EECS 598-08 Foundations of Computer Vision

Electrical Engineering and Computer Science

University of Michigan

Syllabus for Fall 2014

Last updated: 2 September 2014

Instructor: Jason Corso (jjcorso)

Course Webpage: http://web.eecs.umich.edu/~jjcorso/t/598F14.

Syllabus: http://web.eecs.umich.edu/~jjcorso/t/598F14/files/598F14_syllabus.pdf.

Meeting Times: MW 1430–1600

Location: 2150 DOW

Office Hours: Tuesday and Thursday 1430-1600 (4227 EECS)

Course Information Flow and A Note On Contacting The Instructor: This courses uses CTools, Piazza and the instructor's website.

- **CTools** will be used for submitting work and accessing grades (via the Dropbox plugin), among some minor other things that will be noted in due course. The CTools Link is https://ctools.umich.edu/portal/site/c34c6dba-2a95-4c6d-83ea-df248d309954.
- **Instructor's website** (http://web.eecs.umich.edu/~jjcorso/t/598F14) will primarily hold lecture notes and problem-set downloads.
- **Piazza** is used for announcements and to manage student discussions. The piazza course website is piazza.com/umich/fall2014/eecs59808/home (this link is also in the CTools site). Students should ensure they are enrolled in the course. Nearly all questions you have about the course, both logistical and technical should be posted to piazza (after you have already checked piazza to ensure the same question has not already been answered). Only in the event of a concern of privacy, should you directly email the instructor.

Main Course Material

Course Description: Computer Vision seeks to extract useful information from images. This course begins the fundamentals of image formation and then organizes the remaining material according to the class of information to be extracted. We will cover early processes, such as basic features, edges and contours; motion tracking, including optical flow and filtering; shape primarily from a binocular 3D reconstruction point of view; and both object and action detection and recognition. The course has been designed to present an introduction to computer vision targeted to graduate students. The course will balance theory and application both in lectures and assignments.

A coarse sequence of topics we will cover is below. The course web-page will contain the week-to-week schedule for the semester, which evolves over the course of the term.

0. Data Fundamentals: camera models, image formation, range sensing and video.
1. Early Processes: extracting basic features, edges, contours, and segmentation.
2. Motion Tracking: extracting movement, optical flow, tracking, and filtering.
3. Shape: extracting 3D structure, epipolar geometry, stereo, SFM, shape from X.

4. Objects: extracting objects, detection, recognition, and matching.
5. Actions: extraction actions, space-time localization, and detection.

Prerequisites: Graduate standing, a working knowledge of calculus, linear algebra, and probability theory. Students are expected to be (or become on their own time) proficient in MATLAB.

Course Goals: After taking the course, the student should have a clear understanding of

1. the formation and representation of visual data, including images, videos, and volumes;
2. the various classes of information to be extracted from visual content as well as foundational approaches to extracting such information;
3. have some exposure to practical and theoretical issues underlying the complexities in visual content, such as lighting; and
4. practical experience in working with visual content.

These goals are evaluated through the problem sets and exams.

Textbooks: The main (required) textbook for the course is

- Forsyth and Ponce *Computer Vision, A Principled Approach*. Prentice Hall, 2nd Edition, 2011. (ISBN-13: 978-0136085928 ISBN-10: 013608592X)

The textbook has a website: http://luthuli.cs.uiuc.edu/~daf/CV2E-site/cv2eindex.html.

A recommended supplemental textbook is

- Szeliski *Computer Vision: Algorithms and Applications* published by Springer and available for purchase on various website or as a download (free) at http://szeliski.org/Book/.

Course Work and Evaluation

Problem Sets (45%) There will be three problem sets (one each due at the end of September, October and November). These will include both analytical problems and programming assignments (in Matlab). All data for programming assignments will be provided by the instructor. Problem sets may be discussed in groups but must be written independently, including programming. Over-the-shoulder MATLAB debugging, for example, is not permitted. No code from other students, on-line or off-line resources other than that explicitly mentioned in the assignment is permitted.

Comprehension Service Component (15%). Each student will select a unique entry in Wikipedia that is related to computer vision early in the semester. The student will revise and contribute to this Wikipedia entry (off-line) throughout the term. The revision and final entry will be due in beginning of December. Upon instructor approval, the student will then make the revisions to the entry in the on-line site.

Exams (40%) There will be an in-class mid-term exam (mid-to-late October) and a take-home final exam (December). The mid-term exam will not have programming on it; the final exam will.

Late Work and Missed Exam Policy: **No** late work will be accepted. Ample time will be given to complete the problem-sets; use it wisely. Similarly, the date of the mid-term exam will be known far in advance. Do not miss the exam. **No** make-up exams will be given other than for those University approved reasons. This is a firm policy. Do not expect special treatment.

Regrading: Any questions about the grading of a piece of work must be raised within one week of the date that the work was returned by the teaching assistant or the instructor. In other words, if you do not pick up your work in a timely fashion, you may forfeit your right to question the grading of your work.

