Winter 2022

ECE 8300 – Computer Vision

COURSE DESCRIPTION:

A machine learning approach is followed in the discovery of surface shapes, video frame shapes and their geometric shapes via computer vision. This leads to a computerized rendition of reflected and refracted light, radiation from changing physical surfaces. Topics will include a topology of data approach to image object shapes, barcoding, persistence of shapes in image and video frame sequences, space-time character of visual scene shapes, cellular complexes, and the connectedness of visual scene regions.

COURSE OBJECTIVE:

The focus of this course is on various forms of computational methods in detecting structures in computer vision. The goal of this course is to introduce adaptive learning, computational geometry, topology and physics as a basis for the detection, analysis, measurement, comparison, single-shot recognition and classification of physical surface shapes as well as fixed points and cell complexes in visual scenes found in single images and video frame sequences.

PRE-REQUISITES:

Undergraduate background in applied numerical methods.

CONTACT HOURS:

3-hours per week

COURSE CONTENT:

The following topics will be discussed:

- Adaptive learning in detecting video frame foreground;
- Computational geometry of surface shapes in visual scenes;
- Computational topology in detecting image shape nerve structures;
- Visible part of the electromagnetic spectrum;
- Visual shape energy and rate of change;
- Spacetime view in the detection and capture of visual scene shapes;
- Human vs. computer vision;
- Laplace filtering, edge detection and Delaunay triangulation;
- Image Cell complexes;
- Image shape boundaries and interiors;
- Geodesics, cycles, and vortexes in visual scene shape analysis;
- Topology of data and shape persistence in image sequences.
- Video frame barcoding.
- Computer Vision applications 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, Computer Vision Lecture Notes, 2021-2022.

OTHER RESOURCES

J.F. Peters, Computational Geometry, Topology and Physics of Digital Images with Applications. Shape Complexes, Optical Vortex Nerves and Proximities, Springer Int. Pub. AG 2020, DOI 10.1007/978-3-030-22192-8.

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.

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:

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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