ECE 4440 – Computer Vision

Winter 2020

Course Objectives

An introduction to theory and techniques used for processing and analysis of digital images for autonomous machine interpretation.

Course Content

The following topics will be covered:

• Digital image basics: pixels, colour spaces, logical operations, thresholding, gamma transform.
• Visualizing pixel intensity distributions, contrast stretching, histogram matching.
• Linear filtering: convolution, noise, mean, median, rank order and normal distribution filtering.
• Mathematical morphology and image segmentation.
• Edge, line, corner detection: Laplacian, Gaussian, zero-cross, anisotropic filtering.
• Image shape and texture descriptors.
• Geometrical and topological properties of digital images.
• Image classification.
• Use of Matlab in image and video processing and analysis.

Textbook


Other Resources


Learning Outcomes

1. Learning digital image fundamentals: visual perception, digital image pixels, image features.
2. Applying knowledge of Matlab in digital image representation, colour spaces, histogram, quantization of image features.
3. Learning and applying knowledge in analyzing image filtering, DFT, enhancement, and registration methods.
4. Learning and applying knowledge in analyzing image decomposition and reconstruction with wavelets, image morphology, WFT.
5. Learning and applying knowledge in analyzing image segmentation, representation, description, and recognition techniques.

Expected Competency Levels

<table>
<thead>
<tr>
<th>Outcome</th>
<th>KB</th>
<th>PA</th>
<th>IN</th>
<th>DE</th>
<th>ET</th>
<th>IT</th>
<th>CS</th>
<th>PR</th>
<th>IE</th>
<th>EE</th>
<th>EP</th>
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Important Dates

- **Term Tests**
  - Tuesday, February 4th, 2020 (in class)
  - Tuesday, March 10th, 2020 (in class)
- **Voluntary Withdrawal Deadline**
  - March 18th, 2020
- **Louis Riel Day**
  - February 17th, 2020
  - No classes or examinations
- **Spring Break**
  - February 18th – 21st, 2020
  - No classes or examinations

Updated: January 3, 2020
Accreditation Details

**Accreditation Units**
- Mathematics: 15%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 85%
- Engineering Design: 0%

**Attributes**
- KB: A knowledge base for engineering
- PA: Problem analysis
- IN: Investigation
- DE: Design
- ET: Use of engineering tools
- IT: Individual and team work
- CS: Communication skills
- PR: Professionalism
- IE: Impact of engineering on society/environment
- EE: Ethics and equity
- EP: Economics and project management
- LL: Life-long learning

**Competency Levels**
1. Knowledge (Able to recall information)
2. Comprehension (Ability to phrase information)
3. Application (Ability to apply knowledge in a new situation)
4. Analysis (Able to break problem into its components and establish relationships.)
5. Synthesis (Able to combine separate elements into a whole)
6. Evaluation (Able to judge the worth of something)

**Grading Scale**

<table>
<thead>
<tr>
<th>Letter</th>
<th>Mark</th>
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<tbody>
<tr>
<td>A+</td>
<td>95–100</td>
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<td>85–94</td>
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<tr>
<td>B+</td>
<td>80–84</td>
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<tr>
<td>B</td>
<td>70–79</td>
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<tr>
<td>C+</td>
<td>65–69</td>
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<td>C</td>
<td>55–64</td>
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<tr>
<td>D</td>
<td>45–54</td>
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<td>F</td>
<td>&lt;45</td>
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Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.

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**CEAB Graduate Attributes Assessed**

- **KB.4** – Recalls and defines, and/or comprehends and applies information, first principles, and concept in specialized engineering science.
- **PA.4** – Evaluates a solution to a complex engineering problem.

**Evaluation**

The final course grade will be determined from a student’s performance in laboratories, periodic quizzes, 2 term tests, and a final examination. Students must complete all of the laboratories in order to be eligible to receive a passing grade.

<table>
<thead>
<tr>
<th>Component</th>
<th>Value (%)</th>
<th>Method of Feedback</th>
<th>Learning Outcomes Evaluated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quizzes</td>
<td>10</td>
<td>F, S</td>
<td>1, 2, 3, 4, 5</td>
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<tr>
<td>Laboratories</td>
<td>20</td>
<td>F, S</td>
<td>2, 3, 4, 5</td>
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<tr>
<td>Term Tests</td>
<td>20</td>
<td>F, S</td>
<td>1, 2, 3, 4</td>
</tr>
<tr>
<td>Final Examination</td>
<td>50</td>
<td>S</td>
<td>1, 2, 3, 4, 5</td>
</tr>
</tbody>
</table>

* Method of Feedback: F - Formative (written comments and/or oral discussion), S - summative (numerical grade)

**Academic Integrity**

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the General Academic Regulations on Academic Integrity, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

**Requirements/Regulations**

- Attendance at lectures and laboratories is essential for successful completion of this course. Students must satisfy each evaluation component in the course to receive a final grade.
- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should also familiarize themselves with the University’s General Academic Regulations, as well as Section 3 of the Faculty of Engineering Academic Regulations dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, smart watches, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.
- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

**Retention of Student Work**

Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University’s Intellectual Property Policy and the protection of privacy provisions of The Freedom of Information and Protection of Privacy Act (Manitoba). Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.