ECE 468: Digital Image Processing

• Instructor:
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• Office:
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• Office Hours:
  Tuesday 2:30-3PM, or by appointment

• Classes:
  MWF 2-2:50pm, BAT 144

• Class website:
  http://web.engr.oregonstate.edu/~sinisa/courses/OSU/ECE468/ECE468.html
Recommended Textbook

- Additional readings on the class website
Suggested Readings

Course Objectives

• Cover basic theory and algorithms widely used in image processing

• Develop hands-on experience in processing images

• Familiarize with MATLAB Image Processing Toolbox

• Develop critical thinking about the state of the art
Prerequisites

• Signals and systems: ECE 351 and ECE 352

• Linear algebra
  • Matrices, Matrix Operations
  • Determinants, Systems of Linear Equations
  • Eigenvalues, Eigenvectors

• Statistics and probability
  • Probability density function, Probability distribution
  • Mean, variance, co-variance, correlation
  • Priors, Posteriors, Likelihoods
  • Gaussian distribution

• Good programming skills
Requirements

• Homework
  • Turn-in a hard copy
  • Homework = Mini-project must be implemented in MATLAB
  • Homework should be an individual effort
  • Late homework will not be accepted without prior approval

• Graduate students will be given approximately 20% greater amount of work for homework assignments
Exams will be closed-book.

- Midterm on November 6, 2-2:50pm, BAT 144
- Final on December 7, 12-1:30pm, BAT 144
Grading Policy

- Homework = 20%
- Midterm Exam = 35%
- Final Exam = 45%
**Academic Honesty -- Examples of Cheating**

- Bringing forbidden material or devices to the examination
- Working on the exam before or after the official time allowed
- Requesting a re-grade of work altered after the initial grading
- Submitting a homework that is not your own work
A Typical Digital Image Processing System

3D world

camera

input image

algorithms

representations

problem understanding

trade offs

training data

expert systems

knowledge base

users

processed image
What is a Digital Image?
Pixel Values

![Diagram of a 3D pixel value distribution with a 2D representation of the same data.]

Source: DIP/3e
What is a Digital Image?

- Two-dimensional function \( f(x,y) \) or matrix
- \( x, y, f(x,y) \) are discrete and finite
- Image size = \( \max_x \times \max_y \) -- e.g. 640x480
- Pixel intensity value \( f(x,y) \in [0, 255] \)
Visible Spectrum of EM
Based on Psychophysical Studies

• Cones in the human eye
  • red (R) 65%
  • green (G) 33%
  • blue (B) 2%

• R = 700nm
• G = 546.1nm
• B = 435.8nm

• Color = combination of primary colors R, G, B
Color Model = Color System = Color Space

- Purpose: To facilitate specification of colors
- RGB color model
Sources of Energy for Image Formation

**FIGURE 1.5** The electromagnetic spectrum arranged according to energy per photon.
Some Applications -- Medical Diagnostics

- Gamma-ray imaging
- X-ray imaging

Source: DIP/3e
Some Applications -- Magnetic Resonance Imaging
Some Applications -- Microscopy

Visible-light microscopy imaging

Source: DIP/3e
Some Applications -- Industrial Inspection
Some Applications -- Remote Sensing

Aerial images

Satellite images
Some Applications -- Infrared Satellite Images

Source: DIP/3e
Some Applications -- Storing Images

Standard DVD

Blue-ray DVD
Some Applications -- Transmitting Images

Video conferencing
Some Applications -- Image Forensics
Fundamental Steps in Digital Image Processing
Fundamental Steps in Digital Image Processing

• Acquisition
• Spatial and frequency transforms
• Enhancement (subjective)
• Restoration (objective)
• Color processing
• Multi-resolution processing
• Compression
• Morphological processing
• Segmentation