



# THE UNIVERSITY OF WINNIPEG

## APPLIED COMPUTER SCIENCE

Course Number: **GACS-7205-001**  
Course Name: **Digital Image Processing**  
Course Webpage: <https://nexus.uwinnipeg.ca/d2l/home/67106>

### Instructor Information

**Instructor:** Qian Liu  
**E-mail:** [qi.liu@uwinnipeg.ca](mailto:qi.liu@uwinnipeg.ca)  
**Office Hours:** Wednesday 1:00 - 2:00 pm 3D31  
**Class meeting time:** Wednesday 6:00 - 9:00 pm 3D03

### Important Dates

1. First Class: Wednesday, January 8, 2025
2. Reading Week (no classes): February 16-22, 2025
3. Project Proposal Presentation Day: Wednesday, February 12, 2025
4. Final Withdrawal Date w/o academic penalty\*: Friday, March 14, 2025
5. Last Class: Monday, March 31, 2025
6. Final Exam: TBD
7. University closures: Louis Riel Day Monday, February 17, 2025  
Good Friday Friday, April 18, 2025

### Course Objectives / Learning Outcomes

This course provides a comprehensive overview of Digital Image Processing, covering topics such as image acquisition, manipulation, and segmentation, with a focus on applications in research. By completing this course, students will gain the skills to perform image processing and analysis and will be able to apply these techniques in image-based research.

### Evaluation Criteria

- Assignments (20%)
  - 2 assignments, worth 10% each.
  - All assignments are to be completed individually.

- Individual due dates will be posted on course website.
- Assignments will be accepted up to 1 day late with a 20% penalty.
- Project (60%)
  - The project aims to acquaint students with at least one practical application of image processing. It involves selecting a specific problem within the field of image processing and organizing it into a research proposal (within 3 pages). Then, conduct the proposed research by reviewing relevant literatures on the chosen topic, implementing a solution, and documenting the entire process into a comprehensive report (10-15 pages).
  - Project proposal (10%)
  - Project final report (50%)
  - Individual due dates will be posted on course website.
  - Proposal and report will be accepted up to 1 day late with a 20% penalty.
- Presentations (20%)
  1. Project proposal presentation (5%)
  2. Project final presentation (15%)

*Students should contact the instructor as soon as possible* if extenuating circumstances require missing a lab, assignment, test or examination. A medical certificate from a practicing physician may be required before any adjustments are considered.

Students with documented disabilities, temporary or chronic medical conditions, requiring academic accommodations for tests/exams (e.g., private space) or during lectures/laboratories (e.g., note-takers) are encouraged to contact Accessibility Services (AS) at 204-786-9771 or [accessibilityservices@uwinnipeg.ca](mailto:accessibilityservices@uwinnipeg.ca) to discuss appropriate options. All information about a student's disability or medical condition remains confidential.

<https://www.uwinnipeg.ca/accessibility-services>.

Students may choose not to attend classes or write examinations on holy days of their religion, but they must notify their instructors at least two weeks in advance. Instructors will then provide opportunity for students to make up work examinations without penalty. A list of religious holidays can be found in the 2024-25 Undergraduate Academic Calendar online at <http://uwinnipeg.ca/academics/calendar/docs/important-notes.pdf>

### **Final Letter Grade Assignment**

Historically, numerical percentages have been converted to letter grades using the following scale. However, instructors can deviate from these values based on pedagogical nuances of a particular class, and final grades are subject to approval by the Department Review Committee.

A+	90 – 100%	B+	75 – 79%	C	60 – 64%
A	85 – 89 %	B	70 – 74%	D	50 – 59%
A-	80 – 84%	C+	65 – 69%	F	below 50%

## **Required Text Book**

PDF version of Class Notes will be available on course website.

## **Prerequisite and Restriction Information**

This course assumes that students have strong programming skill in Python, and a working knowledge of machine learning/deep learning.

## **Regulations, Policies, and Academic Integrity**

Students are encouraged to familiarize themselves with the Academic Regulations and Policies found in the University Academic Calendar at:

<https://uwinnipeg.ca/academics/calendar/docs/regulationsandpolicies.pdf>

Particular attention should be given to subsections 8 (Student Discipline), 9 (Senate Appeals) and 10 (Grade Appeals).

***Avoiding Academic Misconduct:*** Academic dishonesty is a very serious offense and will be dealt in accordance with the University's policies.

