Course Number and Title: CS 5670: Introduction to Computer Vision

Instructor (Author of Syllabus): Prof. Noah Snavely

Credits and Credit Hour Options: 3 hours, Letter Grade

Time and Location: Tuesday/Thursday 1:25-2:40pm Bloomberg Center, Room 131

Course Description:
The goal of computer vision is to compute properties of the three-dimensional world from digital images. Problems in this field include reconstructing the 3D shape of an environment, determining how things are moving, and recognizing people and objects and their activities, all through analysis of images and videos.

This course will provide an introduction to computer vision, with topics including image formation, feature detection, motion estimation, image mosaics, 3D shape reconstruction, object/face detection and recognition, and deep learning.

Applications of these techniques include building 3D maps, creating virtual characters, organizing photo and video databases, human computer interaction, autonomous driving, robotics, virtual and augmented reality, medical imaging, and vision on mobile devices.

This is a project-based course, in which you will implement several computer vision algorithms throughout the semester.

Prerequisites:

This course will be self-contained; students do not need to have a computer vision background. However, the following are required (or else the permission of the instructor is needed):

- Data structures
- Working knowledge of Python
- Knowledge of how to use git and GitHub (clone, pull, commit, push, etc)
- Linear algebra
- Vector calculus

Corequisites:

None.

Textbook(s) and/or Other Required Materials:

Richard Szeliski. *Computer Vision: Algorithms and Applications*, 2nd ed. Free online download here: http://szeliski.org/Book/.

Class and Laboratory Schedule:

Lectures: 2.5 hrs/wk.

Recitations: None required.

Labs: None required.

Assignments, Exams and Projects:

EXAMPLE

Activity	**Overview**	**Point Values**
Project 1	Programming project	13%
Project 2	Programming project	13%
Project 3	Programming project	13%
Project 4	Programming project	13%
Project 5	Programming project	11%
Takehome midterm	Midterm exam with questions in a variety of formats (true/false, short answer, etc.)	16%
In-class final exam	Final exam with questions in a variety of formats (true/false, short answer, etc.)	16%
In-class quizzes	Roughly weekly 8-minute quizzes at the beginning of class (typically on Thursdays)	5% (lowest quiz grade dropped). No make-up quizzes will be given.
Total Points		100%

A total of four slip days will be available for the Projects. Slip days will be determined based on the date the code portion of an assignment is turned into GitHub Classroom.

Basis of grade determination:

Grading: Letter grade

EXAMPLES (this is an example only). The University grading scale can be found on this page: https://courses.cornell.edu/content.php?catoid=31&navoid=7933

Grade	**Percent**
A+	98 and above
A	93-97
A-	90-92
B+	88-89
B	83-87
B-	80-82

C+	78-79
C	73-77
C-	70-72
D	60-69
F	<60

Typical Topics Covered:

- Image filtering and convolution
- Edge detection
- Image resampling
- Local feature detection
- Local feature invariance
- Local feature descriptors
- Image transformations
- Image alignment
- Robust estimation and RANSAC
- Cameras models
- Projective geometry
- 360 Panoramas
- Single-view modeling
- Binocular stereo
- Multiview stereo
- Illumination
- Photometric stereo
- Two-view geometry
- Structure from motion
- Image recognition methods
- Image classification
- Convolutional neural networks
- Generative Adversarial Networks (GANs)
- Image generation models
- Computer Vision, Ethics, and Society

Course Outcomes:

1. Demonstrate fundamental understanding of core computer vision topics including low-level image processing, 2D image geometry, 3D camera geometry, image classification, and applications of deep learning
2. Demonstrate use of fundamental equations relating 3D world geometry to 2D image measurements
3. Demonstrate use of machine learning methods to solve computer vision problems in image understanding and geometry
4. Demonstrate the ability to translate core computer vision concepts into code

Academic Integrity

Each student in this course is expected to abide by the Cornell University Code of Academic Integrity. Any work submitted by a student in this course for academic credit will be the student's own work. The policy can be found on the university's website here: https://theuniversityfaculty.cornell.edu/academic-integrity/.

You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e-mail, an e-mail attachment file, a diskette, or a hard copy.

Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment, or other penalty determined by the instructor. Penalty for violation of this Code can also be extended to include failure of the course and University disciplinary action.

During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

Students with Disabilities

Your access in this course is important. Please give me your Student Disability Services (SDS) accommodation letter early in the semester so that we have adequate time to arrange your approved academic accommodations. If you need an immediate accommodation for equal access, please speak with me after class or send an email message to me and/or SDS at sds_cu@cornell.edu. If the need arises for additional accommodations during the semester, please contact SDS. You may also feel free to speak with Student & Academic Affairs at Cornell Tech who will connect you with the university SDS office.

Religious Observances

Cornell University is committed to supporting students who wish to practice their religious beliefs. Students are advised to discuss religious absences with their instructors well in advance of the religious holiday so that arrangements for making up work can be resolved before the absence.

Cornell Tech Cares

The Cornell Tech community is a diverse and vibrant group of students, faculty, and staff. We take our responsibility to look out for one another seriously. As members of this community, your openness and proactive communication will allow us all to better care for students and respond to their needs, whether they be interpersonal or academic. Please help us continue to build and strengthen our community by reaching out if you are having an issue or are concerned about a fellow student. Contact studentwellness@tech.cornell.edu with concerns and we will make sure to care for one another. In the event of an emergency, please call 911 and Cornell Tech Safety & Security at 646-971-3611 (This number is also located on the back of your Cornell ID), when safe to do so.