CSE 803: Computer Vision Fall 2022

Department of Computer Science and Engineering
Michigan State University
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Part 1: Course Information

Instructor: Xiaoming Liu Working from home   liuxm@cse.msu.edu
https://d2l.msu.edu/d2l/home/1579266

Teaching Modality: In-Person and Zoom streaming

Office Hours: Thu 10:00-11:00AM at https://msu.zoom.us/j/99202676987

Course: Class is M W 10:20 – 11:40AM in Wells Hall A328
With zoom link at https://msu.zoom.us/j/99202676987

Prerequisites: programming, algorithms, data structures, probability and statistics, linear algebra, 3D calc.

Description: visual information processing problems; human and machine vision systems; image formation; image transforms, encoding, enhancement; edge detection; segmentation; 2D and 3D object description and recognition; scene analysis; applications

Objectives: to study problems associated with image acquisition, processing, and interpretation; to learn tools for solving computer vision problems in industry and various scientific disciplines; to understand the general process of designing a practical computer vision system.

Text: R. Szeliski. *Computer Vision: Algorithms and Applications.* Free copy@ http://szeliski.org/Book/;

References: D. A. Forsyth and J. Ponce. *Computer Vision: A Modern Approach (2nd Edition).*

Discussion: Piazza at https://piazza.com/class/l7grwlvbdml93

Course Requirements

- Internet connection (DSL, LAN, or cable connection desirable)
- Access to Desire2Learn (D2L), or other delivery platform.
- Ability to scan and upload documents (e.g. CamScanner or Adobe Scanner app)
- Any other tools, resources, and materials needed by the student for the course.

If you do not have the necessary technology and/or equipment to adequately address the above requirements, the College of Engineering will make every attempt to assist you in obtaining access by loaning this technology for use during the semester. Please be aware that supplies are limited, and we may not be able to fulfill all requests. If you need assistance securing technology (laptops, tablets, web cams, hotspots), please contact Theodore Caldwell, Assistant Dean for Equity and Inclusion, by email at tc@msu.edu.

Course Delivery Structure

This course will be delivered **in person and with zoom streaming**. You will need your MSU NetID to login to and get the course material from the *https://d2l.msu.edu/d2l/home/1383870* Students may forward their D2L email to an external email address (https://help.d2l.msu.edu/node/4410) .

In D2L, you will access online lessons, course materials, homework assignments, and additional resources. Activities may consist of readings, discussion forums, email, and other online activities.

D2L Technical Assistance

If you need technical assistance at any time during the course or to report a problem you can:
- Visit the [Distance Learning Services Support Site](#)
- Visit the [Desire2Learn Help Site (http://help.d2l.msu.edu/)](#)
- Or call Distance Learning Services: (800) 500-1554 or (517) 355-2345

Resource Persons with Disabilities (RCPD)

- To make an appointment with a specialist, contact: (517) 353-9642 or TTY: (517) 355-1293
- Web site for RCPD: http://MYProfile.rcpd.msu.edu

Part 2: Grading and Schedule

Graded Homework
Homework will be released in D2L. Homework is to be done independently unless otherwise discussed. Use of web or text resources is encouraged, but they must be cited.

Six homework assignments are planned, as shown on the course calendar. Written homework problems provide exercise on concepts and methods. Some programming may be needed to complete homework. Programming is intended to reinforce algorithms and concepts and to get correct results; it is NOT intended to be an exercise in software development (so minimum documentation and usability but careful testing). Students will often use multiple tools or programs. A report of program/algorithm behavior and results is required. Programming work will be submitted electronically to https://d2l.msu.edu. **Please test how to submit a few days before the first homework deadline.** Unless otherwise stated, ANY programming language or computer can be used, while the Python language is preferred. Students will be responsible if conversion of data or program modules is needed. Students should seriously consider using Python due to its rapid development capability. Also, students should become familiar with one or more popular image processing tools. It should be clear when basic algorithms should be implemented by the student and not obtained from an existing library or function.

