State University of New York at Buffalo
Department of Computer Science and Engineering
Fall 2021
CSE 473/573 – Computer Vision and Image Processing

Course Syllabus

Administrative Information
Course Credits: **3 Credits**
Instructor: **Dr. Junsong Yuan** jsyuan@buffalo.edu
Course Communication Platform: **UB learns and piazza**
Office Hours: TBD

Course Description:

CSE 473/573: This course is an introduction to those areas of Artificial Intelligence that deal with fundamental issues and techniques of computer vision and image processing. The emphasis is on physical, mathematical, and information-processing aspects of computational vision and image processing. Topics to be covered include image formation, 3-D vision, edge detection, image convolution, extraction of features such as color, texture, and shape, image segmentation, object detection, and computer vision system architectures and applications.

Prerequisites: (1) Linear Algebra and (2) programming in python **or** C++

Textbook: Computer Vision: Algorithms and Applications, by Richard Szeliski

Main Objective: Understand how images are formed from cameras, and the camera models. Understand stereo vision: how to obtain the 3D structure of the world from two or more cameras. Learn basic concepts of image processing and analysis. Learn how to design algorithms and solutions for real applications: object detection, image segmentation, image analysis, camera calibration, 3D structure from 2D images etc.

At the end of this course, each student should be able to:
(1) Know how the 3D scene will appear on the 2D image plane through a camera model (3D to 2D)
(2) Know how to estimate the intrinsic and extrinsic parameters of a camera
(3) Know how to estimate the 3D scene from two or multiple image (2D to 3D)
(4) Know how to estimate fundamental matrix from two views of images
(5) Know how to perform image convolution to detect corners and edges in an image
(6) Know how to perform image texture analysis and data clustering
(7) Know how to perform image segmentation
(8) Know how to perform morphological image processing for image denoising and analysis
(10) Know how to perform non-linear image processing for image denoising, and image analysis.
(11) Know how to extract local invariant features from images and match them
(12) Know how to detect or find simple object in images
(13) Know how to calculate optical flow from videos
(14) Can solve simple to moderately difficult 3D vision problems arising in applications.
(15) Can solve simple to moderate difficult image processing and analysis problem in real applications.

Grading

Learning assessments will be graded based on rubric criteria and weighted according to the following break-down. The final grading of CSE 473 and CSE 573 will be separated.

Weighting	Assessment / Assignment
10%	Quiz 1
10%	Project 1
10%	Homework 1
15%	Middle-Term
10%	Quiz 2
10%	Homework 2
10%	Project 2
25%	Final
100%	

Students will receive **a grade of F if they are found in violation of the <u>Academic Integrity</u> policy**. Please make sure to thoroughly read and understand the policy for this course.

Important Policies
It is entirely your responsibility to follow the policies. Please ask the instructor if you have questions. Thanks to Steve Ko, Kris Schindler, Atri Rudra, and Carl Alphonce for allowing us to adapt their policies.

Late Submission Policy
- Completed homework and project deliverables are to be submitted by their deadline.
- Late submissions are allowed for one day and will result in a 50% penalty. A day is defined as 24 hours after the day/time the assignment is due (excluding weekends or school holidays). No help will be available from the TAs or from the instructor for an assignment after its scheduled due date.
- After one day, no submissions will be accepted.

Regrading Policy
- Assignments, quizzes and exams may be submitted for regrading to correct grading errors.
- Regrade requests are due no later than one (1) week after the scores are posted.
- Regrade requests must be clearly written and attached to the assignment.
- Regrades requests are intended to correct grading errors, **NOT** for negotiating a higher grade. When work is submitted for regrade, the entire work may be regraded, **which may result in a lower grade.**
- Work done in pencil may not be considered for regrading.

Exam Policy
- No makeup exams will be given except in **provably extreme circumstances**.
- Notify your instructor 24 hours prior to the exam via e-mail if you are going to miss it. If it is medically impossible for you to give prior notice, please obtain a note from a physician detailing the period (and the reason) you were medically incapable of communicating with the instructor.

- If you miss an exam/quiz because of sickness or similar reasons, visit a physician and obtain a note detailing the period and the reason you were medically incapable of taking the exam/quiz.
- You are responsible for knowing about the exam date. Please plan your travel and other activities accordingly.

Grading Policy
- No "I" (Incomplete) will be given except under provably extreme circumstances.
- There is no grade negotiation at the end of the semester.

Disabilities
- If you have a diagnosed disability (physical, learning, or psychological) that will make it difficult for you to carry out the course work as outlined, or that requires accommodations such as recruiting note-takers, readers, or extended time on exams or assignments, please advise the instructor during the first two weeks of the course so that we may review possible arrangements for reasonable accommodations. In addition, if you have not yet done so, contact the Office of Disability Services.

