Worcester Polytechnic Institute

CS/RBE 549 Computer Vision
F Semester 2019

Instructor: **Mike Gennert**
Office: 85P 203
Office Hours: M 11am ***in AK 122***, T 10am, F 9am
Email: michaelg@wpi.edu

Teaching Assistant: **Ashay Aswale (A Term only)**
Office: WB 108
Office Hours: M 2pm, R 3-5pm
Email: asaswale@wpi.edu

Teaching Assistant: **Shou-Shan Chiang (B Term only)**
Office: 85P 205
Office Hours: T 1-3, F3-5
Email: schiang@wpi.edu

Teaching Assistant: **Haoxiang Ma (Fall Semester)**
Office: 85P 206 – Graduate student desk area outside the RBE Conference Room
Office Hours: M 3pm, W 2-4pm
Email: hma2@wpi.edu

Course Info

Lecture: MW 4:30-5:50pm in HL 218

Course Website: Canvas "F19 Computer Vision"

Required Text: R. Szeliski, ``Computer Vision: Algorithms and Applications'', Springer, 2011. Available in the WPI bookstore and as a PDF file at http://szeliski.org/Book/.

COURSE DESCRIPTION

This is a graduate-level course in computer vision: the principles and methods of making computing systems, including robots, aware of their environment from visual data. Topics include: image formation, edge detection, segmentation, shape-from-shading, motion, stereo, texture analysis, pattern classification, and object recognition. We will discuss various representations for visual information, including sketches and intrinsic images.

Recommended background is one of CS 534 Artificial Intelligence, CS543 Computer Graphics, or CS/EE 545 Image Processing. Familiarity with a recursive programming language is assumed.

COURSE OBJECTIVES

It is expected that by the end of this course the student will be able to:

- Understand the basic concepts of image sensing and image processing.
- Understand the pathways from image sensing to world representation.
- Demonstrate the application of Computer Vision concepts in the design of vision systems developed for a team project.
- Demonstrate effective teamwork and communication skills through evaluated participation in team presentations/projects.

ASSIGNMENTS AND GRADING

Weekly homework problems will be assigned and collected. You are encouraged to work together to solve assigned homework problems, but you must submit individual work, i.e., you cannot photocopy or use the same document files as another person. Homework counts 25% of your grade.

There will be two exams during the course; each counts 20% of your grade. Each exam will be open book, open note and will last 1.5 hours. *No electronic devices are allowed during exams.*

Exam dates are 9 Oct and 11 Dec.

The precise numerical cutoffs for grading will be determined at the end of the semester, but those at risk of C or lower will receive an interim assessment after the first exam.

PROJECTS

The major project will be to design and implement a software system to recognize an assigned object, due December 11. An in-class presentation is required. No-fault/no-penalty extensions of the written report are available until 5pm December 12. The project must be well documented. This project is worth 35%.

Projects will be conducted in teams of 4 students. Each student is responsible for contributing to the project work, presentation, and report.

ACADEMIC HONESTY POLICY

Any work that you submit must represent your own work. You are encouraged to work together throughout the semester to understand the material, but submit only your own work.

Team projects are expected to represent each team's own work, although you may use libraries or other tools in developing your projects. If any part of a submitted project is not the team's own work, the source must be **clearly identified**.

Failure to identify non-original work is considered academic dishonesty.

Collaboration or other outside assistance on exams is never allowed.

As with all courses at WPI, the Academic Honesty Policy will be followed (see https://www.wpi.edu/about/policies/academic-integrity/student-guide). You will be assigned to 4-person project teams for the course project. Unless there is a solid reason to suspect otherwise, it will be assumed that all team members contribute equally to the presentations/projects and each team member will receive an identical team grade (the final project report will include a peer review assessment which may affect grade distribution). **All other graded material should be the result of your independent effort and understanding!**

ACCOMMODATIONS

Students with disabilities who need to utilize accommodations in this course are encouraged to contact the Office of Disability Services (ODS) as soon as possible to ensure that such accommodations are implemented in a timely fashion. This office can be contacted via email: DisabilityServices@wpi.edu, via phone: 508-831-4908, or in person: 124 Daniels Hall. If you have approved accommodations, please request your accommodation letters online through the Office of Disability Services Student Portal.

You can find more background and useful links on the ODS website at https://www.wpi.edu/academics/faculty/disability-services.

CAVEAT

Course procedures and schedules are subject to change in the event of extenuating circumstances.

COURSE PHILOSOPHY

I believe in *Active Learning*. My commitment is to make this course as rewarding and meaningful as *you* want it to be. Your part will be to be prepared for each lesson… and learn to communicate, both collaboratively with your class peers and Teaching Assistants, and inquisitively with me. I enjoy and encourage a lot of conversation and discussion during class. Note that the following schedule shows what you *should* do *prior* to each class for preparation.

Mike Gennert

SCHEDULE

Class	Date	Topics	Reading	HW due
01	26 Aug	Introduction & Optics	Ch 1	
02	28 Aug	Image Formation & Coordinates	Ch 2, Optics, Vectors	HW 0
	02 Sep	*Labor Day – No Classes*		
03	04 Sep	Image Operations & Binarization	Ch 3.1-3.2	HW 1
04	05 Sep	Morphology	Ch 3.3	
05	09 Sep	Linear Systems & Correlation		HW 2
06	11 Sep	Fourier Transforms	Ch 3.4-3.5	
07	16 Sep	Edge Detection	Ch 4.1-4.2	HW 3
08	18 Sep	Feature Detection 1	Canny, SIFT, SURF	
09	23 Sep	Feature Detection 2	ORB, BRIEF, HOG	HW 4
10	25 Sep	Hough Transform	Ch 4.3	
11	30 Sep	Segmentation	Ch 5.1-5.3	HW 5
12	02 Oct	Alignment	Ch 6.1-6.2	
13	07 Oct	Calibration	Ch 6.3	HW 6
14	09 Oct	Exam 1		
	14 Oct	*Fall Break – No Classes*		
	16 Oct	*Fall Break – No Classes*		
	21 Oct	*Fall Break – No Classes*		
15	23 Oct	Motion 1	Ch 7	
16	28 Oct	Motion 2 & 3 ***Note: 3-hour Class***	Ch 8.1-8.5	HW 7
17	30 Oct	Object Recognition 1	Ch 14.1-14.2	
18	04 Nov	***Prof. Gennert travel – No Class***		HW 8
19	06 Nov	***Prof. Gennert travel – No Class***		
20	11 Nov	Object Recognition 2 & 3 ***Note: 3-hour Class***	Ch 14.3-14.4	HW 9
21	13 Nov	Pattern Classification	Ch 14.5-14.6	
22	18 Nov	Stereo	Ch 11.1-11.6	HW 10
23	20 Nov	Surface Representation	Ch 12.1-12.4	
24	25 Nov	SLAM	SLAM reading	HW 11
	21 Nov	*Thanksgiving Break – No Classes*		
25	02 Dec	Project Presentations 1		HW 12
26	04 Dec	Project Presentations 2		
27	09 Dec	Project Presentations 3		
28	11 Dec	Exam 2		Projects