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# Computer Vision and Intelligent Systems

## ECG795 Spring 2013

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<http://www.egr.unlv.edu/~b1morris/>

Professor:	Brendan Morris	Class:	TuTh 17:30 - 18:45, WRI C225
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### Textbooks

Computer Vision: Algorithms and Applications, Richard Szeliski, ISBN: 1848829345  
Digital Image Processing, R.C. Gonzalez and R.E. Woods, 3rd Edition, ISBN: 013168728X

### Grading

Final:	30%	05/16 18:00
Project:	30%	Due 05/09
Homework:	40%	Bi-Weekly

Students may study together in groups but all assignments must be completed individually. Homework will be due in class on the designated date. No late homeworks will be accepted unless prior notification and arrangements are made.

The course will have a final video processing project. You will be required to submit a project report in the form of a conference styled manuscript for publication and make a presentation.

### Catalog Description

Introductory graduate course in computer vision, machine learning, and pattern recognition with real-time systems. The course will be divided into two parts: image and video processing. Image processing topics will include image formation, morphology and connected components, feature detection and representation, segmentation, and stereo imaging. Video processing techniques will focus on motion estimation, tracking, and object detection and recognition.

The course will have programming homework assignments and a final project. Readings will be assigned in "Computer Vision: Algorithms and Applications" by Richard Szeliski as well as recent papers from top academic publications.

Programming assignments will use Matlab as well as OpenCV.

**Prerequisites:** Linear Algebra and Programming Experience

### Topics

Image Processing

1. Image Formation - geometric primitives, camera model, digital imaging (sampling and quantization)
2. Image Processing - point operations, color transformations, histogram equalization, spatial image enhancement and filtering, connected components, morphology, multi-resolution pyramids

3. Feature Detection and Representation - corner detectors, invariant features (SIFT, SURF), HoG, edge detection, Canny edge-detector, non-maximal suppression, Hough transform, RANSAC
4. Segmentation - thresholding, region-based segmentation, split-and-merge, mean-shift, graph cuts
5. Stereo Imaging - camera calibration and epipolar geometry, image correspondence, multi-view stereo

#### Video Processing

1. Motion Estimation - optical flow, background modeling, mixture of Gaussians
2. Object Detection - nearest neighbor classification, correlation, Adaboost classifier, SVM
3. Object Recognition - Bayes classifier, Eigenfaces and Fisher faces, bag of words
4. Tracking - Kalman filter, particle filters, Condensation tracking, Mean-Shift tracking, multiple target tracking, feature tracking

Additional course material not present in the textbook will be distributed to the class when needed.

#### Course Objectives and Outcomes

- Students will have a clear understanding of image processing and computer vision fundamentals as well as the challenges.
- Students will be able to design and implement computer vision algorithms for real-time video processing.
- Students will be able to search for and read academic papers and critically evaluate their importance.
- Students will be able to present technical material orally in a clear and concise manner.

#### Course Policies

- There will be no make-up exams or late homework without prior arrangements.
- Extensions will only be granted for medical emergencies or due to the observance of a religious holiday. The instructor must be notified of the absence prior to the last day of late registration.
- As a university student it is your responsibility to conduct yourself ethically and with integrity as described in the Academic Misconduct Policy. Cheating and plagiarism will not be tolerated. Any student caught cheating will be given an F grade.  
(<http://studentconduct.unlv.edu/misconduct/policy.html>)

## University Policies

**Academic Misconduct** – Academic integrity is a legitimate concern for every member of the campus community; all share in upholding the fundamental values of honesty, trust, respect, fairness, responsibility and professionalism. By choosing to join the UNLV community, students accept the expectations of the Academic Misconduct Policy and are encouraged when faced with choices to always take the ethical path. Students enrolling in UNLV assume the obligation to conduct themselves in a manner compatible with UNLV's function as an educational institution.

An example of academic misconduct is plagiarism. Plagiarism is using the words or ideas of another, from the Internet or any source, without proper citation of the sources. See the *Student Academic Misconduct Policy* (approved December 9, 2005) located at: <http://studentconduct.unlv.edu/misconduct/policy.html>.