There are 7 total homework assignments. The first one, Homework0, will NOT be graded, while the other 6 will be graded. Late work will be accepted without penalty only with an acceptable excuse: without such, late penalty is 20% for the first day and another 20% for the next two days. No late work will be accepted three or more days after it's due. Some problems solved are far better than none.

Homework Report

The homework report should be a single .pdf or .doc file. Handwork or hand annotated images or code is acceptable and can be scanned into electronic form. Program modules, if requested, should be in tar or zip form. An entirely paper report is allowed, but must be submitted by the end of business on Friday.

Report format is not rigid, but should include the following elements.

- The problem[s] or homework objectives.
- The approach taken / major algorithm[s], possibly mentioning what alternatives were not taken.
- Results are most important, and *how* to get to the results is important too.
- Provide a few cases where things look good.
- Often there will be required cases.
- Document the parameters, process, etc.
- Provide a few cases where things don't look good.
- Document the parameters, process, etc.
- Concluding comments, how things went overall, what would be good to try if the work continued.

Project

This is an opportunity to explore a topic in depth and should involve substantial work. This is a group project, involving 3-5 people. This can be in implementation (e.g., implementing an existing algorithm), applications (e.g., applying computer vision to an existing problem), or research (e.g., trying something new in computer vision). Your project should amount to two homeworks' worth of work per-person. Please start to look for partners. It will consist of:

- Proposal (2 pages, 5%): The proposal should aim to explain what the problem is, why it's feasible to solve in the given timeline, and how you plan to achieve it.
- Progress report (2 pages, 9%): The progress report should explain what progress you've made and be a stepping stone to the final report. That is, almost all of your work for the progress report should be usable for the final report.
- Final Project Report (6 pages, 20%): The final project report should explain what you have done.

All written work should be in CVPR format .zip file here for word and latex. Keep in mind that we do not see your hard work, we only see the products you deliver.

Final Grade Computation

Grading is NOT competitive; individual performance will be used. Items will be weighted as follows: project (34%), 6 homeworks (66%). A course avg. of 90% ensures a grade of 4.0; 75% will insure a grade of 3.0.

Course Materials

Slides can be found in d2L. Slides are under constant improvement, but are never a substitute for class.

Course Calendar

The following topics and readings are planned by week: reading assignments may be refined as we approach them.

Date	Topic	Suggested Reading	Assignments/ Things Due
Wed Aug 31	Intro to computer vision		
Wed Sep 7	Introduction & Projective Cameras I	S2.1	**HW0 out**
Mon Sep 12	Projective Cameras II	S2.1	
Wed Sep 14	Light and Shading	S2.2, S2.3	**HW1 Out**
Mon Sep 19	Numerical Linear Algebra Part I	Zico Kolter Review	
Wed Sep 21	Numerical Linear Algebra Part II		
Mon Sep 26	Linear and Nonlinear filtering	S3.2	
Wed Sep 28	Detectors and Descriptors I	S4.1	
Mon Oct 3	Detectors and Descriptors II	S4.1	**HW1 Due, HW2 Out**
Wed Oct 5	Transformations I	S2.1, S6	
Mon Oct 10	Transformations II	S2.1, S6	
Wed Oct 12	Linear Models	S14 (skim) for context	**HW3 Out**
Mon Oct 17	Continuous Optimization		**HW2 Due Friday Oct 14**
Wed Oct 19	Backpropagation and Neural Nets	CS231n Backprop Examples	
Mon Oct 24	Convnets Part I	CS231n Convnets	
Wed Oct 26	Convnets Part II	CS231n Convnets	**HW3 Due, HW4 Out**
Mon Oct 31	Labeling Pixels	Deconvolution artifacts	
Wed Nov 2	Detection		**Project Proposals Due**
Mon Nov 7	Optical Flow	S8.4	
Wed Nov 9			**No Lecture, HW4 Due, HW5 Out**
Mon Nov 14	Tracking and Video Problems	S4.14 simple tracking with code	
Wed Nov 16	Calibration and Intro to 3D	S6.3 calibration with opencv	
Mon Nov 21	Single-View Geometry		
Wed Nov 23	Epipolar Geometry	S11.1	
Mon Nov 28	Stereo	S11	**HW5 Due, HW6 Out, Project Progress Report due Nov 29**
Wed Nov 30	Structure from Motion	S7	
Mon Dec 5	Advanced topics		
Wed Dec 7			**No lecture, HW6 Due**
Fri Dec 16 7:45-9:45 AM	Project report out		**Project Due Dec 15 9:59pm**

