

CS/ECE 545 (Digital Image Processing) Midterm Review

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Exam Overview

- Wednesday, March 5, 2014 in-class
- Will cover up to lecture 5 (Harris Corner Detection)
 - Includes today's class
- Can bring:
 - One page cheat-sheet, hand-written (not typed)
 - Calculator
- Will test:
 - Theoretical concepts
 - Mathematics
 - Algorithms
 - Programming
 - ImageJ knowledge (program structure and some commands)



What am I Really Testing?

- Understanding of
 - concepts (NOT only programming)
 - programming (pseudocode/syntax)
- Test that:
 - you can plug in numbers by hand to check your programs
 - you did the projects
 - you understand what you did in projects



General Advise

- **Read your projects** and refresh memory of what you did
- **Read the slides:** worst case – if you understand slides, you're more than 50% prepared
- Focus on **Mathematical results, concepts, algorithms**
- Plug numbers: calculate by hand
- Try to **predict subtle changes** to algorithm.. What ifs?..
- **Past exams:** One sample midterm is on website
- All lectures have references. Look at refs to focus reading
- Do all readings I asked you to do on your own



Grading Policy

- I try to give as much partial credit as possible
- In time constraints, laying out outline of solution gets you healthy chunk of points
- Try to write something for each question
- Many questions will be easy, exponentially harder to score higher in exam

Introduction to Image Processing



- What is an Image?
- Imaging system (parts)
- Digital image: an approximation
- What is image processing?
- Examples image processing operations: know what each type of operation does
 - Noise removal, contrast adjustment, segmentation, edge detection, image compression, etc
- Applications of image processing
 - Face recognition, fingerprinting, law enforcement, etc

Introduction to Image Processing



- Relationships with other fields (computer vision, image analysis)
- The key stages in image processing: know the stages and what each stage does
- Light, the electromagnetic spectrum & Image processing
- Structure of the human eye (rods, cones, fovea, etc)
- Image formation (in the eye & pinhole camera)
- Brightness adaptation and discrimination



Introduction to Image Processing

- Image acquisition
- Spatial sampling
- Image quantization
- Image as a discrete function
- Representing images
- Image resolutions:
 - spatial resolution vs intensity level resolution
- Saturation & noise
- Image File formats

ImageJ



- ImageJ parts
- Key features
 - Interactive tools, plugin mechanism, macro language + interpreter
- Software architecture
- Writing plugins



Histograms

- What is a histogram?
- Uses, interpretation of histograms
- Image issues easily identified using histogram
- Histograms: image brightness, contrast and dynamic range
- Computing histograms and binning



Histograms

- Color histograms
- Cumulative histograms
- What is a point operation?
- Point operations
 - Clamping, inverting images, thresholding, etc
 - Gray level transformations
 - Intensity windowing
- Contrast adjustment
- Histogram equalization

Operations on Histograms

- Histogram specification
- Histogram matching
- Gamma correction
- Alpha blending

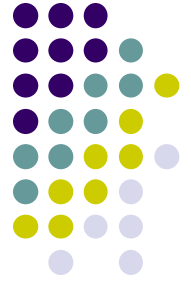




Image Enhancement & Filters

- What is image enhancement?
- What is a filter
- Spatial filtering
- Smoothing using averaging filters
- Weighted smoothing filters
- Dealing with out of range image coordinates
 - Crop, pad, extend, wrap
- Linear filters vs non-linear filters



Filters

- Linear smoothing, gaussian filters
- Difference filters
- Convolution
 - Properties, separability, etc
- Noise
 - What is noise
 - Noise types: speckle noise, salt-and-pepper noise, etc
 - Best filter types to clean types of noise



Filters, Edge Detection

- Non-linear filters: min, max, median, weighted median filters
- Outlier method for cleaning noise
- Edge detection
 - What is an edge, characteristics
 - Edge operators
 - Gradient-based edge detection
 - Prewitt, Sobel, Roberts, Compass edge detection filters



Edge Detection

- Edge detection using 2nd derivatives
- Canny edge detection
- Contours and edge maps
- Image sharpening
 - Edge sharpening using Laplace operator
 - Edge sharpening using unsharp masking
- Harris corner detection