Computer Vision and Pattern Recognition

Course ID: 554SM – Fall 2018

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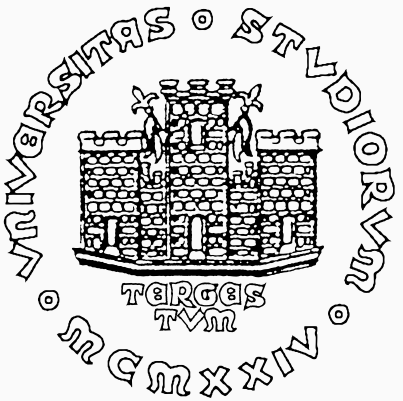

554SM – Course Overview

Course administration

Lecturer and examiner

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Course home page

Moodle@UniTS: 554SM - COMPUTER VISION AND PATTERN RECOGNITION 2018

- slides
- images
- computer code examples

Course credits

6 CFU

Examination

Examination

Final exam consisting of

- a project;
- a written examination;
- a subsequent oral discussion.

The mark depends on the project, the written part and the oral discussion.
Usually, written examination and oral discussion are taking place during the same exam session.

Examination (cont.)

Project

The project consists in designing, implementing and presenting a solution to a problem of computer vision and/or pattern recognition chosen among a set of problems proposed by the lecturer.

The project can possibly be carried out by a group of students and must be delivered (in a way specified in class and published on the lecturer's website) at least 7 days before taking the exam.

The project can be carried out using the preferred language/environment among C++, Matlab and Python.

Examination (cont.)

Written examination

It lasts 45 minutes and consists of:

- some multiple choice questions;
- one essay question.

Questions deal with any possible topic, discussed and analysed in the lectures.

Oral discussion

Oral questions deal with any possible topic, discussed and analysed in the lectures.
A short discussion about the written examination and/or the project may also take place.

Examination (cont.)

Language

The course is taught in English, however:

- multiple choice questions are formulated in English and Italian.
- non-DSSC students may answer the essay question in Italian;
- non-DSSC students may also take the oral discussion in Italian;

Exam sessions

Examination schedule

- 3 sessions in January-February
- 3 sessions in June-July
- 1 session in September

How to sign up for examinations

- In order to participate to the exam session you must register for the exam **(compulsory)**
- To sign up, use the student career management system Esse3 to access to the on-line University Services.
- Please, **pay attention** to the dates of the registration periods and the examination periods!

Course Information

Prerequisites

- Linear algebra:
  - linear systems of equations;
  - eigenvalue decomposition;
  - singular value decomposition;
  - positive definite matrices.
- Calculus:
  - derivatives;
  - integrals;
  - exponentials;
  - complex numbers;
  - directional derivatives and gradient.

References

There is not a textbook covering all the topics of the course to the required detail. The following are *suggested* textbooks:

[1] Szeliski, R. (2010). *Computer vision: algorithms and applications*.
Springer Science & Business Media

[2] Ponce, J. and Forsyth, D. (2015). *Computer vision: a modern approach*.
Pearson Education Limited

[3] Fusiello, A. (2018). *Visione computazionale: Tecniche di ricostruzione tridimensionale*.
FrancoAngeli

[4] Trucco, E. and Verri, A. (1998). *Introductory techniques for 3-D computer vision*.
Prentice Hall Englewood Cliffs

Original papers

The course material (slides) refers often to the original paper where the described method/algorithm has been introduced. The students are encouraged to access and read (some of) the original papers.

Lectures

Lect.	Content	Suggested readings
1	Course overview. Introduction to Computer Vision.	[1], ch. 1.
2	Image formation.	[1], ch. 2, [2], ch. 2, [3], ch. 2.
3	Camera models.	[1], ch. 2, [2], ch. 2, [3], ch. 2.
4	Camera calibration.	[1], ch. 2, [2], ch. 3, [3], ch. 3.
5	Linear filtering.	[1], ch. 3, [2], ch. 7.
6	Nonlinear filtering and morphological operations.	[1], ch. 3.
7	Fourier transforms.	[1], ch. 3, [2], ch. 7.
8	Feature detection.	[1], ch. 4, [3], ch. 8.
9	Feature matching.	[1], ch. 4, [2], ch. 15.
10	Tracking.	[1], ch. 4, [2], ch. 17
11	Stereopsis.	[1], ch. 11, [2], ch. 11, [3], ch. 4.
12	Object detection.	[1], ch. 14, [2], ch. 22

Tentative schedule

October, 2018

01	02	03	04	05	06	07
08	09	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

November, 2018

			01	02	03	04
05	06	07	08	09	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

December, 2018

					01	02
03	04	05	06	07	08	09
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

October, 2018		November, 2018		December, 2018	
1		1	*No class*	1	
2		2		2	
3		3		3	
4		4		4	Object detection #1
5		5		5	Object detection #2
6		6	*No class*	6	Object detection #3
7		7	*No class*	7	
8		8	*No class*	8	
9	Introduction	9		9	
10	Image formation	10		10	
11	Camera models	11		11	Object detection #4
12		12		12	Object detection #5
13		13	Feature detection #2	13	Laboratory class #4
14		14	Feature detection #3	14	
15		15		15	
16	Camera calibration	16	Feature matching	16	
17	Linear filtering	17		17	
18	Nonlinear filtering	18		18	
19		19		19	
20		20	Tracking #1	20	
21		21	Tracking #2	21	
22		22		22	
23	Fourier transforms	23	Laboratory class #2	23	
24	Feature detection #1	24		24	
25	Laboratory class #1	25		25	
26		26		26	
27		27	Tracking #3	27	
28		28	Stereopsis	28	
29		29	Laboratory class #3	29	
30	*No class*	30		30	
31	*No class*			31	

Laboratory

Not a hands-on course

The course is not a hands-on course. It provides the basic concepts and theoretical foundations. *The student is encouraged to experiment by himself using the preferred language/environment.*
For those familiar with Python or C++, a recommended option is using the free, open source library OpenCV (https://opencv.org/).
Those familiar with Matlab may use the Computer Vision System Toolbox and the Image Processing Toolbox, in addition to the external toolbox VLFeat).

Lab lectures

However, some lab lectures will take place. The lectures are based on Matlab.
Why?

- digital images are matrices and Matlab deals natively and simply with matrices;
- Matlab is both a fast prototyping tool and a production tool thanks to the code generation capabilities;
- Matlab is rigorously tested and well documented;
- being familiar with Matlab is definitely a plus in one's CV.

Matlab Campus License

Installation instructions

- Create a MathWorks account, using the e-mail address provided by UniTS: http://mathworks.com/accesslogin/createProfile.do.
- Associate a license through the License Center: http://mathworks.com/licensecenter.
- Download the installer: http://mathworks.com/downloads/web_downloads/select_release.
- Run the installer.
- When prompted, select to install (at least) the following toolboxes:
  - Computer Vision System Toolbox;
  - Image Processing Toolbox;
  - Deep Learning Toolbox;
  - Statistics and Machine Learning Toolbox.
- Activate Matlab when prompted.

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Course Overview

END