Rochester Institute of Technology
Rochester, New York
COLLEGE of SCIENCE
Center for Imaging Science

Information Theory for Imaging Science 1051-714

Date: October 24, 2006 Credit Hours: 4
Prerequisite(s): 1051-713 or permission of instructor.

Goals of the course
• Understanding of information measures
• Understanding of source coding techniques based on symbol sequences
• Understanding of storage and communication channel models
• Understanding of transformation, quantization and coding for compression
• Understanding of error control techniques for storage and communications

Course description
This course develops a basic understanding of the efficient representation of information for storage and transmission. Classical concepts of information theory are developed and applied to image compression, storage and transmission. The intent is to develop a foundation for the efficient handling of image-based information in imaging systems. Also offered online. Class 4, Credit 4 (S)

Possible resources (texts, references, computer packages, etc.)
1. Instructor’s Course Notes
2. Journal and conference papers

Topics
2. The classical measure of information and its relationship to entropy. The relationship of entropy to efficient source coding.
3. Mutual information and channel capacity
4. Limits on information transmission rate. Shannon’s channel coding theorem discussed via the law of large numbers.
5. Basic error control techniques using linear block codes.
6. Waveform and image coding by use of linear prediction to reduce sample redundancy.

7. Image transformations for the reduction of redundancy and match to perceptual factors. Emphasis on DCT and wavelet coding.

8. Examples of transform-based lossy compression (JPEG and JPEG 2000)

9. Decision theory and optimal decision rules

**Intended learning outcomes and associated assessment methods of those outcomes**

<table>
<thead>
<tr>
<th>Learning Outcome</th>
<th>In class attendance and evaluation</th>
<th>Homework Assignments</th>
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<tbody>
<tr>
<td>7.1 Ability to construct efficient lossless coding algorithms</td>
<td>X</td>
<td>X</td>
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<tr>
<td>7.2 Ability to analyze rate-distortion tradeoff for lossy compressing systems</td>
<td>X</td>
<td>X</td>
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<td>7.3 Ability to estimate the capacity of an information transmission channel</td>
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<td>X</td>
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<td>7.4 Ability to compute information relationships in source-observer systems</td>
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**Instructional Techniques:**

2.1 Course notes will be provided for most topics above. Additional reading will be required from conference papers and journal articles.

2.2 The lectures will focus on the main points of each topic. Lecture Slides are posted in the **Content** section of **myCourses**.

2.3 Problem sets will be assigned and posted in the **Content** section of **myCourses**. The problem sets will generally be collected and graded. Solutions will be posted in the **Content** section of **myCourses**.

**Learning Assessment:**

3.1 The assessment of your degree of mastery of the course material and achievement of the course objectives is based on your performance on two exams and your homework grade. Each exam is worth 100 points and the homework is worth 100 points.

3.2 Exams are proctored, closed-book, problem-type exams. Each exam is designed to test your basic understanding and your ability to apply the concepts in solving problems.
3.3 The final grade will be based on the total number of points earned (300 points maximum). The conversion of the final numerical grade into a course letter grade is based on a curve.

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