**Copyright** - The University requires all members of the University Community to familiarize themselves and to follow copyright and fair use requirements. **You are individually and solely responsible for violations of copyright and fair use laws.** The university will neither protect nor defend you nor assume any responsibility for employee or student violations of fair use laws. Violations of copyright laws could subject you to federal and state civil penalties and criminal liability, as well as disciplinary action under University policies. Additional information can be found at: <http://provost.unlv.edu/copyright/statements.html>.

**Disability Resource Center (DRC)** - The Disability Resource Center (DRC) determines accommodations that are reasonable in promoting the equal access of a student reporting a disability to the general UNLV learning experience. In so doing, the DRC also balances instructor and departmental interests in maintaining curricular standards so as to best achieve a fair evaluation standard amongst students being assisted. In order for the DRC to be effective it must be considered in the dialog between the faculty and the student who is requesting accommodations. For this reason faculty should only provide students course adjustment after having received an "Academic Accommodation Plan." If faculty members have any questions regarding the DRC, they should call a DRC counselor.

UNLV complies with the provisions set forth in Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990. The DRC is located in the Student Services Complex (SSC-A), Room 143, phone (702) 895-0866, fax (702) 895-0651. For additional information, please visit: <http://drc.unlv.edu/>.

**Religious Holidays Policy** - Any student missing class quizzes, examinations, or any other class or lab work because of observance of religious holidays shall be given an opportunity during that semester to make up missed work. The make-up will apply to the religious holiday absence only. It shall be the responsibility of the student to notify the instructor no later than the end of the first two weeks of classes, February 1, 2013, of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. This policy shall not apply in the event that administering the test or examination at an alternate time would impose an undue hardship on the instructor or the university that could not reasonably be avoided. For additional information, please visit: <http://catalog.unlv.edu/content.php?catoid=4&navoid=164>.

**Incomplete Grades** – The grade of I - Incomplete - can be granted when a student has satisfactorily completed all course work up to the withdrawal date of that semester/session but for reason(s)

beyond the students control, and acceptable to the instructor, cannot complete the last part of the course, and the instructor believes that the student can finish the course without repeating it. A student who receives an I is responsible for making up whatever work was lacking at the end of the semester. If course requirements are not completed within the time indicated, a grade of F will be recorded and the GPA will be adjusted accordingly. Students who are fulfilling an Incomplete do not register for the course but make individual arrangements with the instructor who assigned the I grade.

**Tutoring** - The Academic Success Center (ASC) provides tutoring and academic assistance for all UNLV students taking UNLV courses. Students are encouraged to stop by the ASC to learn more about subjects offered, tutoring times and other academic resources. The ASC is located across from the Student Services Complex (SSC). Students may learn more about tutoring services by calling (702) 895-3177 or visiting the tutoring web site at: <http://academicsuccess.unlv.edu/tutoring/>.

**UNLV Writing Center** - One-on-one or small group assistance with writing is available free of charge to UNLV students at the Writing Center, located in CDC-3-301. Although walk-in consultations are sometimes available, students with appointments will receive priority assistance. Appointments may be made in person or by calling 895-3908. The students Rebel ID Card, a copy of the assignment (if possible), and two copies of any writing to be reviewed are requested for the consultation. More information can be found at: <http://writingcenter.unlv.edu/>

**Rebelmail** - By policy, faculty and staff should e-mail students Rebelmail accounts only. Rebelmail is UNLV's official e-mail system for students. It is one of the primary ways students receive official university communication such as information about deadlines, major campus events, and announcements. All UNLV students receive a Rebelmail account after they have been admitted to the university. Students e-mail prefixes are listed on class rosters. The suffix is always @unlv.nevada.edu.

**Final Examinations** - The University requires that final exams given at the end of a course occur at the time and on the day specified in the final exam schedule. See the schedule at: <http://www.unlv.edu/registrar/calendars>