Introduction to Computer Vision

Autumn 2021

Lecture: Sunday 10: 30 to 12 pm
Discussion: Tuesday 11- 1

Course Information

Professor

Dr. Ahmed Elngar
Phone: +2010074007852
Email: elngar_7@yahoo.co.uk

Teaching Assistants

Eng. Heba

Class Description

The goal of computer vision is to compute properties of the 3D world from images and video. Problems in this field include identifying the 3D shape of a scene, determining how things are moving, and recognizing familiar people and objects. This course provides an introduction to computer vision with topics such as feature detection, image segmentation, motion estimation, object recognition, and 3D shape reconstruction.

Grading

There will be five Homework, a midterm, and a final exam. The assignments will contain both written questions and Python programming questions.

Grading

- Lab activities and assignments: 10%
- Lab attendance: 5%
- Final project: 15%
- Mid-term exam: 20%
- Final exam: 50%
- Extra credit: 5% for students who participate actively on the lectures.
- Extra credit: 5% for students who obtain the best final project.

Zoom

We will be using Zoom as a forum for discussion. You'll be able to interact with the professor, the TAs, and your classmates on Zoom. If you have a question or confusion, it is likely that other students do too, so as a first step we recommend heading to Zoom to (a) first check if anyone else has asked your question and if not, to (b) ask it yourself! Note that class announcements will also be made on Zoom, so you should check Zoom and/or your email somewhat frequently.

Podcasts

We will try to make podcasts available for the class, but we cannot make any guarantees due to potential technical difficulties. In any case, you are highly encouraged to attend lectures in person so that Professor Elngar doesn't get lonely.

Textbooks

This course does not require a textbook. Primary readings can be found in two online texts:

- [RS] Computer Vision: Algorithms and Applications, by Rick Szeliski
- [GBC] Deep Learning, by Ian Goodfellow, Yoshua Bengio and Aaron Courville

A good secondary source is an old text:

- [TV] *Introductory Techniques for 3-D Computer Vision*, E. Trucco and A. Verri, Prentice Hall, 1998 [eresearve]

Prerequisites

Linear algebra (e.g. Math 20F), multivariable calculus (e.g. Math 20A), Python. Probability can also be useful.

Late Policy

Each assignment will come with a description of the relevant submission procedure. However, unless otherwise stated, the late penalty is 10% per day and submissions will only be accepted for up to three days after the deadline.

Collaboration Policy

You may work together on homework assignments to discuss ideas and methods only. The work and code you submit should be your own. It is never permitted to copy or directly reference the code or written work of others.

Assignments

All assignments must be submitted on Gradescope as a single PDF file. Written problems may be either typeset or handwritten/scanned, but we may dock points if your handwriting is illegible or hard to read. Programming problems should be done in the provided IPython notebooks and exported (including outputs and figures) as a PDF.

Syllabus

Note that the syllabus is tentative and subject to change.

1	Introduction to Computer Vision, Linear Algebra Intro	[RS, *1-28*]	
2	Geometric Image Formation	[RS, *29-52*]	Assignment 0 released
3	Filtering	[RS, *sec 3.2-3.3*]	
4	Corner Detection and SIFT	[RS, *sec 4.1.1, opt 4.2*]	Assignment 0 due Assignment 1 released
5	3D Shape Recovery: Shape-from-X, Introduction to Stereo, 3D Cameras	[RS, *sec 4.1.2, 7.1*]	
6	Stereo 1: Epipolar Constraint and the Fundamental Matrix	[RS, *sec 11.1, 7.2*]	
7	Stereo 2: Rectification + Stereo Matching		
8	Aligning 2D and 3D Images and Structure from Motion		Assignment 1 due Assignment 2 released
9	Model Fitting and RANSAC		
10	Photometric Image Formation		
11	Color		
12	Recovering Fine Surface Geometry: Photometric Stereo		Assignment 2 due
13	Midterm (Sample Midterm Questions)		
14	Video 1: Optical Flow and the Motion Field	[TV, *177-191*]	Assignment 3 released
15	Video 2: Tracking	[TV, *191-198*]	
16	Recognition		
17	Memorial Day		Assignment 3 due
18	Neural Networks and Learning		Assignment 4 released
19	Convolutional Networks		
20	Human Visual System		Assignment 4 due