CS B657: Computer Vision, Spring 2017

Instructor	Associate Instructors		
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Contacting course staff and other students: Communication between you, us, and other students is really important. Help us make this more efficient by following these guidelines!

- For asking questions of general interest to other students, e.g. regarding clarifications to course material, assignments, etc., please use Piazza so that others can benefit from the answers.
- For more informal interactions with other students in the class, e.g. for group projects, please use Slack, which you can join using your IU email at `https://b657-sp2017.slack.com/signup`.
- For more personal matters like grading, email us at **csb657@indiana.edu**. Expect a reply from someone on the course staff within 24 hours; re-send your email if you do not get one.
- For more sensitive personal matters, email the instructor directly (djcran@indiana.edu).

Office hours are as listed on the course Canvas website.

Lectures: Mondays and Wednesdays 7:15pm-8:30pm, Fine Arts 102.

Course overview: This is an introductory course in computer vision. We will give a broad overview of the field, with a slight bias towards some topics to reflect current research trends (e.g. object recognition, deep learning). The emphasis will be on algorithms, mathematical models, and techniques that are broadly applicable to many problems not only in vision but also in other areas of AI and CS. Topics will include (tentatively and not necessarily in this order):

- Basic image manipulation: digital image representation, image filtering, morphology
- Feature detection: edge detection, corner detection, invariant interest point detection Segmentation
- Recognition: subspace methods, hausdorff/chamfer matching, bags-of-words, pictorial structures
- Learning for vision: support vector machines, neural networks, deep learning
- Geometry and image transformations: camera models, image transformations, 2d & 3d geometry
- Graphical models: Markov models, Markov Random Fields, belief propagation, graph cuts
- Motion: Optical flow, parametric motion
- Reconstruction: stereo, structure from motion, shape from X, image restoration

Prerequisites: CSCI B551 or equivalent is recommended but not absolutely necessary. No background in image processing or computer vision is required. You will need to be proficient in a general-purpose programming language; as a quick rule-of-thumb, you should be able to easily implement basic matrix operations using basic data structures of the language (e.g. matrix multiplication using arrays). We strongly recommend C/C++ and it is the language we will "officially" support; higher-level languages like Java, Python, or Matlab are acceptable but tend to be frustratingly slow for computation-intensive vision algorithms. Computer vision draws from many other fields including linear algebra, basic calculus, machine learning, graph theory, probability theory, geometry, and statistics. Exposure to these topics is helpful but not required, although you may need to do some background reading.

Relationship to other courses: Computer vision is a broad and diverse field. If you've taken a vision course at another university, this course may still be valuable because we will likely cover many topics you have not seen before. If you took CS B659: Vision for Intelligent Robotics, the overlap may be as high as 50%.

A textbook is not required; we will supply online articles and book chapters. Suggested additional resources include:

- Gonzalez and Woods, *Digital Image Processing.*
- Szeliski, *Computer Vision: Algorithms and Applications.*
- Jain, Kasturi, and Schunck, *Machine Vision.*

Schedule, readings, and resources will be available via Canvas, `canvas.iu.edu`.

Course structure and grading: The first half of the course (roughly before spring break) will consist primarily of lectures and programming assignments. The second half of the course will build on this foundation through a mix of lectures and seminar-style discussions of research papers, during which students will focus on a final project of their own choice.

- *Programming projects (50%),* approximately 4 and conducted in small groups. The projects involve implementing and experimenting with techniques discussed in class.
- *Final project (30%),* on a topic of the student's choice. See below for more details.
- *In-class and online quizzes and activities, and participation (20%).* The lowest grade will be dropped.

Final project: The final project will consist of research or implementation into a topic of the student's own choosing (in consultation with the instructor). Projects may be done individually or in small groups. There will be three deliverables: a brief (2 page) proposal, due approximately 6 weeks into the semester, a poster or demo at a public poster session near the end of the semester, and a report with the approximate length and formatting of a conference paper along with an electronic copy of the source code developed during the project. Students will be encouraged but not required to submit their work to a conference or workshop.

Late policy: Assignments will be accepted up to 48 hours after the due date with a 10% late penalty. Assignments received more than 48 hours late will not be accepted. **Note:** All assignments must be submitted electronically according to the instructions given on the assignment hand-outs. We use the time that submissions are *received by the servers* to judge timeliness. It is the student's responsibility to upload submissions well ahead of the deadline to avoid last minute problems with network connectivity, browser crashes, etc. It is a good idea to make early submissions and upload updates as the deadline approaches; we will grade the last submission received before the deadline.

