# Syllabus

## *Kursbeschreibung*

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| **Titel der Lehrveranstaltung** | Introduction to Computer Vision |
| **Code der Lehrveranstaltung** | 42431 |
| **Zusätzlicher Titel der Lehrveranstaltung** | |
| **Wissenschaftlich-disziplinärer Bereich** | IINF-05/A |
| **Sprache** | Englisch |
| **Studiengang** | Bachelor in Elektrotechnik und Cyber-Physische Systeme |
| **Andere Studiengänge (gem. Lehrveranstaltung)** | |
| **Dozenten/Dozentinnen** | Dott. Diaeddin M A Rimawi, Diaeddin.Rimawi@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/46519 |
| **Wissensch. Mitarbeiter/Mitarbeiterin** | |
| **Semester** | Zweites Semester |
| **Studienjahr/e** | 3 |
| **KP** | 6 |
| **Vorlesungsstunden** | 40 |
| **Laboratoriumsstunden** | 20 |
| **Stunden für individuelles Studium** | 90 |
| **Vorgesehene Sprechzeiten** | 18 |
| **Inhaltsangabe** | This course provides a comprehensive introduction to the fundamental concepts, algorithms, and applications of computer vision, the field that enables machines to interpret and understand visual information from the world. Students explore how images are formed, how visual information is represented and processed, and how computers can extract structure, meaning, and motion from images and video. |

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| | The course covers classical computer vision techniques, including image formation and color, image filtering and edge detection, geometric transformations and warping, feature detection, description and matching, stereo vision and multi-view geometry, and motion estimation and tracking. In addition, the course introduces machine-learning-based approaches for image classification, and object detection, with an emphasis on understanding core ideas and practical usage.<br>Laboratory sessions complement the lectures by deepening students' understanding through hands-on, Python-based implementation and application of computer vision algorithms, forming a solid foundation for further studies. |
| **Themen der Lehrveranstaltung** | - Fundamentals of Image Formation: image formation and geometry, light and color, digital images, point operations, and histograms.<br>- Preprocessing, Feature Detection and Matching: linear filtering, edge detection, geometric transformations, corner and edge features, descriptors, feature matching, and panoramas.<br>- Image Registration, Stereo, and Multi-View Reconstruction: stereo vision, epipolar geometry, disparity, camera pose estimation, and multi-view geometry.<br>- Image Classification, Detection, and Segmentation: supervised learning, deep neural networks, convolutional neural networks, image classification pipelines, object detection, and image segmentation.<br>- Motion Estimation, Tracking, and Action Recognition: motion estimation, tracking methods, and action recognition.<br>- Advanced Topics and Applications: selected advanced applications. |
| **Stichwörter** | Computer vision; Image processing |
| **Empfohlene Voraussetzungen** | Knowledge of linear algebra, and calculus. Basic skills of Python programming language. |
| **Propädeutische Lehrveranstaltungen** | |
| **Unterrichtsform** | A combination of frontal lectures and hands-on Python-based laboratory sessions, complemented by assignments and a project. |
| **Anwesenheitspflicht** | The attendance is kindly suggested |
| **Spezifische Bildungsziele** | The objective of this course is to provide students with a solid |

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| **und erwartete Lernergebnisse** | introduction to the fundamental principles, methods, and applications of computer vision, with a focus on engineering intuition and practical implementation. Students will learn how visual information is formed, represented, processed, and interpreted by computational systems, and how computer vision techniques are integrated into cyber-physical and electronic systems.<br>By the end of the course, students will be able to understand core computer vision algorithms, implement basic vision pipelines in Python, and apply them to real-world problems involving images and video, forming a foundation for more advanced studies in vision, robotics, and intelligent systems.<br>nowledge and understanding<br>D1.1 – Knowledge of the fundamental concepts of computer vision, including image formation, image representation, and visual information processing.<br>D1.2 – Understanding of basic image processing techniques such as filtering, feature extraction, geometric transformations, and histogram-based methods.<br>D1.3 – Knowledge of classical computer vision methods for feature detection, matching, stereo vision, and motion estimation.<br>D1.4 – Introductory knowledge of machine learning and deep learning approaches for image classification, object detection, and segmentation.<br>Applying knowledge and understanding<br>D2.1 – Ability to implement and test basic computer vision algorithms using Python and standard vision libraries.<br>D2.2 – Ability to apply computer vision techniques to practical problems involving images and video data.<br>D2.3 – Ability to analyze visual data, interpret results, and evaluate the performance of vision algorithms.<br>Making judgments<br>D3.1 – Ability to choose appropriate computer vision methods for a given application scenario.<br>Communication skills<br>D4.1 – Ability to use technical English to describe computer vision concepts, algorithms, and results.<br>Learning skills<br>D5.1 – Ability to independently study and apply new computer vision tools and libraries based on provided documentation. |

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| **Spezifisches Bildungsziel und erwartete Lernergebnisse (zusätzliche Informationen)** | |
| **Art der Prüfung** | Oral exam and project work. The mark for each part of the exam is 18-30, or insufficient.<br>The oral exam comprises verification questions, and open questions to test knowledge application skills. It counts for 50% of the total mark.<br><br>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 (encouraged). It is discussed during the oral exam, and it counts for 50% of the total mark. |
| **Bewertungskriterien** | 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.<br><br>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.<br><br>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.<br><br>Non-attending students have the same evaluation criteria and requirements for passing the exam as attending students. |
| **Pflichtliteratur** | All the required reading material will be provided during the course and will be available in electronic format. |

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| **Weiterführende Literatur** | Szeliski: Computer Vision: Algorithms and Applications |
| **Weitere Informationen** | Programming languages: Python |
| **Ziele für nachhaltige Entwicklung (SDGs)** | Hochwertige Bildung |