Additional Information

Differences from EECS 442: This course and EECS 442 share the same goal: an introduction to modern computer vision. This 598 course will differ from 442 in the level of depth of material, and in topic coverage, such as a greater emphasis in video. EECS 442 is not a prerequisite for this course; nor is any prior course in computer vision. In summary, this is an introductory computer vision course designed for graduate students.

Credits and Requirements: EECS 598-08 will satisfy the same program requirements as EECS 442, except that 598-08 counts 3 credits whereas 442 counts 4. Students cannot earn credit for both 442 and 598-08.

Similar Courses at Other Institutions: (incomplete and in no important order)

- UC Berkeley, Prof. Darrell: http://www.eecs.berkeley.edu/~trevor/CS280.html
- UW, Profs. Seitz, Szeliski, Farhadi, Shapiro: http://courses.cs.washington.edu/courses/cse576/
- Johns Hopkins, Prof. Vidal: http://www.vision.jhu.edu/teaching/vision13/
- UTexas, Prof. Grauman: http://www.cs.utexas.edu/~grauman/courses/spring2011/index.html
- EPFL, Prof. Fua: http://moodle.epfl.ch/course/view.php?id=472
- Many more...

General Notes

If you don't understand something covered in class, ask about it right away. The only silly question is the one which is not asked. If you get a poor mark on an assignment or exam, find out why right away. Don't wait a month before asking. The instructor and GSI(s) (if associated). Don't be afraid to ask questions, or to approach the instructor or TA in class, during office hours, through the discussion board or through e-mail. This course is intended to be hard work, but it is also intended to be interesting and fun. We think computer vision is interesting and exciting, and we want to convince you of this.

Disabilities

If you think you need an accommodation for a disability, please let me know at your earliest convenience. Some aspects of this course, the assignments, the in-class activities, and the way the course is usually taught may be modified to facilitate your participation and progress. As soon as you make me aware of your needs, we can work with the Office of Services for Students with Disabilities (SSD) to help us determine appropriate academic accommodations. SSD (734-763-3000; http://ssd.umich.edu) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. Any information you provide is private and confidential and will be treated as such.

Counseling Center

Your attention is called to the Counseling and Psychological Services (734-764-8312), 3100 Michigan Union. The Counseling Center staff are trained to help you deal with a wide range of issues, such as how to deal with exam-related stress and other academic and non-academic issues. Services are free and confidential and do not impact student records. Shivaun Nafsu is the CAPS consultant directly within COE: snafsu@umich.edu or 734-763-8211. Their web site is http://caps.umich.edu/.

Standards of Conduct – Behavioral Expectations

The following are classroom "etiquette" expectations:

- Attending classes and paying attention. Do not ask an instructor in class to go over material you missed by skipping a class or not concentrating.
- Not coming to class late or leaving early. If you must enter a class after lecture has clearly begun, do so quietly and do not disrupt the class by walking between the class and the instructor. Do not leave class unless it is an absolute necessity.
- Not talking with other classmates while the instructor or another student is speaking. If you have a question or a comment, please raise your hand, rather than starting a conversation about it with your neighbor.
- Showing respect and concern for others by not monopolizing class discussion. Allow others time to give their input and ask questions. Do not stray from the topic of class discussion.
- Not eating during class time.
- Turning off the bothersome electronics: cell phones, pagers, and beeper watches.
- Avoiding audible and visible signs of restlessness. These are both rude and disruptive to the rest of the class.
- Focusing on class material during class time. Sleeping, talking to others, doing work for another class, reading the newspaper, checking email, and exploring the internet are unacceptable and can be disruptive.
- Not packing bookbags or backpacks to leave until the instructor has dismissed class.

College of Engineering Honor Code

The full Engineering Honor Code is available at http://www.eecs.umich.edu/acal/honor.html. All students are expected to read, understand and follow the honor code.

The Honor Code outlines certain standards for ethical conduct for persons associated with the College of Engineering at the University of Michigan. The policies of the Honor Code apply to graduate and undergraduate students, faculty members, and administrators.

In 1915, the students of the College of Engineering petitioned for the establishment of an Honor Code. The Code was promptly adoped with faculty approval and has been basic to life in the College of Engineering.

The Honor Code rests upon the following principles:

- Engineers must possess personal integrity both as students and as professionals. They must be honorable people to ensure safety, health, fairness, and the proper use of available resources in their undertakings.
- Students in the College of Engineering are honorable and trustworthy persons.
- The students, faculty members, and administrators of the College of Engineering trust each other to uphold the principles of the Honor Code. They are jointly responsible for precautions against violations of its policies.
- It is dishonorable for students to receive credit for work which is not the result of their own efforts.

The Engineering Honor Code is based on the principle that students will follow all guidelines for study and prepared work set forth by the instructor, and that students can be trusted to take examinations without cheating.

Students are responsible for reporting infractions of the honor code.