# SYLLABUS

## 1. Data about the program of study

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| 1.1 Institution | The Technical University of Cluj-Napoca |
| 1.2 Faculty | Faculty of Automation and Computer Science |
| 1.3 Department | Computer Science |
| 1.4 Field of study | Computer Science and Information Technology |
| 1.5 Cycle of study | Masters |
| 1.6 Program of study / Qualification | Data Science / Masters |
| 1.7 Form of education | Full time |

## 2. Data about the subject

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| 2.1 Subject name | ***Advanced in Computer Vision*** | | | Subject code | **16.2** |
| 2.2 Course responsible / lecturer | Lect. dr. eng. Petrovai Andra - Andra.PETROVAI@cs.utcluj.ro | | | | |
| 2.3 Teachers in charge of seminars / Laboratory / project | Lect. dr. eng. Petrovai Andra - Andra.PETROVAI@cs.utcluj.ro | | | | |
| 2.4 Year of study | II | 2.5 Semester | 1 | 2.6 Type of assessment (E - exam, C - colloquium, V – verification) | E |
| 2.7 Subject category | Formative category: DF – fundamental, DS – speciality, DC – complementary | | | | DC |
| | Optionality: DOB – mandatory, DOP – optional (alternative), DFA – optional (free choice) | | | | DOP |

## 3. Estimated total time

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|---|---|---|---|---|---|---|---|---|---|---|
| 3.1 Number of hours per week | 3 | of which: | Course | 2 | Seminars | 1 | Laboratory | - | Project | - |
| 3.2 Number of hours per semester | 42 | of which: | Course | 28 | Seminars | 14 | Laboratory | - | Project | - |
| 3.3 Individual study: | | | | | | | | | | |
| (a) Manual, lecture material and notes, bibliography | | | | | | | | | | 23 |
| (b) Supplementary study in the library, online and in the field | | | | | | | | | | 23 |
| (c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays | | | | | | | | | | 10 |
| (d) Tutoring | | | | | | | | | | - |
| (e) Exams and tests | | | | | | | | | | 2 |
| (f) Other activities: | | | | | | | | | | - |
| 3.4 Total hours of individual study (suma (3.3(a)…3.3(f))) | | | | | | | | | | 58 |
| 3.5 Total hours per semester (3.2+3.4) | | | | | | | | | | 100 |
| 3.6 Number of credit points | | | | | | | | | | 4 |

## 4. Pre-requisites (where appropriate)

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| 4.1 Curriculum | Image processing and computer vision |
| 4.2 Competence | Operation with mathematical methods and models, techniques and technologies specific to the field of image processing |

## 5. Requirements (where appropriate)

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| 5.1. For the course | Blackboard, video projector, screen, computer |
| 5.2. For the applications | Computers, equipment and specific software |

**6. Specific competence**

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| 6.1 Professional competences | • analyse big data<br>• analyse business processes<br>• analyse decentralised applications<br>• build predictive models<br>• create data models<br>• debug software<br>• define software architecture<br>• define technical requirements<br>• design cloud architecture<br>• design process for blockchain-based systems<br>• develop blockchain innovative architectures<br>• develop software prototype<br>• develop with cloud services<br>• evaluate blockchain architectures<br>• explain blockchain implications<br>• explain distributed ledger technologies principles<br>• identify blockchain innovation opportunities<br>• implement smart contracts<br>• interpret technical requirements<br>• manage cloud data and storage<br>• outline blockchain-based identity management<br>• oversee development of software<br>• perform data cleansing<br>• perform data mining<br>• perform scientific research<br>• provide technical documentation<br>• recognise blockchain application areas<br>• recognise blockchain risks<br>• use data processing techniques<br>• use software design patterns<br>• use software libraries<br>• utilise computer-aided software engineering tools<br>• utilise machine learning |
| 6.2 Cross competences | The graduate:<br>• develop an analytical approach<br>• taking a proactive approach<br>• developing strategies to solve problems<br>• being open minded coordinate engineering teams |

**7. Expected Learning Outcomes**

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| Knowledge | The student has knowledge of:<br>• computer science<br>• cloud technologies<br>• software components<br>• ICT debugging tools |
| Skills | The student is able to:<br>• manage research data<br>• manage ICT data architecture<br>• process data<br>• use software design patterns |

