CSC420 Intro to Image Understanding

Assignment 1 Fall 2018

Posted: Sept 19, Due Sept 26

Submit your solutions in a pdf or doc file on MarkUs, along with your code. Include images of your output. You can use built-in functions from OpenCV, Numpy, Scipy, or Matlab...etc, unless it is stated that you should write your own. For each piece of code, specify the question to which it corresponds.

1. **[2.5 points]** Write your own function that implements the correlation (for grayscale or color images and 2D filters) between an input image and a given correlation filter. The function must take as input: an input image 'I', a filter 'f', and a string 'mode', that can either be 'valid', 'same' or 'full'. The output must match what is specified by 'mode'.

2. **[1 point]** How would you use your function from part A to calculate the **convolution** between a filter and an image? Use your function from question 1 to convolve iris.jpg with a Gaussian filter $\sigma_x = 3$, $\sigma_y = 5$, use 'mode' = 'same'.

3. **[1 point]** Is convolution a commutative operation (f*g =? g*f)? Is correlation a commutative operation? Briefly Explain.

4. **[1 point]** Is the horizontal derivative. $\partial G(x,y)/\partial x$, of a Gaussian filter G a separable filter? Explain.

5. **[1 point]** Given a $n \times n$ image, I, and $m \times m$ filter, h, what is the computational cost of computing $h \bullet I$ if h is not separable? What is the computational cost if h is separable?

6. [**1 point]** Construct two different separable filters, such that when added, the result is a separable filter.

7. **[1 point]** Apply the derivative of Gaussian filter and Laplacian of Gaussian filter to portrait.jpg, show your results.

8. **[1 point]** Detect waldo.jpg in whereswaldo.jpg using correlation (use built-in methods). Your output should show whereswaldo.jpg with a rectangle around waldo.

9. **[1 point]** How does Canny edge detection work? In your explanation, state the purpose of each step.

10. **[0.5 point]** Briefly explain why the zero crossings of Laplacian of Gaussian can be used to detect edges (Hint: Laplacian is like second derivatives in 2D)

11. **[1 point]** Use Canny Edge detection on portrait.jpg, adjust the parameters to get rid of the details from the background.