THE UNIVERSITY OF WINNIPEG

APPLIED COMPUTER SCIENCE

Graduate Course Number: **GACS-7205-001**
Graduate Course Title: **Digital Image Processing**
Class Meeting Time: **Mondays & Wednesdays, @10:00-11:15**
Class Room: **3D03**
Course Webpage: http://newion.uwinnipeg.ca/~sliao/Courses/DIP.html
Office Hours: Mondays 1:00 - 2:00 pm

Instructor Information

Instructor: Simon Liao
Office: 3D31
Phone: (204)-786-9416
E-mail: s.liao@uwinnipeg.ca
Instructor's home page: https://www.uwinnipeg.ca/~sliao

Important Dates

1. First Class: September 7, 2022
2. Mid-term reading week (no classes) October 9 – 15, 2022
3. Final Withdrawal Date w/o academic penalty: November 16, 2022
   (A minimum of 20% of the work on which the final grade is based will be evaluated and available to all students before the voluntary withdrawal date.)
4. Last Class: December 5, 2022
5. Project Presentation Day: December 19, 2022

University closures:
   - Truth and Reconciliation Day: September 30, 2022
   - Thanksgiving Day: October 10, 2022
   - Remembrance Day: November 11, 2022

Course Objectives/Learning Outcomes

This course will provide students a detailed overview of Digital Image Processing and its applications. Image processing has found applications in many areas from medical imaging to computer graphics. This course covers the fundamental concepts of visual perception and image acquisition, basic techniques of image manipulation, segmentation and coding, and a preliminary understanding of Computer Vision. With successful completion of the course, students will be able to perform image manipulations and analysis in many different fields.

Computer system administrator

The system administrator:

Mr. Nischal Ghorasaini (n.ghorasaini@uwinnipeg.ca).

Prerequisite and Restriction Information

Consent of the Department Graduate Program Committee Chair or Instructor

This course assumes that students have strong programming skill in MATLAB, and a working knowledge of Intermediate Calculus, Linear Algebra, basic estimation techniques, and some statistical topics on the level of introductory courses in Statistics.

Evaluation Criteria

Assignments (42%)

- Number of Assignments: 3 (10%+10%+10%)

  All assignments are to be completed **individually**. Late submitted work will receive a 20% penalty daily.

- Students will be asked to read some material for selected problems, to write 5-7 pages typed review of the provided topic, to develop computer programs for simulating results, and to give a 20-minute presentation on the topic (12%).

Final Exam (48%)

The final exam will be replaced by a Final Project.

The purpose of the project is to make students familiar with at least one of applications of image processing. The project includes choosing a particular problem in image processing (theory or application), searching and reading related papers on this topic, implementing the solution, and writing a 15-20 pages report.

The project will be evaluated by its originality and novelty (20/48), technical soundness and completeness of the solution (20/48), and readability and organization of the typed report (8/48).

Presentation of the Final Project (10%)

The project will be represented in a 30-minute presentation on December 19, 2022.

Students should contact the instructor as soon as possible if extenuating circumstances require missing an assignment or presentation. 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 786-9771 or accessibilityservices@uwinnipeg.ca to discuss appropriate options. All information about a student's disability or medical condition remains confidential. http://www.uwinnipeg.ca/accessibility.

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 2021-22 Undergraduate Academic Calendar online at http://uwinnipeg.ca/academics/calendar/docs/important-notes.pdf.

Students facing a charge of academic or non-academic misconduct may choose to contact the University of Winnipeg Students' Association (UWSA) where a student advocate will be available to answer any questions about the process, help with building a case, and ensuring students have access to support. For more information or to schedule an appointment, visit our website at www.theuwsa.ca/academic-advocacy or call 204-786-9780.

All students, faculty and staff have the right to participate, learn and work in an environment that is free of harassment and discrimination. The UW Respectful Working and Learning Environment Policy may be found online at www.uwinnipeg.ca/respect.

The University of Winnipeg promotes a scent-free environment. Please be respectful of the needs of classmates and the instructor by avoiding the use of scented products while attending lectures. Exposure to perfumes and other scented products (such as lotion) can trigger serious health reactions in persons with asthma, allergies, migraines or chemical sensitivities.

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 Graduate Studies Committee.

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

Required Text Book

Digital Image Processing (Third Edition) by R.C. Gonzalez and R.E. Woods (ISBN 978-0-13-168728-8)

Regulations, Policies, and Academic Integrity

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

Avoiding Academic Misconduct: 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). Please note, in particular, the subsection of Student Discipline pertaining to plagiarism and other forms of cheating.

Detailed information can be found at the following:

• Academic Misconduct Policy and Procedures: https://www.uwinnipeg.ca/institutional-analysis/docs/policies/academic-misconduct-policy.pdf and https://www.uwinnipeg.ca/institutional-analysis/docs/policies/academic-misconduct-procedures.pdf.

• UW Library video tutorial "Avoiding Plagiarism"
https://www.youtube.com/watch?v=UvFdxRU9a8g

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.

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/institutional-analysis/docs/policies/acceptable-use-of-information-technology-policy.pdf.

• Non-Academic Misconduct Policy and Procedures: https://www.uwinnipeg.ca/institutional-analysis/docs/student-non-academic-misconduct-policy.pdf and https://www.uwinnipeg.ca/institutional-analysis/docs/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/docs/copyright_policy_2017.pdf.

Privacy

Students have rights in relation of the collecting of personal data the University of Winnipeg: https://www.uwinnipeg.ca/privacy/admissions-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 system.

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

Please let 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 planned to be covered (some of the listed topics may not be covered)

1.   Introduction to Digital Image Processing

2.   Digital Image Fundamentals

        Elements of Visual Perception
        Light and the Electromagnetic Spectrum
        Image Sensing and Acquisition
        Image Sampling and Quantization
        Some Basic Relationships between Pixels
        An Introduction to the Mathematical Tools Used in Digital Image Processing

3.   Intensity Transformations and Spatial Filtering

        Some Basic Intensity Transformations
        Histogram Processing
        Fundamentals of Spatial Filtering
        Smoothing Spatial Filters

Sharpening Spatial Filters
Combining Spatial Enhancement Methods

4.   Filtering in the Frequency Domain

Preliminary Concepts
Sampling and the Fourier Transform of Sampled Functions
The Discrete Fourier Transform of One Variable
Extension to Functions of Two Variables
Some Properties of the 2-D Discrete Fourier Transform
The Basic of Filtering in the Frequency Domain
Image Smoothing and Sharpening Using Frequency Domain Filters
Selective Filtering
Implementation

5.   Image Restoration and Reconstruction

A Model of the Image Degradation/Restoration Process
Noise Models
Restoration in the Presence of Noise Only – Spatial Filtering
Periodic Noise Reduction by Frequency Domain Filtering
Linear, Position-Invariant Degradations
Estimating the Degradation Function
Inverse Filtering
Minimum Mean Squares Filtering
Geometric Mean Filter
Image Reconstruction from Projections

Note that all topics listed may not be covered and can be offered in a different time order.