Attendance policy: Students are expected to attend all class sessions. To allow for an occasional exception, we will drop the single lowest in-class quiz or activity score when computing the final course grade. Make-up quizzes and activities will not be offered unless (1) a student is missing class for a valid academic or religious event (such as a job interview or conference) and notifies the instructor and presents substantiating documentation at least **1 week** ahead of time, or (2) a student misses class for health reasons (involving themselves or a dependent child), notifies the instructor within 24 hours of missing class, and presents written documentation.

Academic Integrity Policy: *We take academic integrity very seriously.* You are required to abide by the Indiana University policy on academic integrity, as described in the Code of Student Rights, Responsibilities, and Conduct, as well as the Computer Science Statement on Academic Integrity (`http://www.soic.indiana.edu/doc/graduate/graduate-forms/Academic-Integrity-Guideline-FINAL-2015.pdf`). It is your responsibility to understand these policies. Briefly summarized, the work you submit for course assignments, projects, quizzes, and exams must be entirely your own (or entirely that of your group, if groupwork is permitted). If you use the ideas (including text, source code, algorithms, concepts, diagrams, slides, etc.) of others, you must give proper credit **with a prominent citation and an explicit indication of which idea(s) or material(s) you borrowed so that another person (e.g. a grader) can**

easily separate your contribution from the work of others. You may discuss assignments with other students (or students in other groups) at a high level, by for example discussing general methods or strategies to solve a problem, but you must cite the other student in your submission. **Looking at someone else's code related to an assignment, whether online or from another student, will almost certainly lead to academic dishonesty. Sharing your assignment code with another student also almost certainly constitutes academic dishonesty.**

The consequences of academic dishonesty are extremely serious. We will respond to acts of plagiarism and academic misconduct according to university policy. In assigning sanctions, we will follow CS Program policy: "The ordinary departmental level penalty for cheating is **failure in the course**" but "in all cases, **the penalty will be more severe than not turning in the assignment**." In addition, "the student will **no longer be eligible for the guaranteed financial aid** provided by the CS program." Moreover, University policy requires us to report the incident to the Dean of Students, who may apply additional sanctions, including expulsion from the university.

Students agree that by taking this course, papers and source code submitted to us may be subject to textual similarity review, for example by Turnitin.com. These submissions may be included as source documents in reference databases solely for the purpose of detecting plagiarism of such papers or codes.

Disabilities: Every attempt will be made to accommodate qualified students with disabilities (e.g. mental health, learning, chronic health, physical, hearing, vision neurological, etc.). You must have established your eligibility for support services through the appropriate office that services students with disabilities. Note that services are confidential, may take time to put into place and are not retroactive; captions and alternate media for print materials may take three or more weeks to get produced. Please contact Disability Services for Students at `http://disabilityservices.indiana.edu`, 812-855-7578, or in Wells Library Room W302. Walk-ins are welcome 8 AM to 5 PM, Monday through Friday. You can also locate a variety of campus resources for students and visitors that need assistance at: `http://www.iu.edu/~ada/index.shtml`

Religious Holidays: Indiana University respects the right of all students to observe religious holidays and will make reasonable accommodation, upon request, for such observances. Each year, instructors are provided with the dates of major religious holidays for which students may request accommodation. Students must submit written requests for accommodation in writing by the end of the second week of the semester. Instructors are expected to give students the opportunity to do appropriate make-up work that is intrinsically no more difficult than the original exam or assignment.

Emergency Preparedness: Although rare, emergencies can and do occur, and it's important that you know how to handle them. Below is a brief summary; see `http://protect.iu.edu/` for more information.

- *Tornado:* Seek shelter. Move to an interior room on the lowest level. Stay away from windows and exterior doors. Listen to a weather radio for updates. Stay away from hazardous materials.
- *Fire:* Evacuate. Pull the fire alarm. Call 911. Leave the building, closing doors behind you. If unable to exit go to the nearest stairwell or place of refuge, dont use elevators. Assemble in designated area.
- *Medical emergency:* Call 911. Do not move the victim unless in immediate danger. If trained, administer first aid, CPR/AED.
- *Suspicious activity, e.g. object is out of the ordinary, person is behaving strangely, gut feeling that something is wrong:* If you see something suspicious, call 911.
- *Hazardous materials:* Stay back. If life-threatening, pull the fire alarm, evacuate and call 911. If non-life-threatening, call 911 and provide information on type of incident and location.
- *Bomb threat:* Remain calm. Get as much information as possible from the caller: location of device, what it looks like, what will cause it to explode. Note background sounds, gender of caller, other notable characteristics of the caller's voice. Call 911.
- *Active shooter:* Call 911. Leave the building if possible, otherwise hide in a concealed place. Lock and barricade door, turn off lights. Wait for law enforcement. As a last resort, overpower the shooter.