CMSC 426-0201: Computer Vision

Fall '21

Instructor:

Christopher Metzler, metzler@umd.edu, Section 0201.

Office: Online due to COVID.

Course Overview: This course offers an introduction to computer vision and computational photography. The course will cover basic principles of image processing, image recognition using both classical methods and deep learning, and multiple view geometry for visual navigation. It will explore the topics of image formation, image features, image stitching, image and video segmentation, motion estimation, tracking, and object and scene recognition.

The course is organized around several projects. Through these projects you will learn the theory and practical skills required to obtain a computer vision engineering job.

Text: All concepts will be covered during in class lecture. However, we also recommend the following books as good references:

- Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer, 2010 online version.
- D. Forsythe and J. Ponce, *Computer Vision: A Modern Approach*, Prentice-Hall, 2003 (available online).
- Rafael Gonzalez, and Richard Woods, *Digital Image Processing*, Prentice Hall, 2008.
- Richard Hartley, and Andrew Zisserman, *Multiple View Geometry in Computer Vision*, Cambridge University Press, 2008.

Prerequisites: Each student is expected to know the basic concepts of Python programming, linear algebra and calculus.

Course Work and Exams: Course work will consist of individual homework assignments, several ~~group-based~~ individual programming projects, and a larger, ~~group-based~~ individual final programming project. You may discuss problems and general solution strategies with classmates, but you *must* write up the solutions yourself. We will be using Python programming language for this course.

Assignments will be turned in on ELMS, https://www.elms.umd.edu.

All work must be typed (preferably in LaTeX), not handwritten. Poorly written work will not be graded. When writing programming assignments be sure not only that your solution is correct, but also that it is easy for the grader to understand why your solution is correct. Part of your grade will be based not only on correctness, but also on the simplicity, clarity, and elegance of your solutions.

Do not post any of your project/homework code publicly online (e.g., github public repository). Doing so is a violation of academic integrity policy.

Late Policy: We encourage students to submit work on time. Except for the final project, **which will not be accepted late**, students have 8 late days (total all over all assignments) they can use as they see fit. An assignment submitted 1 second after the deadline will count as one day late. Late days are counted on an individual basis, so please coordinate with your project groups to turn in assignments on time. After a student has used all 8 of their late days, any assignment turned in late will not be graded.

Final Project:

The final project will be due on:

Wednesday, May 19 at 11:59 PM (ET)

Piazza: We will be using Piazza (www.piazza.com), a question-and-answer system designed to streamline discussion outside of the classroom. It supports LaTeX, code formatting, embedding of images, and attaching of files. It will be moderated by the instructor and TAs, but students are encouraged to answer questions.

Zoom: Lectures will be presented live on Zoom at the scheduled class time. Lectures will be recorded and posted on ELMS.

ELMS: We will be using ELMS to view recorded lectures, hand in assignments and to see grades.

Grading: Final grades will be based on the homework, projects, and a final project. The weighting for each will be approximately 60% for projects, 15% for homework, and 25% for the final project. We aim to have a standard 90/80/70/… breakdown for letter grades but reserve the right to curve up.

Disability Support Services: Any student eligible for and requesting reasonable academic accommodations due to a disability is requested to provide, to the instructor via email, a letter of accommodation from the Office of Disability Support Services (DSS) within the first two weeks of the semester.

Course Evaluations: The Department of Computer Science takes the student course evaluations very seriously. Evaluations will usually be open during the last few weeks of the course. Students can go to www.courseevalum.umd.edu to complete their evaluations.

Copyright: Students are permitted to use course materials for their own personal use only. Course materials may not be distributed publicly or provided to others (excepting other students in the course), in any way or format.

Class Concerns: If you have any class concerns, feel free to contact the instructor. If an issue arises with the instructor, report it using the form available at https://www.cs.umd.edu/classconcern

Syllabus: This is the current version of the syllabus. The instructors reserve the right to change it at any time.

Office Hours: (Zoom links found on ELMS)
Chris Metzler: Fridays 11:00 to noon or by appointment
Kanishka Ganguly: Tuesdays and Thursdays 5:00 to 6:00
Shantam Bajpai: Thursdays 2:30 to 4:30
Jiaye Wu: Mondays 3:15-5:15

Topics: The following is a *tentative* list of topics and readings in *approximate* order.

1. Introduction to Computer Vision, Linear Algebra and Python
2. Image Processing / Correlation / Convolution / Edge Detection
3. Feature Detection / Corner detection (Harris) / SIFT
4. Classification with Classical Methods / Bag of Features / Nearest Neighbor / SVM
5. Neural Networks
6. Convolutional Neural Networks
7. 2D Transformations / RANSAC
8. Multi-view Geometry / Stereo / Structured Light / Structure from Motion
9. Optical Flow
10. Segmentation
11. Computational Photography
12. Recent Trends in Computer Vision