

Summary of Questions for the First Exam

CS5680/CS6680 Fall 2024

Problem I: Basic Concepts: Spatial Filters [Total: 25 points, 4 questions]

Slides 38-44, 47-49, 51-57, and 63 of my class notes Ch3.1.DIPBasicSpatial.pdf

Low-pass filter:

Standard averaging filter, weighted averaging filter, median filter, weighted median filter

High-pass filter:

Laplacian filter (Strong and Weak), Sobel filters (G_x and G_y)

You need to be familiar with the following:

- 1) The appearance of each filter (i.e., the coefficients in each filter)
- 2) The properties (or characteristics) of each filter.
- 3) The effect of applying a low-pass filter or a high-pass filter to the original image.
- 4) Convolution operations
- 5) Standard median filtering and weighted median filtering (Assignment 3)
- 6) Using a Laplacian filter to enhance an image
- 7) Using Sobel filters to detect edges, identify ignificant edges, and determine edge orientation
- 8) Built-in functions for performing convolution, calculating the average value of a matrix, finding the median value of a matrix, and determining the total of a matrix.

Problem II: Basic Concepts: Frequency Domain (Fourier and Wavelet) [Total: 30 points]

Fourier Transform [18 points; 2 questions]

Slides 11, 43-45, 54-64, and 68-76 of my class notes Ch3.2.DIPBasicFreq.pdf

Low-pass filter:

Ideal low-pass filter, Butterworth low-pass filter, and Gaussian low-pass filter

High-pass filter:

Ideal high-pass filter, Butterworth high-pass filter, and Gaussian high-pass filter

You need to be familiar with the following:

- 1) The appearance of each filter when displayed as a 2D image
- 2) The properties (or characteristics) of each filter
- 3) Write a function to generate a filter based on its formula
- 4) Write a function to perform operations in the Fourier transformed domain
- 5) The Fourier spectrum (magnitude) and phase spectrum (phase), as well as filtering in the Frequency domain (*slides 11, 45, and 46 of my class notes Ch3.2.DIPBasicFreq.pdf*)
- 6) The overall appearance of centered Fourier transformed images for a given image with specific properties
- 7) The phase is more important than the magnitude (Assignment 4)

- 8) Built-in functions for performing fast Fourier transformation, inverse Fourier transformation, shifting the zero-frequency component to the center, rearranging a zero-frequency-shifted Fourier transform back to the original transform output, finding the phase of a Fourier transformed image, finding the magnitude of a Fourier transformed image, and extracting the real and imaginary parts of a complex number.

Wavelet Transform [12 points; 2 questions]

Slides 106-110 and 127 of my class notes Ch3.2.DIPBasicFreq.pdf

You need to be familiar with the following:

- 1) The differences between the two sets of wavelet transform and inverse wavelet transform functions
- 2) The effect on the original image after modifying some values in a specified subband. (Assignment 4)
- 3) Write a function to perform operations in the wavelet transformed domain
- 4) Built-in functions for performing wavelet transform and inverse wavelet transform.

Problem III: Questions related to image enhancement techniques [Total: 25 points, 3 questions]

Slides 9-16, 19 and 25-29 of my class notes Ch3.1.DIPBasicSpatial.pdf

You need to be familiar with the following:

- 1) Compute and plot histogram, normalized histogram, and cumulative normalized histogram
- 2) Histogram equalization technique
- 3) Linear scaling technique (Assignment 2)
- 4) Various transformation functions
- 5) Write a function to compute histogram, normalized histogram, and cumulative normalized histogram, as well as to perform histogram equalization and linear scaling operations.

Problem IV: Questions related to the filtering in the spatial domain [Total: 10 points, 2 questions]

You need to be familiar with the following:

- 1) Perform various filtering operations (including convolution and median filtering) to obtain the filtered images
- 2) Compute edge orientation and edge histogram (Assignment 3)
- 3) Apply the thresholding technique (Assignment 1)

Problem V: Questions related to morphological operations [Total: 10 points, 4 questions]

Slides 2-17, 27-33, 38-40, 42-43, 49-50, and 65-70 of my class notes Ch4.DIPMorphology.pdf

You need to be familiar with the following:

- 1) Dilation and erosion operations:
 - Given a binary image, demonstrate the results after performing a series of morphological operations, including dilation and erosion operations.
- 2) Set operations