University of Manitoba

Department of Electrical & Computer Engineering
Graduate Course Outline

Winter 2022

ECE 8220 –Image Processing

COURSE DESCRIPTION:

A study of digital image structures and patterns that includes image processing fundamentals such as image formation, false-colouring, filtering, pixel and voxel manipulation, feature extraction, shape detection and description implementation methods, structures visualization, geometric realization of single image and video frame shapes. Topics will include the art of image capture, adaptive learning video frame foreground, computational geometry and topology of visual scenes, detection, analysis and classification of object shapes in single camera images and in sequences video frames with applications.

COURSE OBJECTIVE:

The focus of this course is on the use of computational methods in the study of digital images. The goal of this course is to provide an artificial intelligence and intelligent systems view of digital images and video frames in discovering physical surface shapes from recorded reflected and refracted light, cell complexes, hidden patterns, fixed points, cycles, vortexes, repeated image regions and geometry-based quantizers in discovering image shape rate of change, proximities as well as approximating and measuring target picture elements.

PRE-REQUISITES:

Undergraduate background in elementary numerical methods.

CONTACT HOURS:

3-hours per week

COURSE CONTENT:

The following topics will be discussed:

- Digital image basics;
- Vector spaces over digital images;
- Image geometry, topology and physics;
- Colour spaces;
- Visible part of the electromagnetic spectrum;
- Linear filtering, edge detection and image triangulation methods;
- Single image and video frame edges and segmentation;
- Detect rates of change in single image and video frame shapes;
- Image morphology;
- Video frame barcoding and image shape persistence over time;
- Applications in image processing using Matlab;

Additional advanced research topics as determined by the instructor.

HOMEWORK:

Homework will consist of assignments that include a research notebook.

TEXTBOOK:

J.F. Peters, *Lectures on Computational Geometry, Topology and Physics of Digital Images* and Coursenotes.

OTHER RESOURCES

J.F. Peters, Foundations of Computer Vision. Computational Geometry, Visual Image Structures and Object Shape Detection, Springer Int. Pub. AG 2017, DOI 10.1007/978-3-319-52483-2.
B. Jähne, Digital Image Processing, Springer, 2005.
D.M. Etter, Engineering Problem Solving with Matlab, Prentice-Hall Inc., 1997.
S.C. Chapra, Applied Numerical Methods with Matlab, McGraw-Hill, 2018.

GRADE ANNOUNCEMENTS:

Grades for this course will be announced by May 2022

EVALUATION:

Your final course grade is determined by your performance in the components list below in the Evaluation Table (assignments, term tests, and a final examination). Students must receive a minimum of 50% on the final examination and must complete and pass all components in the course in order to be eligible to receive a passing grade.

Each component is weighted as follows:

COMPONENT	NO	VALUE %	TOTAL VALUE	DETAILS / ADDITIONAL INFO
Assignments	3	25%	25	
Term Tests	2	25%	25	
Final Examination	1	50%	50	
TOTAL			100	

GRADE SCALE:

LETTER	MARK	LETTER	MARK	LETTER	MARK	LETTER	MARK
A+	95-100	B+	80-84	C+	65-69	D	45-54
A	85-94	B	70-79	C	55-64	F	<45

INSTRUCTOR INFO:

Name: ..... James F. Peters
Office: ..... E1-330 EITC
Tel:..... (204) 474-9603
Email: ..... james.peters3@umanitoba.ca

Office Hours:..... By appointment

VOLUNTARY WITHDRAW:

Wednesday, 23 March 2022

REQUIREMENTS/REGULATIONS

Student Responsibilities: It is the responsibility of each student to contact the instructor if he/she is uncertain about his/her standing in the course and his/her potential for receiving a failing grade. Students should also familiarize themselves with Sections 4 and 6 of the Regulations dealing with, among others, incomplete term work, deferred examinations, attendance and withdrawal, etc.

Lectures: Attendance at lectures is essential for successful completion of this course. Students must satisfy each evaluation component in the course.

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 and Requirements of the University of Manitoba, Section 7.1, students are reminded that plagiarism* or any other form of cheating is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university) regardless of media.

- examinations
- assignments
- laboratory reports
- term exams

A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty

Please refer any questions regarding Academic Integrity to your course instructor.

***Plagiarism**: to steal and pass off (the ideas or words of another) as one's own; use (another's production) without crediting the source

EVALUATION:

Your final course grade is determined by your performance in the components list below in the Evaluation Table (seminar, assignments, project, mid-term, and a final examination. Students must receive a minimum of 50% on the final examination and must complete and pass all components in the course in order to be eligible to receive a passing grade.

Each component is weighted as follows:

COMPONENT	NO	VALUE %	TOTAL VALUE	DETAILS / ADDITIONAL INFO
Seminars	1	10%	10	
Assignments	5	3%	15	
Project	1	25%	25	
Mid-Term Exam				
Final Examination	1	50%	50	
TOTAL			100	

GRADE SCALE:

LETTER	MARK	LETTER	MARK	LETTER	MARK	LETTER	MARK
A+	95-100	B+	80-84	C+	65-69	D	45-54
A	85-94	B	70-79	C	55-64	F	<45

INSTRUCTOR INFO:

Name: ..... Dean K. McNeill
Office: ..... E2-390J EITC
Tel:..... (204) 474-8963
Email: ..... Dean.McNeill@umanitoba.ca

Office Hours:..... By appointment

VOLUNTARY WITHDRAW:

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REQUIREMENTS/REGULATIONS

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