

# 198:334 Introduction to Imaging and Multimedia

## Proposed Syllabus

Dr. Ahmed Elgammal has offered this course on an experimental basis in Spring 2008 and Fall 2009.

**Last experimental offering class web page:** <http://www.cs.rutgers.edu/~elgammal/cs442.htm>

### Overview:

This is a basic undergraduate-level class that covers fundamentals image processing, computer vision, and multimedia computing. The students will be exposed to dealing with image and video data through programming assignments using Java and Matlab.

### Topics:

- Introduction to Multimedia: Historical overview, multimedia representations, software tools, authoring tools.
- Basics of Image Formation: Camera and lenses, image formation, basic camera models and geometry. Standard image formats. Colors in images and videos.
- Image Computing: Binary image analysis: The basics of processing 2D images, thresholding, convolution, edge detection, mathematical morphology, and shape descriptors. Application: implementation of a simple Optical Character Recognition (OCR) System.
- Multimedia compression basics: Lossless Compression: Variable length coding, Dictionary based coding. Basics for Lossy Compression: Fourier Transform, Discrete Cosine Transform. Application to image compression (JPEG compression)
- Video Processing: Fundamental concepts of video, image and video compression, MPEG video coding, MPEG4, 7, and beyond.
- Audio Processing: Basics of digital audio, quantization and transmission of Audio. Audio compression, Audio MPEG.
- Multimedia applications: content-based retrieval in digital libraries: case studies.

### Programming Assignments:

Course assignments will be using Java and Matlab. We will use ImageJ, which is an image processing library using Java. Prior knowledge of Matlab is not required.

### Recommended Background:

Linear algebra and basic probability and statistics. Java Programming.

### PreReq:

- 198:112 OR 14:332:351
- 198:206 OR 14:332:321
- 640:250

### Textbooks

- W. Burger & M. Burge “Digital Image Processing: An algorithmic introduction using Java”, Springer 978-1-84628-379-6
- Z. Li and M. S. Drew, “Fundamentals of Multimedia”, Prentice Hall 0-13-061872-1

### Course Load

- Homework/programming assignments and small projects: (60%) 4-5 assignments.
- Exams: Midterm (15%) and Final (25%).

## Tentative Class Calendar

FMM: Fundamental of Multimedia text book

DIP: Digital Image Processing text book

Week	Lecture
Week 1	<ul style="list-style-type: none"><li>▪ Introduction to Multimedia - FMM Ch 1, Ch 2</li><li>▪ Image formation and Cameras - DIP Ch 2</li></ul>
Week 2	<ul style="list-style-type: none"><li>▪ Image Histograms and applications – DIP Ch 4</li><li>▪ Point Operations –DIP Ch 5</li><li>▪ Image Formats</li></ul>
Week 3	<ul style="list-style-type: none"><li>▪ Image Filters &amp; Convolution - DIP Ch 6</li><li>▪ Edges and Contours – DIP Ch 7</li></ul>
Week 4	<ul style="list-style-type: none"><li>▪ Edges and Corners – DIP Ch 7 &amp; 8</li><li>▪ Perceptual Grouping: Curves and Hough transform - DIP Ch 9</li></ul>
Week 5	<ul style="list-style-type: none"><li>▪ Binary Image Analysis and Morphology – DIP Ch 10</li><li>▪ Region Descriptors – DIP Ch 11</li></ul>
Week 6	<ul style="list-style-type: none"><li>▪ Color Images, Color spaces: Color spaces for TV and Video; Color spaces for Printing, Colorimetric color spaces.</li><li>▪ Color quantization – DIP Ch 12</li></ul>
Week 7	<ul style="list-style-type: none"><li>▪ Fourier Transform, Discrete Fourier Transform, Discrete Cosine Transform – DIP Ch 13 &amp; 14</li></ul>
Week 8	<ul style="list-style-type: none"><li>▪ Lossless compression: Variable length coding, Dictionary-based coding, LZW compression -- FMM Ch 7</li></ul>
Week 9	<ul style="list-style-type: none"><li>▪ Lossy Compression, Image Compression standards, JPEG, JPEG 2000 - FMM Ch 8 &amp; 9</li><li>▪ Concepts of Video -FMM Ch 5</li></ul>
Week 10	<ul style="list-style-type: none"><li>▪ Video Compression: Motion Compensation, H.261 standard -- FMM Ch 10</li></ul>
Week 11	<ul style="list-style-type: none"><li>▪ Video Compression, MPEG1, MPEG2, MPEG4- FMM 11, 12</li></ul>
Week 12	<ul style="list-style-type: none"><li>▪ Basics of Audio - FMM Ch 6</li></ul>
Week 13	<ul style="list-style-type: none"><li>▪ Audio Compressions: Temporal and Frequency Masking, MP3 - FMM Ch 13, 14</li></ul>
Week 14	<ul style="list-style-type: none"><li>▪ Multimedia Applications: Content-based retrieval in digital libraries - FMM Ch 18</li></ul>