## 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 | Specialized | | | | |
| Course coordinator | dr hab. inż. Tomasz Trzciński, prof. PW | | | | |
| Implementing unit | WEiTI | Scientific discipline / disciplines* | information and communication technology | | |
| 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

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### 1. Prerequisites

Linear algebra, basics of machine learning, programming knowledge.

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### 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

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### 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

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### 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 |
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- 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 |
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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 |
| | **Total number of hours** | **90** |
| | **ECTS credits** | **3** |

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