CMSC 426-0201: Computer Vision

Spring 2022

Instructor:

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Course Overview: This course offers an introduction to Computer Vision and Computational Photography. The course will cover basic principles of Image Processing, Multiple View Geometry for Visual Navigation, and Image Recognition using Classical and Deep Learning . It will explore the topics of image formation , image feature, image stitching, image and video segmentation, motion estimation, tracking, and object and scene recognition. The course is intended for anyone interested in processing images or video, or interested in acquiring general background in real-world perception. The course is , organized around a number of projects. Through these projects you will learn the theory and practical skills required in jobs of computer vision engineering.

Text: All concepts will be covered in class lecture, and in the lecture notes. 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: Minimum grade of C- in CMSC330 and CMSC351 and 1 course with a minimum grade of C- from (MATH240, MATH341, MATH461); or must be in the (Computer Science (Doctoral), Computer Science (Master's)) program; or permission of the instructor. Each student is expected to know Python programming.

Course Work and Exams: Course work will consist of written homework and programming assignments and projects, with one exam. You may discuss homework 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.

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

As a courtesy to the grader, home works are to be written clearly and neatly. 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.

All projects are intended to be done in groups of up to 3. However, home works must be done individually.

Late Policy : We encourage students to submit in time. Late submissions are accepted for 1 day for a 20% reduction in points.

Exam:

The midterm exam will be:

Thursday, April 21 during lecture

If the exam date is a problem for you, get in touch with the course staff now.

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 instructors and TAs, but students are encouraged to answer questions.

ELMS: We will be using ELMS to hand in assignments, and to see grades. Also, post final grades and to see recorded lectures (if any).

Grading: Final grades will be based on weekly quizzes, home works, projects, and a midterm exam. The weights of these will be approximately 5% for quizzes, 40% for projects (3 to 4), 30% for home works(3 to 4), and 25% for midterm.

Disability Support Services: Any student eligible for and requesting reasonable academic accommodations due to a disability is requested to provide, to the instructor in office hours, 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.

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

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

1. Introduction to Computer Vision, Linear Algebra and Python
2. Camera and Projections
3. Image Processing / Correlation / Convolution
4. Edge Detection/ RANSAC
5. Feature Detection / Corner detection (Harris)
6. Gaussian Mixture Model/ Expectation Maximization
7. Difference of Gaussian / SIFT
8. Segmentation
9. K-Means clustering
10. Tracking
11. Linear classification
12. Nearest neighbors
13. Bag of Features
14. SVM
15. Neural Networks
16. Deep Learning / CNN's