THE UNIVERSITY OF WINNIPEG

APPLIED COMPUTER SCIENCE

Graduate Course No.: GACS-7205-001
Graduate Course Title: Digital Image Processing

Instructor Information

Instructor: Simon Liao
Office: 3D31
Class Meeting Time: 11:30-12:45 Tuesdays & Thursdays
Class Room: 3D03
Office Hours: Tuesdays 14:00-15:00, or by email appointment
Phone: 786-9416
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Course Web Page: http://ion.uwinnipeg.ca/~sliao/Courses/DIP.html

When it is necessary to cancel a class due to exceptional circumstances, the instructor will make every effort to inform students via uwinnipeg e-mail, as well as the Department Assistant and Chair/Dean so that class cancellation forms can be posted outside classrooms.

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 their course instructors.

Important Dates

1. First Class: September 4th, 2018.
2. Reading Week (no classes): October 7 – 13, 2018.
3. Final Withdrawal Date without academic penalty: Monday, November 12, 2018. (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.) Please note that withdrawing before the VW date does not necessarily result in a fee refund.
4. December 17, 2018: Project Presentation Day
5. The dates the university is closed for holidays (i.e. no classes are held on these dates):
   - October 8th, 2018
   - November 11th, 2018
   - December 22nd, 2018 – January 2nd, 2019

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.

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**.
- 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. All presentations will be given in Room 3C13 on October 23, 2018 (12%).
- Late submitted work will receive a 20% penalty daily.

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 17, 2018.

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%		

Services for Students

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 email accessibilityservices@uwinnipeg.ca to discuss appropriate options. All information about a student's disability or medical condition remains confidential.
http://www.uwinnipeg.ca/accessibility.

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.

Required Text Book

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

Misuse of Computer Facilities, Plagiarism, and Cheating

Academic dishonesty is a very serious offense and will be dealt in accordance with the University's discipline bylaw. Be sure that you have read and understood **Regulations & Policies #8**, in the 2018-2019 UW Course Calendar available at: http://www.uwinnipeg.ca/index/calendar-calendar.

Avoiding Academic Misconduct: Uploading essays and other assignments to essay vendor or trader sites (file-sharing 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.

Avoiding Copyright Violation: Course materials are owned by the instructor who developed them. Examples of such materials are course outlines, assignment descriptions,

lecture notes, test questions, and presentation slides. Students who upload these materials to file-sharing 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 photographing or recording slides, presentations, lectures, and notes on the board.

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