

## COURSE OFFERED IN THE DOCTORAL SCHOOL

Code of the course	4606-ES-000000C-0128	Name of the course	Polish	Widzenie maszynowe (CV)		
			English	Computer Vision (CV)		
Type of the course	General courses					
Course coordinator	dr hab. inż. Tomasz Trzciniński, prof. PW					
Implementing unit	WEiTI	Scientific discipline / disciplines*				
Level of education	Doctoral studies	Semester	Summer			
Language of the course	English					
Type of assessment:	Graded credit	Number of hours in a semester	30	ECTS credits	3	
Minimum number of participants	10	Maximum number of participants	30	Available for students (BSc, MSc)	Yes/No	
Type of classes		Lecture	Auditory classes	Project classes	Laboratory	Seminar
Number of hours	in a week	1	0	1	0	0
	in a semester	15	0	15	0	0

\* does not apply to the Researcher's Workshop

### 1. Prerequisites

Linear algebra, basics of machine learning, programming knowledge.

### 2. Course objectives

The aim of the course is to familiarize students with the theory and practical aspects of machine vision, image processing and the use of machine learning methods for image analysis

### 3. Course content (separate for each type of classes)

#### Lecture

*The lecture* includes presentations of: (a) camera models and transformation geometry, (b) 3D reconstruction, (c) detectors of characteristic points and image descriptors (d) classification and detection of objects, including the use of convolutional neural networks, (e) segmentation, (f) learning image representations

#### Project

Project leading to a research paper prepared according to the CVPR conference template and/or shared publicly implementation and presentation of the results

### 4. Learning outcomes

	Learning outcomes description	Reference to the learning outcomes of the WUT DS	Learning outcomes verification methods*
Knowledge			
K01	Absolwent zna główne trendy rozwojowe związane z dziedziną widzenia i uczenia maszynowego	SD_W3	Project evaluation
Skills			
S01	Absolwent umie prezentować rezultaty badań wykorzystując specjalistyczne nazewnictwo związane z informatyką techniczną	SD_U4	Project evaluation

S02	Absolwent umie współpracować w zespole w celu realizacji projektu badawczo-rozwojowego	SD_U7	Project evaluation
Social competences			
SC01	Absolwent działa w sposób kreatywny i nowatorski w celu rozwiązania istniejącego problemu, lub jego szerszego zrozumienia	SD_K4	Project evaluation

\*Allowed learning outcomes verification methods: exam; oral exam; written test; oral test; project evaluation; report evaluation; presentation evaluation; active participation during classes; homework; tests

#### 5. Assessment criteria

- To complete the course the students are asked to present a group project on the problems relevant for computer vision.
- The proposed topics for a group project are: re-implementation of a publication, survey of existing methods, development of a new approach to an existing problem or a new scope of research.
- The subject of the work together with the the team members' list must be submitted to the leader and project leaders by the date indicated in the first lecture.
- The project should result in:
  - Research paper (6-8 pages, not including references) based on the CVPR conference template.
  - Implementation (shared publicly, for example, in the form of a repository on GitHub or GitLab).
  - 10-minute presentation of the project results and 5-minute Q&A session.
- The final evaluation takes into account: technical aspects of the project, quality of the prepared article and the final presentation

#### 6. Literature

##### Textbooks

- [1] R. Hartley and A. Zisserman. Multiple View Geometry in Computer Vision, Academic Press, 2002.  
[2] R. Szeliski. Computer Vision: Algorithms and Applications. Springer, 2011

##### Additional resources

- [1] Learning OpenCV, by Gary Bradski & Adrian Kaehler, O'Reilly Media, 2008.  
[2] I. Goodfellow, Y. Bengio, A. Courville. Deep Learning, MIT Press, 2016.  
... *proceedings of major computer vision and machine learning conferences (CVPR, ICCV, ECCV, NeurIPS, ICML)*

#### 7. PhD student's workload necessary to achieve the learning outcomes\*\*

No.	Description	Number of hours
1	Hours of scheduled instruction given by the academic teacher in the classroom	30
2	Hours of consultations with the academic teacher, exams, tests, etc.	15
3	Amount of time devoted to the preparation for classes, preparation of presentations, reports, projects, homework	30
4	Amount of time devoted to the preparation for exams, test, assessments	15
<b>Total number of hours</b>		<b>90</b>
<b>ECTS credits</b>		<b>3</b>

\*\* 1 ECTS = 25-30 hours of the PhD students work (2 ECTS = 60 hours; 4 ECTS = 110 hours, etc.)