CAP 5400 Digital Image Processing

QUIZ 1/2 (sample questions)

Sample Questions: (expect 4-5 questions on each exam)

- Describe in as much details as possible the idea of histogram stretching. How would you implement it? (Assume the range of initial histogram [a,b] and modified histogram [0,255].) Give short pseudo-code with all the formulas. What is main disadvantage of histogram stretching as compared to histogram equalization?
- Explain the concepts of variable thresholding. Give the exact formula. Give at least one advantage and one disadvantage as comparing to fix thresholding. Explain what image conditions call for variable thresholding technique.
- Explain the idea of image histogram. How is it used to guide threshold selection when binarizing an image? How histogram shape would indicate if thresholding is likely to be good or subdivision of images into sub-regions is needed (for different thresholds for each sub-image)?
- Explain the concepts of (a) threshold-based and (b) directional edge-preserving smoothing. How would you select which to use? Can you combine both concepts?
- Describe and compare RGB and HSI color representation schemes. What is the principal advantage of HSI representation? What is its main drawback? Consider applying histogram equalization to color images. Which representation you would choose: how and why? (Note: you do not need to provide HSI-RGB conversion formulas).
- Explain the idea of directional edge-preserving smoothing operation in details. What is the motivation for its use? Indicate selection of window size. How does it compare to threshold-based edge-preserving smoothing? When is it utilized vs. threshold-based edge-preserving smoothing?
- When converting between color and grey level images consider (a) RGB to/from YIQ color conversion and (b) RGB to/from HSI color conversion. Explain why each is utilized and discuss advantages of each representation. (Note: you do not need to provide exact formula, just discuss approximate computation required).

- Explain **in details** the idea of Gaussian smoothing. Specify how window weights are computed. Would you implement such smoothing as 2D window or two 1D windows? Explain why. How one decides on window size while implementing Gaussian smoothing.
- Consider 12bit intensity data. How would you utilize the idea of histogram equalization to display such data using all three color channels (R,G,B) of the computer monitor (each displayed using 8 bits). Give enough details to implement such algorithm.
- Explain the idea of compass operator for implementation of gradient-based edge detector. Give some examples. Compare this implementation to the directional-derivatives based implementation.
- Explain the idea and describe the algorithm of the median filter. What image content makes the median filter useful? What is its computational complexity? Suggest at least one way to speed it up.
- Describe **in detail** the iterative (optimal) threshold selection algorithm. Explain all the steps including initialization and stopping criterion.
- Explain the idea of gradient-based grey level edge detection (based on directional derivatives, df/dx and df/dy). Define edge strength and edge direction (give formulas). Show how the Sobel operator implements this approach.
- Explain an idea and application of 2D median filter. Under what noise condition it should be utilized, i.e. what kind of noise it removes. Give 3x3 numeric example. Consider image of thin line drawings. How median filter will affect such image? Consider 3x3 and 5x5 median filters for previous question.
- Consider implementation of 3x3 Sobel edge detector as compass operator. Give all masks and explain how edge strength and edge direction is computed.