Western University
Faculty of Engineering
Department of Electrical & Computer Engineering

ECE 9201a – Introduction to Digital Image Processing

COURSE OUTLINE 2023-2024

DESCRIPTION

The aim of this introductory course is to provide a solid background in the fundamentals of digital image processing. The course covers many of the major topics in the field, including image representation, histograms, contrast enhancement, algebraic operations, registration, digital filtering, and segmentation. The course concentrates on those techniques that have proven most useful in practice. A major aim of this course is to expose students to real-world applications of image processing in industry, science, and medicine. Through assignments, students will become familiar with the image processing facilities available in the popular MATLAB numeric computation and visualization environment.

PREREQUISITES

Undergraduate courses in signal processing (e.g., ECE 3331b at Western) and statistics (e.g., SS 2141a at Western)

ENROLLMENT RESTRICTIONS

Enrollment in this course is restricted to graduate students in Electrical & Computer Engineering, as well as any student that has obtained special permission to enroll in this course from the course instructor as well as the Graduate Chair (or equivalent) from the student's home program.

TOPICS

Topic #	Description	Learning Activities	Tentative timeline
1	Introduction and definitions	• Lectures	Sept. 8, 11, 12
2	Review of MATLAB and introduction to the image processing toolbox	• Lectures and demos • Assignment	Sept. 15, 18, 19, 22
3	Researching image-processing topics	• Lecture • Project	Sept. 25
4	Histograms	• Lectures • Practice problems	Sept. 26 Oct. 2
5	Point operations	• Lectures • Practice problems • Assignment	Oct. 3, 6, 10, 13
6	Algebraic operations	• Lectures • Practice problems • Assignment	Oct. 16, 20
7	Geometric operations	• Lectures • Practice problems • Assignment	Oct. 23, 24, 27 Nov. 6, 7
8	Making oral presentations	• Lecture • Demo • Project	Nov. 10
9	Convolution	• Lectures • Practice problems	Nov. 13, 17
10	Segmentation	• Lectures and demo	Nov. 20, 21, 24
11	Case studies	• Student presentations	Nov. 27, 28 Dec. 1, 4, 5

SPECIFIC LEARNING OUTCOMES

Degree Level Expectation	Weight	Assessment Tools	Outcomes
Depth and breadth of knowledge	50%	• Assignments • Quizzes • Project • Examination	• Understanding mathematical basis of algorithms • Awareness of important challenges in the field of study
Research & scholarship	20%	• Project	• Ability to conduct critical evaluation of current advancements in the field of specialization • Ability to conduct coherent and thorough analyses of complex problems using established techniques/principles and judgment
Application of knowledge	40%	• Assignments • Project	• Ability to select most appropriate algorithms for a given problem

			• Ability to develop, modify, and implement image-processing algorithms
Professional capacity / autonomy	5%	• Project	• Awareness of academic integrity • Ability to implement established procedures and practices in the coursework • Defends own ideas and conclusions • Integrates reflection into his/her learning process
Communication skills	10%	• Project	• Ability to communicate (oral and/or written) ideas, issues, results, and conclusions clearly and effectively
Awareness of limits of knowledge	10%	• Project	• Awareness of the need of assumptions in complex scientific analyses and their consequences • Understanding of the difference between theoretical and empirical approaches • Ability to acknowledge analytical limitation due to complexity of practical problems

ASSESSMENTS

Assessment Type	Material Covered	Tentative Due Date	Weight
Assignment 1	Topics 2 and 3	Fri., Oct. 6, 2023	5%
Assignment 2	Topic 4	Fri., Oct. 20, 2023	5%
Assignment 3	Topic 5	Fri., Nov. 10, 2023	5%
Assignment 4	Topic 6	Fri., Nov. 24, 2023	5%
Quiz 1	Topics 1-4	Tues., Oct. 17, 2023	5%
Quiz 2	Topics 5-7	Tues., Nov. 14, 2023	5%
Project presentation	Project topic to be decided later in consultation with instructor	Nov. 24, 27, 28 Dec. 1, 4, 5	20%
Final exam	All topics	Dec 10–22	50%

Activities in which collaboration is permitted:
- Assignments
- Practice problems
- Project

Activities in which students must work alone (collaboration is not permitted):
- Quizzes
- Final exam

REQUIRED TEXTBOOK
None. Complete lectures will be provided.

OPTIONAL COURSE READINGS
1. K.R. Castleman, <u>Digital Image Processing</u>, Prentice-Hall, Inc., Englewood Cliffs, 1996. (Forms basis of many of the lectures. On reserve at Allyn & Betty Taylor Library.)
2. Documentation on Matlab and the Image Processing Toolbox can be found on the Mathworks' Web site at https://www.mathworks.com/help/

CHEATING, PLAGIARISM/ACADEMIC OFFENCES
Academic integrity is an essential component of learning activities. Students must have a clear understanding of the course activities in which they are expected to work alone (and what working alone implies) and the activities in which they can collaborate or seek help; see information above and ask instructor for clarification if needed. Any unauthorized forms of help-seeking or collaboration will be considered an academic offense. University policy states that cheating is an academic offence. If you are caught cheating, there will be no second warning. Students must write their essays and assignments in their own words. Whenever students take an idea or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence. Academic offences are taken seriously and attended by academic penalties which may include expulsion from the program. Students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence at the following website: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf

CONDUCT
Students are expected to follow proper etiquette to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in course activities and/or is not following the rules and responsibilities associated with the course activities, will be reported to the Associate Dean (Graduate) (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Associate Dean (Graduate), the student could be debarred from completing the assessment activities in the course as appropriate.

HEALTH/WELLNESS SERVICES
As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several health and wellness related services to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. Information regarding health- and wellness-related services available to students may be found at http://www.health.uwo.ca/.

Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Faculty of Engineering has a Student Wellness Counsellor. To schedule an appointment with the counsellor, contact Kristen Edwards (khunt29@uwo.ca) via confidential email and you will be contacted by our intake office within 48 hours to schedule an appointment.

Students who are in emotional/mental distress should refer to Mental Health@Western: http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help.

SICKNESS

Students should immediately consult with the Instructor (for a particular course) or Associate Chair (Graduate) (for a range of courses) if they have problems that could affect their performance. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal. Obtaining appropriate documentation (e.g., a note from the doctor) is valuable when asking for accommodation due to illness.

Students who are not able to meet certain academic responsibilities due to medical, compassionate or other legitimate reason(s), could request for academic consideration. The Graduate Academic Accommodation Policy and Procedure details are available at:
https://www.eng.uwo.ca/graduate/current-students/academic-support-and-accommodations/index.html

ACCESSIBLE EDUCATION WESTERN (AEW)

Western is committed to achieving barrier-free accessibility for all its members, including graduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective graduate program. Graduate students with disabilities (for example, chronic illnesses, mental health conditions, mobility impairments) are strongly encouraged to register with Accessible Education Western (AEW): http://academicsupport.uwo.ca/accessible_education/index.html

AEW is a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both AEW and their graduate programs (normally their Graduate Chair and/or Course instructor) to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction.