Free University of Tbilisi

Syllabus

Year	2016/2017	**Semester**	VIII Spring
Course ID	CS404045	**Course Name**	Computer Vision
Type	Optional	**ECTS Credits**	6
Language	Georgian/English	**Classroom Number**	
Professor	Koba Natroshvili	**E-mail**	koba.natroshvili@intel.com k.natroshvili@freeuni.edu.ge

Consultation by appointment

Course Description

How can computers understand the visual world of humans? This course treats vision as a process of inference from noisy and uncertain data and emphasizes probabilistic, statistical, data-driven approaches. Topics include image processing; segmentation, grouping, and boundary detection; recognition and detection; motion estimation and structure from motion. We will train and evaluate classifiers to recognize various visual phenomena. We will look a deeper look to the statistical learning approaches like Support Vectors Machines and Reduced Set Methods, Deep Learning methods especially Convolutional Deep Neural Network.

Prerequisites

Data Structures and Algorithms

Linear Algebra

Statistics

Knowledge in Artificial Intelligence is not necessary but benefit

Purpose of the course

The main aim of the course is to achieve some intermediate knowledge in the methods and algorithms for Computer Vision.

Albert Einstein said:

'Imagination is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the entire world, and all there ever will be to know and understand.'

Learning Outcomes

In this respect we can consider the course as successful if the students learn to look to the problems analytically and think in the innovative and creative manner.

Teaching Strategy

Most of the part of the course will be in Georgian Language. The slides, exercises and exam will be in English.

The course will be based on the MIT and Stanford University courses in Computer Vision. http://vision.stanford.edu/teaching/cs131_fall1617/index.html

We will have 1x2 hours of lectures 1x2 hours practical work weekly. In complete we will have 16x2h lectures. Final note will be based on the results of homework and the final examination.

Evaluation

The grade would be calculated based on the following scheme:

Homework 0: Problem Set	5 points
Homework 1: Problem Set	10 points
Homework 2: Programming Assignment	10 points
Homework 3: Problem Set	10 points
Homework 4: Programming Assignment	10 points
Homework 5: Problem Set	15 points
Final Exam	40 points

Grade		Percentage	Gradepoints, qualitypoints
A		91 - 100	3.39 – 4.0
B		81 – 90	2.78 – 3.38
C		71 – 80	2.17 – 2.77
D		61 – 70	1.56 – 2.16
E		51 - 60	1.0 – 1.55
FX		41 – 50	0
F		0 – 40	0

Problem Set Evaluation
Each problem in a set consists of a number of subtasks. Each subtask will be graded according to the following criteria:

- 4- answer is complete; the task is executed flawlessly. The solution is conveyed accurately and comprehensively.
- 3- answer is complete, but clipped. There are no essential errors, though some minor deficiencies are observed.
- 2 - the answer is incomplete; several substantial errors are observed.
- 1 - the task is done unsatisfactory, though student put some effort and completed the very minimum of demand.
- 0 – there is no answer, or answer does not meet requirements. The student does not know the material.

Total grade for a problem set will be calculated as a sum of scores for each subtask.

Programming Assignment Evaluation
Programming assignments will be automatically graded according to the number of test casespassed. Automated tests are included in each programming assignment bundle.

Final Examination Evaluation
Each task in the final exam will be evaluated according to the same criteria as the subtasks in problem sets. Afterwards, a score for each task will be multiplied by a certain weight (according to the difficulty of the task, it may be 1, 2 or 3). Total score for the examination will be calculated as a sum of all weighted scores.

For example: Final exam consists of 5 problems with weights of *1*, *1*, *2*, *2* and *3* respectively. Student gets 3, 4, 1, 3, 1 for each of the problems respectively. Thus, student's final evaluation will be computed as:
3 * *1* + 4 * *1* + 1 * *2* + 3 * *2* + 1 * *3* = 18 out of 36, which is 50% of maximal result. Respectively, student's final grade in final exam will be 40*0.50=20 points.

A minimum score of 19% is required to be pass the intermediate evaluation.

A minimum score of 40% is required to be pass the final examination.

Reading materials

- Computer Vision, Algorithms and Applications, R. Szeliski
- Multiple View Geometry in Computer Vision, R. Hartley
- Computer Vision - A Modern Approach, DA Forsyth & J. Ponce

Semester Plan

Week	Lec/Sem	Topic	Homework

1		Introduction in Computer Vision, Introduction to MATLAB (Part 1)	HW0
2,3		Linear algebra primer, Introduction to MATLAB (Part 2)	
4		Pixels and filters, spatial and frequency domain processing	HW1
5		Edge detection, RANSAC, Feature detectors, Harris corner detection, Radon transformation	
6		Harris corner detection , Difference of Gaussian, SIFT, SURF	HW2
7		Camera modeling, intrinsic and extrinsic parameters	
8		Multiple view geometry, Structure and Motion estimation algorithms - Part 1	
9		Multiple view geometry, Structure and Motion estimation algorithms - Part 2	
10		Image stitching, Optical flow, Lucas-Kanade tracker	HW3
11		Basic segmentation approaches, K–Means clustering, Mean shift, Introduction to object recognition	HW4
12		Face recognition, Pedestrian recognition	
13		Machine Learning, SVM, Reduced Set Methods	
14		PCA and Eigenfaces	HW5
15		Sensor fusion with Kalman filter, Lane tracking of the vehicle implementations with Kalman and Particle filters	
16		Neural Networks, Deep Learning, Convolutional Neural Networks	

Additional Requirements

Assignments, exams, quizzes should be performed **individually**. In case of plagiarism or cheating you will get **F** as your final grade in the **course**.

Present syllabus can be changed upon the agreement between lecturer and students.