Detailed information can be found at the following:

- Academic Misconduct Policy and Procedures:  
<https://www.uwinnipeg.ca/policies/docs/policies/academic-misconduct-policy.pdf> and  
<https://www.uwinnipeg.ca/policies/docs/procedures/academic-misconduct-procedures.pdf>
- About Academic Integrity and Misconduct, Resources and FAQs:  
<https://library.uwinnipeg.ca/use-the-library/help-with-research/academic-integrity.html>

Uploading essays and other assignments to essay vendor or trader sites (filesharing sites that are known providers of essays for use by others who submit them to instructors as their own work) involves "aiding and abetting" plagiarism. Students who do this can be charged with Academic Misconduct.

***Academic Integrity and AI Text-generating Tools:*** Students must follow principles of academic integrity (e.g., honesty, respect, fairness, and responsibility) in their use of material obtained through AI text-generating tools (e.g., ChatGPT, Bing, Notion AI). AI tools are permitted, but students must cite them. According to the MLA (<https://style.mla.org/citing-generative-ai/>), writers should

- cite a generative AI tool whenever you paraphrase, quote, or incorporate into your own work any content (whether text, image, data, or other) that was created by it
- acknowledge all functional uses of the tool (like editing your prose or translating words) in a note, your text, or another suitable location
- take care to vet the secondary sources it cites

**Non-academic misconduct:** Students are expected to conduct themselves in a respectful manner on campus and in the learning environment irrespective of platform being used. Behaviour, communication, or acts that are inconsistent with a number of UW policies could be considered “non-academic” misconduct. More detailed information can be found here:

- Respectful Working and Learning Environment Policy  
<https://www.uwinnipeg.ca/respect/respect-policy.html>,
- Acceptable Use of Information Technology Policy  
<https://www.uwinnipeg.ca/policies/docs/policies/acceptable-use-of-information-technology-policy.pdf>
- Non-Academic Misconduct Policy and Procedures:  
<https://www.uwinnipeg.ca/policies/docs/policies/student-non-academic-misconduct-policy.pdf> and <https://www.uwinnipeg.ca/policies/docs/procedures/student-non-academic-misconduct-procedures.pdf>

**Copyright and Intellectual Property:** Course materials are the property of the instructor who developed them. Examples of such materials are course outlines, assignment descriptions, lecture notes, test questions, and presentation slides—irrespective of format. Students who upload these materials to filesharing sites, or in any other way share these materials with others outside the class without prior permission of the instructor/presenter, are in violation of copyright law and University policy. Students must also seek prior permission of the instructor/presenter before, for example, photographing, recording, or taking screenshots of slides, presentations, lectures, and notes on the board. Students found to be in violation of an instructor’s intellectual property rights could face serious consequences pursuant to the Academic Misconduct or Non-Academic Misconduct Policy; such consequences could possibly involve legal sanction under the Copyright Policy:

<https://copyright.uwinnipeg.ca/basics/copyright-policy.html>

## **Privacy**

Students have rights in relation of the collecting of personal data the University of Winnipeg

1. Student Privacy: <https://www.uwinnipeg.ca/privacy/admissions-privacy-notice.html>
2. Zoom Privacy: <https://www.uwinnipeg.ca/privacy/zoom-privacy-notice.html>

## **Class Cancellation, Correspondence with Students and Withdrawing from Course**

When it is necessary to cancel a class due to exceptional circumstances, the course instructor will make every effort to inform students via UWinnipeg email and Nexus.

Students are reminded that they have a responsibility to regularly check their UWinnipeg e-mail addresses to ensure timely receipt of correspondence from the University and/or the course instructor.

Please let the course instructor know if you plan on withdrawing from the course. Note that withdrawing before the VW date does not necessarily result in a fee refund.

### **Topics to be covered (tentative)**

1. Introduction
  - What is an image?
  - Computerized processes
  - Early digital images
  - Applications of digital image processing
2. Digital image fundamentals
  - Elements of visual perception
  - Light and the electromagnetic spectrum
  - Image sensing and acquisition
  - Image sampling and quantization
  - Relationships between pixels
3. Intensity transformations and spatial filtering
  - Image transformations
  - Image slicing
  - Histogram processing
  - Spatial filtering
  - Image enhancing
4. Filtering in the frequency domain
  - Fourier transform
  - Discrete Fourier transform
  - Frequency domain filtering
  - Image smoothing and sharpening
5. Color fundamentals
6. Image restoration
  - Noise models
  - Degradation functions
  - Inverse filtering
  - Minimum mean squares filtering
  - Geometric mean filter
7. Advanced Topics in Digital Image Processing
  - Image segmentation
  - Feature extraction
  - Deep convolutional neural networks

*A permitted or necessary change in the mode of delivery may require adjustments to important aspects of course outlines, like class schedule and the number, nature, and weighting of assignments and/or exams.*