I070	**Computer Vision**	L	P	S	ECTS
		2	2	0	6

Course objectives. To describe general formation of photography by addressing physical quantities of light, shade and colour and to enumerate different modalities of sensors that convert these quantities into computer representation. To define linear filters, cross-correlation and convolution and apply them in context of image pre-processing and finding of salient regions. Thereafter, to describe more precisely various techniques for detection of features and descriptors. To enumerate different state-of-the-art computer vision problems: classification, semantic segmentation, object detection and their corresponding methods. To define computational geometry in order to reconstruct a scene from photography. To implement all the mentioned topics by using OpenCV and PyTorch.

Prerequisites. Undergraduate study in mathematics/mathematics and computer science

Course content.

1. Geometrical model of camera. Light, shade and colour.
2. Linear filters. Local image features. Image texture.
3. Harris corner detector. Shi-Tomasi corner detector. SIFT (scale invariant feature transform) and SURF (speeded-up robust features) features. FAST features, BRIEF descriptors and ORB descriptors.
4. Local image features clustering. Histogram of oriented gradients. Vector of locally aggregated descriptors.
5. Image classification. Image semantic segmentation. Object detection and localization on image.
6. Introduction to computational geometry. Stereopsis. Scene reconstruction.

LEARNING OUTCOMES

No.	LEARNING OUTCOMES
1.	To define and describe convolution and cross-correlation. To enumerate and describe various linear filters and their role.
2.	To describe and enumerate local feature techniques.
3.	To describe clustering of local features and to enumerate and to describe global descriptor techniques.
4.	To split classic computer vision from its “deep convolutional neural network” counterpart. To apply both classic and DCNN computer vision on various problems.
5.	To describe 3D scene reconstruction.
6.	To apply all the outcomes by using PyTorch and OpenCV.

RELATING THE LEARNING OUTCOMES, ORGANIZATION OF THE EDUCATIONAL PROCESS AND ASSESSMENT OF THE LEARNING OUTCOMES

TEACHING ACTIVITY	ECTS	LEARNING OUTCOME **	STUDENT ACTIVITY*	EVALUATION METHOD	POINTS	
					min	max
Attending lectures and exercises	1	1-6	Lecture attendance, discussion, team work and independent work on given tasks	Attendance lists, tracking activities	0	10

Homework	1	1-6	Preparing for written exam	Evaluation	10	10
Written exam (Mid-terms)	2	1-6	Preparing for written exam	Evaluation	20	40
Final exam	2	1-6	Revision	Oral exam	20	40
TOTAL	6				50	100

Teaching methods and student assessment. Lectures and exercises are obligatory. The exam consists of a written and an oral part. Upon completion of the course, students can take the exam. Successful midterm exam scores replace the written exam. Exercises are partially auditory and partially laboratory. In order to gain outcome, students can write homework and/or a seminar paper.

Can the course be taught in English: Yes

Basic literature:

1. D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, 2nd edition, Pearson Education, 2012.
2. R. Szeliski, Computer Vision: Algorithms and Applications, Springer, 2010.

Recommended literature:

1. R. Hartley, A. Zisserman, Multiple View Geometry in Computer Vision, 2nd edition, Cambridge University Press, 2003.
2. S. J. D. Prince, Computer Vision: Models, Learning and Inference, Cambridge University Press, 2012.