CS 543 / ECE 549 – Computer Vision – Spring 2011

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Room:	**Everitt 241**
Class Time:	**Tuesday and Thursday 2:00pm – 3:15pm**
Office Hours:	TBA
Web Page:	http://www.cs.illinois.edu/class/sp11/cs543/

Computer vision algorithms attempt to make sense of photographs, video, and other imagery. Applications include analysis of medical images, automated quality inspection, entertainment, vehicle safety, security, and media search, among many others.

In this course, we will cover many of the basic concepts and algorithms of computer vision: single-view and multi-view geometry, lighting, linear filters, texture, interest points, tracking, RANSAC, K-means clustering, segmentation, EM algorithm, recognition, and so on. In homeworks, you will put many of these concepts into practice. As this is a survey course, we will not go into great depth on any topic, but at the end of the course, you should be prepared for any further vision-related investigation and application.

General Information

The recommended **textbook** is Computer Vision: A Modern Approach by David Forsyth and Jean Ponce. Other useful books include the draft Computer Vision: Algorithms and Applications by Rick Szeliski and Multiple View Geometry in Computer Vision by Hartley and Zisserman.

More useful books:
Computer Vision, Shapiro and Stockman *(a nice introduction to computer vision)*
Linear Algebra and its Applications, Gilbert Strang *(excellent book on linear algebra)*
Vision Science: Photons to Phenomenology, Stephen Palmer *(great book on human perception)*
Digital Image Processing, 2nd edition, Gonzalez and Woods *(a good general image processing text)*

Prerequisites include basic knowledge of linear algebra, calculus, and probability. Most or all homeworks will involve programming in Matlab.

Attendance is expected. Lecture slides will be posted, but they may be difficult to interpret without attending lectures.

To obtain **disability-related academic adjustments** and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TDD), or e-mail a message to disability@uiuc.edu.

Assignments and Grading

Grades are based on four or five homeworks and a final project. The homeworks are worth 75%, and the final project is worth 25%. To have a guaranteed "A", you need an average grade of 90%. I reserve the right to lower but not raise this threshold. Homeworks can be completed in groups. Each person should submit his or her own complete solutions and indicate any collaborators.

Academic Honesty: You are expected to do your own work. When you turn in an assignment, be sure to list any collaborators. Collaboration means that you discuss assignments, but don't share code or copy solutions. Do not use outside code without prior permission from the instructor. Also, make sure to list any sources of ideas or code, no matter how minor. Violations of the student code of academic honesty will be reported, with a minimum penalty of getting no credit for the assignment.

Late Policy: You are expected to do assignments on time. Late assignments will be assigned a penalty of 10% per day. Late days will be forgiven for **one** assignment for up to one week, applied at the end of the semester to the assignment with the most late days. Generally, homeworks can only be turned in once (not revised), though special circumstances may be considered.

Tentative **due dates** are Feb 15, March 8, April 5, April 26, and the final period for the homeworks and the final project, respectively. These are subject to change.

Final Project

The project is a chance to further explore a topic of interest. Groups of up to four are highly encouraged. More is expected of larger groups. Projects will include a short written component and a poster presentation. Various types of projects are possible, including those below. The work does not have to be of publishable originality, though at least one project last year was revised into a conference submission.

Research Project: Perform a project in a topic of your choice. Formulate a goal, devise an approach, and evaluate. When proposing, indicate what dataset you will use for evaluation. For example, you could base your project on an existing paper and try to improve the accuracy or speed with some modification. You could also apply existing algorithms to your own field (e.g., robotics).

Review and Implement a Paper: Choose a paper or set of papers and write a scholarly review. Then, implement and evaluate the algorithm. If done in a group, more than one paper should be implemented and compared. Reviews should be written independently for each person, but the group can collaborate on implementation and evaluation.

Planned Schedule

Weeks 1-3: Image Formation and Basic Processing

- Camera models, geometry, and single-view metrology
- Shading and color
- Image filters, Gaussian pyramid, texture

Weeks 4-6: Grouping and Fitting

- Edge detection, line fitting, and registration
- Clustering, EM, and mixture models
- Image segmentation and MRFs

Weeks 7-10: Recognition

- Interest points, SIFT, and object instance recognition
- Face recognition
- Image features and categorization
- Object category recognition
- Statistical templates and part-based recognition

Weeks 11-13: Multiple Views and Motion

- Image stitching
- Point tracking and optical flow
- Epipolar geometry and stereo
- Structure from motion
- Tracking with Kalman filters

Weeks 14-15: Special Topics

- Action recognition
- 3D scene interpretation