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| Responsibilities and autonomy | The student has the ability to work independently in order to:<br>• develop an analytical approach<br>• take a proactive approach<br>• develop strategies to solve problems<br>• be open minded<br>• coordinate engineering teams |

**8. Discipline objective (as results from the *key competences gained*)**

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| 8.1 General objective | The development of skills and abilities for the development of artificial vision systems in the field of intelligence and artificial vision, computers and information technology |
| 8.2 Specific objectives | Assimilation of knowledge and skills regarding:<br>- understanding and using artificial vision concepts, paradigms and models<br>- the nuanced understanding and use of artificial vision algorithms<br>- studying, designing, implementing and evaluating artificial vision application modules<br>- image processing and pattern recognition methods |

**9. Contents**

| **9.1 Lectures** | Hours | Teaching methods | Notes |
|---|---|---|---|
| Introduction | 2 | Systematic exposure, student involvement in presentations and debates. | |
| Image Classification | 2 | | |
| Neural Networks and Backpropagation | 2 | | |
| Convolutional Neural Networks | 2 | | |
| Training Neural Networks | 2 | | |
| Convolutional Neural Networks Architecture | 2 | | |
| Detection and Segmentation | 2 | | |
| Introduction in Projective Geometry | 2 | | |
| Stereo Vision | 2 | | |
| Structure from motion and epipolar geometry | 2 | | |
| Multiple View Geometry | 2 | | |
| Similarity Measures and Point-feature Extraction | 2 | | |
| Optical Flow | 2 | | |
| Detection and Segmentation in the 3D Space | 2 | | |
| Bibliography:<br>Convolutional Neural Networks for Visual Recognition, http://cs231n.stanford.edu/<br>2. David Forsyth, Jean Ponce „Computer Vision A Modern Approach", Prentice Hall, USA, 2002<br>3. IEEE Transactions on Pattern Analyses and Machine Intelligence<br>4. IEEE Transactions on Image Processing<br>5. IEEE Transactions on Intelligent Transportation Systems<br>6. CVPR, ECCV and ICCV papers | | | |
| **9.2 Applications - Seminars/Laboratory/Project** | Hours | Teaching methods | Notes |
| Machine Learning Topics-1 | 2 | | |
| Machine Learning Topics-2 | 2 | | |
| Deep Learning Based Computer Vision | 2 | | |
| Detection, classification, semantic segmentation from images and image sequences | 2 | | |
| Stereovision and depth from monocular images | 2 | | |
| Optical flow, motion flow | 2 | | |
| Detection, classification, semantic segmentation of 3D Point Clouds | 2 | | |

Bibliography:

Convolutional Neural Networks for Visual Recognition, http://cs231n.stanford.edu/
2. David Forsyth, Jean Ponce „Computer Vision A Modern Approach", Prentice Hall, USA, 2002
3. IEEE Transactions on Pattern Analyses and Machine Intelligence
4. IEEE Transactions on Image Processing
5. IEEE Transactions on Intelligent Transportation Systems
6. CVPR, ECCV and ICCV papers

*Se vor preciza, după caz: tematica seminariilor, lucrările de laborator, tematica și etapele proiectului.*

**10. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field**

It is carried out through periodic meetings with representatives of the economic environment.

**11. Evaluation**

| Activity type | Assessment criteria | Assessment methods | Weight in the final grade |
|---|---|---|---|
| Course | Exam | Written examination | 50% |
| Seminar | Individual presentation of a subject in the field | Oral examination | 50% |
| Laboratory | - | - | - |
| Project | - | - | - |
| Minimum standard of performance:<br>Both, Written examination and Oral examination, marks are bigger or equal with 5 | | | |

| **Date of filling in:** 29.04.2026 | **Responsible** | **Title First name Last name** | **Signature** |
|---|---|---|---|
| | Course | Lect. dr. eng. Andra PETROVAI | |
| | Applications | Lect. dr. eng. Andra PETROVAI | |
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| Date of approval in the department | Head of department,<br>Prof.dr.eng. Rodica Potolea |
| Date of approval in the Faculty Council | Dean,<br>Prof.dr.eng. Vlad Mureșan |