

# 198:334 Introduction to Imaging and Multimedia

## Fall 2016 - Course Syllabus

Instructor: Dr. Ahmed Elgammal -- email: [elgammal\\_a-t.cs.rutgers.edu](mailto:elgammal_a-t.cs.rutgers.edu)  
Office hours: Friday 2:30-3:30pm - CoRE 316

**Email policy: please include CS334 in the subject line.**

TA: Ji Zhang ([jj462@rutgers.edu](mailto:jj462@rutgers.edu)) - Office hours: Wednesday 4:00-5:00 pm in CBIM.

TA: Hui Qu ([hui.qu@cs.rutgers.edu](mailto:hui.qu@cs.rutgers.edu)) - Office hours: Tuesday 10:30 am to 11:30 in CBIM.

Regular class time:

Lectures: Tue&Thu 3:20- 4:40 PM - Livingston TIL-232

Recitations: Sec 01 Tue 5:15-6:10 PM - Livingston LSH-B117

Sec 02 Thu 6:55-7:50 PM - Busch SEC-202

**Class Web page:** <http://www.cs.rutgers.edu/~elgammal/cs334.htm>, Also a Sakai page

### Course Goals

The aim of CS334 is to introduce the student to fundamental techniques and concepts used in computational imaging and multimedia. Upon completion of this course, a successful student should be able to design and implement programs that deal with image, video, and audio data.

### Description:

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

### Recommended Background:

Linear algebra, basic probability and statistics. Java Programming.

### Pre-Requisites:

- 01:198:112 OR 14:332:351 (Data Structures)
- 01:198:206 OR 14:332:226 OR 01:640:477 (Discrete Mathematics and Probability)
- 01:640:250 (Linear Algebra)

### Topics:

- Introduction to Multimedia: Historical overview, multimedia representations, software tools, authoring tools.
- Basics of Image Formation: Camera and lenses, digitization, 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 and corner 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.

### Textbooks

- W. Burger & M. Burge “Digital Image Processing: An algorithmic introduction using Java”, Springer 978-1-84628-379-6 - First Edition or Second Edition
- P. Havaldar and G. Medioni “Multimedia Systems – Algorithms, Standards and Industry Practices”, Cengage Learning – 978-1-4188-3594-1 (recommended for some topics – not required)

### Course Load

- Homework/programming assignments and small projects: (60%) 4-5 assignments.
- Exams: Midterm (15%) and Final (25%).
- Presentation: (extra credit) 5% can be achieved by researching and presenting a technology review topic.

### Tentative Class Calendar

MS: Multimedia Systems

DIP: Digital Image Processing text book

Week	Lecture
Week 1	<ul style="list-style-type: none"><li>▪ Introduction to Multimedia - MS Ch 1</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 DIP Ch 2 or MS Ch 3</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. DIP Ch 12 or MS Ch 4</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 – MS Ch 6</li></ul>
Week 9	<ul style="list-style-type: none"><li>▪ Lossy Compression, Image Compression standards, JPEG, JPEG 2000 - MS Ch 7</li><li>▪ Concepts of Video – MS Ch 3</li></ul>
Week 10	<ul style="list-style-type: none"><li>▪ Video Compression: Motion Compensation, H.261 standard – MS Ch 8</li></ul>
Week 11	<ul style="list-style-type: none"><li>▪ Video Compression, MPEG1, MPEG2, MPEG4- MS Ch 8</li></ul>
Week 12	<ul style="list-style-type: none"><li>▪ Basics of Audio – MS Ch 3</li></ul>
Week 13	<ul style="list-style-type: none"><li>▪ Audio Compressions: Temporal and Frequency Masking, MP3 – MS Ch 9</li></ul>
Week 14	<ul style="list-style-type: none"><li>▪ Multimedia Applications: Content-based retrieval in digital libraries</li></ul>