Part 5: Course Policies

Participation

Students are expected to participate in all online activities as listed on the course calendar.

Inform Your Instructor of Any Accommodations Needed

Michigan State University is committed to providing equal opportunity for participation in all programs, services and activities. Requests for accommodations by persons with disabilities may be made by contacting the Resource Center for Persons with Disabilities at 517-884-RCPD or on the web at rcpd.msu.edu. Once your eligibility for an accommodation has been determined, you will be issued a verified individual services accommodation ("VISA") form. Please present this form to me at the start of the term and/or two weeks prior to the accommodation date (test, project, etc). Requests received after this date will be honored whenever possible.

Drops and Adds

The last day to add this course is the end of the first week of classes. The last day to drop this course with a 100 percent refund and no grade reported is 9/23/2022. You should immediately make a copy of your amended schedule to verify that you have added or dropped this course. The details about the academic calendar can be found at https://reg.msu.edu/ROInfo/Calendar/Academic.aspx.

Commercialized Lecture Notes

Commercialization of lecture notes and university-provided course materials is not permitted in this course.

Complete Assignments

Assignments for this course will be submitted electronically through D2L unless otherwise instructed. Assignments must be submitted by the given deadline or special permission must be requested from instructor before the due date. Extensions will not be given beyond the next assignment except under extreme circumstances.

All discussion assignments must be completed by the assignment due date and time. Late or missing discussion assignments will affect the student's grade.

Academic Honesty:

The Department of CSE adheres to the policies on academic honesty as specified in General Student Regulations 1.0, Protection of Scholarship and Grades, and in the all-University Policy on Integrity of Scholarship and Grades, which are included in Spartan Life; Student Handbook and Resource Guide. Students who plagiarize will receive a 0.0 on the assignment/test/quiz.

Spartan Code of Honor academic pledge

 "As a Spartan, I will strive to uphold values of the highest ethical standard. I will practice honesty in my work, foster honesty in my peers, and take pride in knowing that honor is worth more than grades. I will carry these values beyond my time as a student at Michigan State University, continuing the endeavor to build personal integrity in all that I do." (adopted by ASMSU on March 3, 2016, endorsed by Academic Governance on March 22, 2016, and recognized by the Provost, President, and Board of Trustees on April 15, 2016).

Tuition refund period Details can be found at https://reg.msu.edu/ROInfo/Calendar/Academic.aspx

Religious observance: Michigan State University has long had a policy to permit students, faculty/academic staff, and support staff to observe those holidays set aside by their chosen religious faith If you wish to be absent from class to observe a religious holiday, make arrangements in advance with the instructor.

Final Exam Policy can be found at https://reg.msu.edu/ROInfo/Calendar/FinalExam.aspx

The Office of Institutional Equity policies can be found at:

- Disability and Reasonable Accommodation Policy-https://oie.msu.edu/policies/disability-and-reasonable-accommodation-policy.html
- Policy on RVSM- https://oie.msu.edu/policies/rvsm.html

Tolerance and Civility- " MSU strives to build an academic community with living and learning environments that expects tolerance of viewpoints and civility toward others, whether at public forums, athletic events, in residential communities, classrooms or laboratories.
We call upon all who participate in university events to promote tolerance and civil behavior and to hold themselves to high standards that reflect the university's commitment to respect viewpoints that may be different from their own. Only by respecting individuals with diverse perspectives and ideas can we build an environment of civility that is conducive to advancing knowledge and transforming lives."