 rows and the left and right 8 rows, so that the correlation window will completely fit into the image at all placements. [5]

b. Suppose that we choose a subtemplate of size 5x5 and correlate this against the image (again, ignoring the same rows and columns as in (a)), and then for the highest p% correlation values, we correlate the remaining 200 pixels from the template against the image at those locations. Write an expression, as a function of p, that reflects the total number of arithmetic operations that this two stage method uses. [15]

c. For what value of p is this two stage method more efficient than the one stage method? [5]

3. For the following binary image label its connected components using 8 adjacency for the 1's and 4 adjacency for the 0's. [10 points]

0000000000000
0011110011000
0110011001100
0110110100101
0111000000010
0011100000000
1100001100001
1100001100001

4. Image pyramids [20 points]

a. Given an image of size 2^n x 2^n how many pixels are there in the image at level i of the pyramid, where the original image is at level 0 and levels increase as we move upward? [5 points]

b. Write an expression that is equal to the total number of pixels in an image pyramid having at its base an image of size 2^n x 2^n . [15]

5. Edge detection [20 points]

a. Why is it important to smooth an image before applying an edge detector? [5 points}

b. When smoothing an image with a large convolution window, what is the advantage of the smoothing function being separable? [8 points]

c. What is non-maxima supression and why is it important in edge detection? [7 points]