Fakultät für Ingenieurwesen
Facoltà di Ingegneria
Faculty of Engineering

COURSE DESCRIPTION – ACADEMIC YEAR 2025/2026

Course title	**Computer Vision**
Course code	73075
Scientific sector	IINF-05/A
Degree	Master in Computing for Data Science (LM-18)
Semester	2
Year	2
Credits	6
Modular	No

Total lecturing hours	40
Total lab hours	20
Attendance	Attendance is not compulsory, but non-attending students have to contact the lecturers at the start of the course to agree on the modalities of the independent study.
Prerequisites	Knowledge of linear algebra, calculus and optimization, and solid machine and deep learning concepts. Basic Python coding skills.
Course page	Teams

Specific educational objectives	The course belongs to the type "caratterizzanti – discipline informatiche". Students gain an understanding of the theoretical and practical concepts of computer vision including image formation, scene reconstruction, recognition and generation, and applications in computer vision and vision and language. After this course, students should be able to develop computer vision algorithms and trainable vision and multimodal models, reproduce research results and conduct original research in this area.

Lecturer	Oswald Lanz
Contact	Office B1.5.14, Faculty of Engineering, NOI Techpark, Via Buozzi, 1. lanz@inf.unibz.it
Scientific sector of lecturer	IINF-05/A
Teaching language	English
Office hours	During the lecture time span, Friday, 15:30-17:00, by previous appointment.
Lecturing Assistant	--
Contact LA	--
Office hours LA	--
List of topics	• Image Formation: Geometric, Radiometric, Sensing Pipeline • Reconstruction: Features, Structure-from-Motion, Stereo Reconstruction, Shape-from-X • Image Recognition: Classification, Semantic Segmentation, Object Detection and Segmentation • Video Understanding: Optical Flow, Object Tracking, Action Recognition, Simultaneous Localization and Mapping

	• Image/Video Generation: Diffusion Models, Neural Radiance Fields, Gaussian Splatting • Vision and Language: Image/Video Captioning, Image/Video Retrieval, Vision Language Models This course will introduce the practical and theoretical principles of computer vision. Amongst other topics, we will cover image formation, scene reconstruction, image recognition and video understanding, as well as advanced image and video generation models and vision language models. In addition, computer vision and multimodal learning applications will be presented throughout the course. Guest talk from industry experts is also planned. The labs will deepen the understanding of computer vision algorithms and models by implementing and applying them in OpenCV and PyTorch.
Teaching format	Frontal lectures, exercises, tutorials/labs, projects, seminars.

Learning outcomes	Knowledge and understanding: • D1.1 - Knowledge of the key concepts and technologies of data science disciplines • D1.2 - Understanding of the skills, tools and techniques required for an effective use of data science • D1.3 - Knowledge of principles, methods and techniques for processing data in order to make them usable for practical purposes, and understanding of the challenges in this field • D1.7 - Knowledge of artificial intelligence techniques and methods for the implementation of intelligent systems Applying knowledge and understanding: • D2.1 - Practical application and evaluation of tools and techniques in the field of data science • D2.2 - Ability to address and solve a problem using scientific methods Making judgments • D3.2 - Ability to autonomously select the documentation (in the form of books, web, magazines, etc.) needed to keep up to date in a given sector Communication skills • D4.1 - Ability to use English at an advanced level with particular reference to disciplinary terminology. Learning skills • D5.3 - Ability to deal with problems in a systematic and creative way and to appropriate problem solving techniques

Assessment	Oral exam and project work. The mark for each part of the exam is 18-30, or insufficient. The oral exam comprises verification questions, and open questions to test knowledge application skills. It counts for 50% of the total mark. The project consists of a computer vision project and verifies whether the student is able to apply the concepts taught or presented in the course to solve concrete problems. It is assessed through a final

	presentation, a demo, and a project report and can be carried out either individually or in a group of 2 students. It is discussed during the oral exam, and it counts for 50% of the total mark.
Assessment language	English
Assessment Typology	Monocratic
Evaluation criteria and criteria for awarding marks	The final mark is computed as the weighted average of the oral exam and the project. The exam is considered passed when both marks are valid, i.e., in the range 18-30. Otherwise, the individual valid marks (if any) are kept for all 3 regular exam sessions, until also all other parts are completed with a valid mark. After the 3 regular exam sessions, all marks become invalid. Relevant for the oral exam: clarity of answers; ability to recall principles and methods, and deep understanding about the course topics presented in the lectures; skills in applying knowledge to solve exercises about the course topics; skills in critical thinking. Relevant for the project: skill in applying knowledge in a practical setting; ability to summarize in own words; ability to develop correct solutions for complex problems; ability to write a quality report; ability in presentation; ability to work in teams. Non-attending students have the same evaluation criteria and requirements for passing the exam as attending students.

Required readings	All the required reading material will be provided during the course and will be available in electronic format. Copy of the slides will be available as well.
Further readings	• Szeliski: Computer Vision: Algorithms and Applications • Hartley & Zisserman: Multiple View Geometry in Computer Vision • Bishop: Deep Learning: Foundations and Concepts • Scientific papers mentioned in the lecture slides Subject Librarian: David Gebhardi, David.Gebhardi@unibz.it
Software used	Python, OpenCV, PyTorch