



CS 5840 / MATH 5840

Computer Vision

MW 4:45-6:00pm, OSB B216



Prof. Jonathan Ventura

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<http://jventura.net/> (course page: <http://jventura.net/cs5840>)

ENGR 194

Office Hours: W 2-4pm and by appointment

(719) 255-3559

**Course Description:** This graduate course will introduce students to the field of computer vision. Visual perception is a fundamental component of human and animal intelligence, and replicating this capability in computers and robots has long been a goal of artificial intelligence researchers. Discovering successful algorithmic approaches to computer vision tasks can also reveal insights into the mechanisms of biological vision. Computer vision is a broad and deep field, and this course will cover a wide range of topics, including an overview of the human visual system, fundamentals of cameras and optics, image formation, image processing and filtering, detection of lines and shapes, reconstruction of 3D geometry, object segmentation, object detection, and object recognition. In addition to completing homework assignments, students will also conduct experimental research and present their findings in class.

**Prerequisite(s):** Calculus, linear algebra, and some programming experience (any language). Probability and statistics is also useful, and signal processing would be a huge plus!

**Credit Hours:** 3

**Texts:** R. Szeliski. *Computer vision: algorithms and applications*. Springer, 2010.

The textbook is available online for free as a [PDF download](#) at Richard Szeliski's website, and is also available for purchase at the UCCS Bookstore.

S. Palmer. *Vision Science: Photons to Phenomenology*. MIT Press, 1999.

which is [available](#) through the library.

I. Goodfellow, Y. Bengio, and A. Courville. *Deep Learning*. MIT Press, 2016.

The textbook is available online for free as a [PDF download](#).

And, various research papers which can be accessed through the [UCCS Library Proxy](#).

**Course Objectives:** Upon successful completion of this course, students will be experts in the fundamental theories and techniques of computer vision, from low-level image processing to high-level semantic recognition. Students in this course will also conduct research into computer vision topics related to their own interests and professional goals, and thus gain a deeper understanding of the current state-of-the-art.

## Grade Distribution:

Category	Points Possible	Percentage of Grade
Homeworks	400	40%
Midterm Exam	300	30%
Final Project	200	20%
Paper Presentation	100	10%
Total	1000	100%

## Letter Grade Distribution:

>= 93.00	A	73.00 - 76.99	C
90.00 - 92.99	A-	70.00 - 72.99	C-
87.00 - 89.99	B+	67.00 - 69.99	D+
83.00 - 86.99	B	63.00 - 66.99	D
80.00 - 82.99	B-	60.00 - 62.99	D-
77.00 - 79.99	C+	<= 59.99	F

## Course Policies:

### • General

- Computers are not to be used in class except for note-taking.
- Quizzes and exams are closed book, closed notes unless I say otherwise.

### • Homeworks

- Students are expected to work independently on the homework assignments. **Offering** and **accepting** solutions from others is an act of **plagiarism**, which is a serious offense and **all involved parties will be penalized according to the Academic Honesty Policy**. Discussion amongst students is encouraged, but when in doubt, direct your questions to the professor.

### • Attendance and Absences

- Attendance is expected.
- Students are responsible for all missed work, regardless of the reason for absence. It is also the absentee's responsibility to get all missing notes or materials.
- Late homeworks will only be accepted with consent of the instructor given **prior** to the due date.
- Makeup exams will only be arranged with consent of the instructor given **prior** to the exam day.

## University Policies:

Please read over the university policies on plagiarism, student code of conduct and discrimination / harassment. Plagiarism of code from the internet or from other student's is a serious issue and will be handled at my discretion. Please do your own work and don't copy. All submitted source code will be automatically checked for plagiarism.

- [Plagiarism](#)
- [Student Code of Conduct and Behavior Policy](#)

- [Discrimination and Harassment](#)

## **Support Services and Information**

*Disability Accommodations:* If you are a student with a disability and believe you will need accommodations for this class, it is your responsibility to register with Disability Services and provide them with documentation of your disability. They will work with you to determine what accommodations are appropriate for your situation. To avoid any delay, you should contact Disability Services as soon as possible. Please note that accommodations are not retroactive and disability accommodations cannot be provided until a Faculty Accommodation Letter has been given to me. Please contact Disability Services for more information at Main Hall room 105, 719-255-3354 or [dservice@uccs.edu](mailto:dservice@uccs.edu).

*Military Students:* If you are a military student with the potential of being called to military service or training during the course of the semester, you are encouraged to contact your UCCS course instructor no later than the first week of class to discuss the class attendance policy. Please see the Military Students web site ([www.uccs.edu/deploy](http://www.uccs.edu/deploy)) for more information.

*Library Information:*

- [Kramer Family Library](#)
- [Off-campus access to Library resources](#)

*Academic for Centers Excellence:* The [Academic Centers for Excellence](#) (ACE) at UCCS include the Language Center, the Mathematics Center, the Communication Center, the Science Center, and the Writing Center – five academic centers designed to provide critical academic and individual support to all students in the University in all major academic areas, both within and beyond the classroom. These particular centers may be helpful to you:

- [Mathematics Center](#) (includes Computer Science tutoring)
- [Writing Center](#)

*Technology Support:*

- EAS students can install MATLAB on their own computer. More information can be found at the [EAS help desk](#).
- For Blackboard support, call 1-877-654-8309 or visit the Online Support Center
- For technology assistance related to logging into campus computers, determining your UCCS e-mail address or how to connect to the campus network from off-campus, visit the [UCCS IT Help Desk web site](#) or call 719-255-3536.

**Course Outline:**

- Introduction to computer vision
- Human visual system
- Image formation and geometric transformations
- Image filtering and frequency analysis
- Detecting edges, corners and blobs (scale space)
- Epipolar geometry and 3D reconstruction
- Introduction to machine learning and neural networks
- Object detection and recognition
- Image segmentation

Please visit the course website and Blackboard for the schedule of lectures, readings, and assignments.