COURSE DESCRIPTION CARD - SYLLABUS

Course name

Edge AI and Computer Vision

Course

Field of study
Computing

Year/Semester
1/2

Area of study (specialization)
Edge Computing

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
30

Laboratory classes
30

Other (e.g. online)

Tutorials

Projects/seminars

Number of credit points

5

Lecturers

Responsible for the course/lecturer:

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Responsible for the course/lecturer:

Prerequisites

Knowledge: Student starting this module should have a basic knowledge in the field of digital electronics and computer vision.

Skills: The student should be able to obtain information from the indicated sources, as well as understand the need to expand his competences and be ready to cooperate in a team.

Social Competences: The student should show such features as: honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

1. To provide students with knowledge related to selected issues of computer vision and image processing, with an emphasis on the artificial intelligence and hardware implementation for edge devices.

2. To present students a set of modern technologies for designing and testing image processing devices.

3. Developing students' skills in solving technical problems in the field of video processing at the edge.

4. Shaping teamwork skills in students - the ability to cooperate in the design teams and in the preparation of final research reports.

Course-related learning outcomes

Knowledge

1. Has advanced and in-depth knowledge of broadly understood IT systems as well as methods and tools used for their implementation, especially regarding building the hardware layer of vision systems.

2. Has advanced detailed knowledge of selected issues in the field of computer science, in particular regarding the processes of image acquisition, image content analysis, and the construction of video processing systems.

3. Has advanced and detailed knowledge of the processes taking place in the life cycle of IT systems, especially the hardware layer of the systems.

4. Knows advanced techniques and tools used in solving engineering tasks and conducting research in image processing systems, in particular regarding the methodology of conducting experiments and system evaluation.

Skills

1. Is able to combine knowledge from different areas of computer science (and if necessary from other scientific disciplines) to formulate and solve engineering tasks related to hardware-software development.

2. Is able to assess the usefulness and the possibility of using new achievements (methods and tools) and new IT products

3. Is able to make a critical analysis of existing technical solutions and propose their improvements.

4. Is able to assess the usefulness of methods and tools for solving an engineering task consisting in the construction or assessment of an IT system or its components, including the limitations of these methods and tools.

5. Is able to, in accordance with a given specification, design a complex device, IT system or process and implement this project using appropriate methods, techniques and tools, including adapting existing or developing new tools for this purpose.

Social competences

1. Understands that knowledge and skills related to computer science quickly become obsolete,
2. Understands the importance of using the latest knowledge in the field of computer science in solving research and practical problems.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:
a) lectures: based on the answers to the questions which test understanding of material presented on the lectures
b) laboratory classes: based on the assessment of the tasks done during classes

Summative assessment:
a) in the field of lectures, verification of the assumed learning outcomes is carried out by the exam in electronic form on the Moodle platform, in case of doubt, the oral part of the exam is carried out;

b) verification of assumed learning objectives related to laboratories is based on:
- evaluating the report prepared partly during the course and partly after its completion; this assessment also includes teamwork skills;.
- assessing the implementation of a complex task requiring integrating knowledge and skills acquired during laboratory classes;

The final grade is determined using the following scale: (90%, 100%] -> 5.0, (80%, 90%] -> 4.5, (70%, 80%] -> 4.0, (60%, 70%] -> 3.5, (50%, 60%] -> 3.0, (0%, 50%]-> 2.0.

Getting extra points for activity during classes, especially for:
- proposing to discuss additional aspects of the issue,
- effectiveness of applying the acquired knowledge while solving a given problem,
- ability to work within a team that practically performs a specific task in a laboratory.

Programme content

The lecture program includes the following topics:

Unit 1: description, acquisition and presentation of video data (elements of a modern vision system, standards, description methods, data preparation - removing distortions and interferences from video signals before automatic analysis).

Unit 2: application of AI for video signals (design patterns of neural network architectures for image processing and computer vision; selected learning algorithms and model effectiveness assessment metrics; use of TensorFlow, scikit-learn, PyTorch frameworks; video signal analysis - object recognition, behavior analysis).

Unit 3: computer vision applications for edge devices (OpenVINO package, testing solutions and implementation using Intel DevCloud; performance analysis for various hardware platforms).

Laboratory classes are conducted in the form of 2-hour lab exercises, preceded by a 2-hour instructional session at the beginning of the semester. Exercises are carried out by 2-person teams.
The program of laboratory classes includes the following topics:
Hardware implementation of typical computer vision applications (occupancy detection, number-plate

recognition, face recognition, behavior identification, etc.). Using OpenVINO and Intel DevCloud to accelerate the development of AI solutions for the edge. Implementation of image processing on CPU / VPU / FPGA platforms (using UP Squared AI Vision Development Kits, Movidius VPU, ESP32-Cam with PlatformIO).

Teaching methods

1. Lecture with multimedia presentation (diagrams, formulas, definitions, etc.) supplemented by the content of the board.
2. Laboratory exercises: multimedia presentation, presentation illustrated with examples given on the board and performance of tasks given by the teacher - practical exercises.

Bibliography

Basic
1. Katarzyna Stąpor, Metody klasyfikacji obiektów w wizji komputerowej, PWN, 2011.
2. Sebastian Raschka, Vahid Mirjalili, Python: uczenie maszynowe, Helion, 2019.
3. Domański M., Obraz cyfrowy, WKŁ, Warszawa 2010.

Additional
1. Choraś, R. Komputerowa wizja. Metody interpretacji i identyfikacji obiektów. EXIT, 2006.
2. ITU-T Rec., H.264, Advanced video coding for generic audiovisual service, 2003.
3. N. SEBE, IRA COHEN, ASHUTOSH GARG, THOMAS S. HUANG, Machine Learning in Computer Vision, Springer, 2005.

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,0
Classes requiring direct contact with the teacher	60	2,5
Student's own work (literature studies, preparation for laboratory classes, preparation for tests, techical reports preparation) [1]	65	2,5

[1] delete or add other activities as appropriate