Academic Integrity:

- All work must be your own
    - Do not take the answers, words, ideas or research findings of other people as yours; cite and acknowledge properly, and develop your own ideas.
- No cheating
    - According to departmental policy, any violation of academic integrity may result in an "F" for the course, and termination of departmental financial scholarship.
    - Tools will be used to check similarity. **Similar submissions will result in "F" for all involved parties.**
- Use of a code from an online repository, e.g. Github, must include a proper and clearly visible attribution in your report.

Reference to the university Graduate Academic Integrity policy:
https://grad.buffalo.edu/succeed/current-students/policy-library.html.

Quoted from above:

Academic integrity is a fundamental university value. Through the honest completion of academic work, students sustain the integrity of the university while facilitating the university's imperative for the transmission of knowledge and culture based upon the generation of new and innovative ideas.

Examples of Academic Dishonesty

Academic dishonesty includes, but is not limited to, the following:

- **Previously submitted work.** Submitting academically required material that has been previously submitted - in whole or in substantial part - in another course, without prior and expressed consent of the instructor.

- **Plagiarism.** Copying or receiving material from any source and submitting that material as one's own, without acknowledging and citing the particular debts to the source (quotations, paraphrases, basic ideas) or in any other manner representing the work of another as one's own.
- **Cheating.** Soliciting and/or receiving information from, or providing information to, another student or any other unauthorized source (including electronic sources such as cellular phones and PDAs), with the intent to deceive while completing an examination or individual assignment.
- **Falsification of academic materials.** Fabricating laboratory materials, notes, reports or any forms of computer data; forging an instructor's name or initials; resubmitting an examination or assignment for reevaluation which has been altered without the instructor's authorization; or submitting a report, paper, materials, computer data or examination (or any considerable part thereof) prepared by any person other than the student responsible for the assignment.
- **Misrepresentation of documents.** Forgery, alteration or misuse of any university or official document, record or instrument of identification.
- **Confidential academic materials.** Procurement, distribution or acceptance of examinations or laboratory results without prior and expressed consent of the instructor.
- **Selling academic assignments.** No person shall sell or offer for sale to any person enrolled at the University at Buffalo any academic assignment, or any inappropriate assistance in the preparation, research or writing of any assignment, which the seller knows, or has reason to believe, is intended for submission in fulfillment of any course or academic program requirement.
- **Purchasing academic assignments.** No person shall purchase an academic assignment intended for submission in fulfillment of any course or academic program requirement.

Reference to the department Academic Integrity policy:

https://engineering.buffalo.edu/computer-science-engineering/information-for-students/policies/academic-integrity-students.html

Quoted from above:

The academic degrees and the research findings produced by our Department are worth no more than the integrity of the process by which they are gained. If we do not maintain reliably high standards of ethics and integrity in our work and our relationships, we have nothing of value to offer one another or to offer the larger community outside this Department, whether potential employers or fellow scholars. For this reason, the principles of Academic Integrity have priority over every other consideration in every aspect of our departmental life, and we will defend these principles vigorously. It is essential that every student be fully aware of these principles, what the procedures are by which possible violations are investigated and adjudicated, and what the punishments for these violations are. Wherever they are suspected, potential violations will be investigated and determinations of fact sought. In short, breaches of Academic Integrity will not be tolerated.

The following statement further describes the specific application of these general principles to a common context in the CSE Department environment, the production of source code for project and homework assignments. It should be thoroughly understood before undertaking any cooperative activities or using any other sources in such contexts.

All academic work must be your own. Plagiarism, defined as copying or receiving materials from a source or sources and submitting this material as one's own without acknowledging the particular debts to the source (quotations, paraphrases, basic ideas), or otherwise representing the work of another as one's own, is never allowed. Collaboration, usually evidenced by unjustifiable similarity, is never permitted in individual assignments. Any submitted academic work may be subject to screening by software programs designed to detect evidence of plagiarism or collaboration.

It is your responsibility to maintain the security of your computer accounts and your written work. Do not share passwords with anyone, nor write your password down where it may be seen by others. Do not change permissions to allow others to read your course directories and files. Do not walk away from a workstation without logging out. These are your responsibilities. In groups that collaborate inappropriately, it may be impossible to determine who has offered work to others in the group, who has received work, and who may have inadvertently made their work available to the others by failure to maintain adequate personal security. In such cases, all will be held equally liable.

These policies and interpretations may be augmented by individual instructors for their courses. Always check the handouts and web pages of your course and section for additional guidelines.