

# Praktikum/Lab Course - Perception and Learning in Robotics and Augmented Reality

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# Introduction

- **Computer Vision**

High-level image understanding

- Object recognition
- Object detection
- Pose estimation

- **Deep Learning**

Learn representations of data

- Learn from examples
- Model features relevant for a given task
- Boost performance in CV problems

- **Application in Robotics**

- Grasping and Manipulation
- Navigation
- Obstacle avoidance

- **Augmented Reality**

- Render virtual/augmented content on real objects of known shape or pose



# Contents

- Theory
  - Image matching using keypoints and features
  - 3D data representations
  - Surface matching via 3D descriptors
  - 3D Object detection and pose estimation
  - Basics of Convolutional Neural Networks (CNNs)
  - Image classification and object detection using deep networks
- Practice
  - OpenCV (C++, open source)
  - Point Cloud Library (C++, open source)
  - Tensorflow (Python, open source)

# Goals

- Be familiar with practical aspects of computer vision and deep learning for typical 3D perception tasks such as feature extraction, surface matching, object localization, pose estimation
- Learn to develop code with relevant open source libraries for computer vision, 3D perception and deep learning
- Learn to build up an end-to-end framework for the goal of object detection and pose estimation
- Be ready to challenge your code under unseen (and unpredictable) working conditions

# Pre-requisites

- Basic knowledge of Python and C++

# Schedule

- Thursday afternoon
- Seminarraum

# Structure

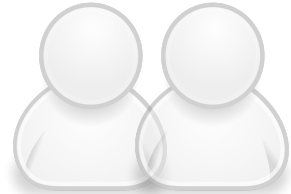
- Lectures & Assignments stage:
  - 1 weekly lecture of one hour, for 7 weeks
  - Weekly assignments - to be submitted via GitHub  
(**deadline:** Thursday morning before every lecture, 9am)
- Challenge stage:
  - Project building with gradual milestones (Challenge I and II)
  - Final project evaluation at the end of the course
- Final challenge and leaderboard (not counted for grading - secret prize for the winning team)

# Evaluation criteria

- Weekly assignments (50%)
- Challenges (50%)

# Teams

- Students are grouped in pairs and evaluated jointly
  - Registered students are requested to communicate with their team before the beginning of the semester
  - Unpaired students will be paired randomly
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- 6 teams
  - Each team will be assigned to a tutor





# Tentative schedule

27.04	Computer vision basics	OpenCV (I)	
04.05	Feature description and matching	OpenCV (II)	
11.05	3D data representations	PCL (I)	
18.05	3D description and surface matching	PCL (II)	
25.05	Feiertag		
01.06	3D object detection and pose estimation	PCL (III)	
08.06	Fundamentals of CNNs and deep feature learning	TensorFlow (I)	
15.06	Feiertag		
22.06	Image classification and object detection with CNNs	TensorFlow (II)	
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29.06	Framework building and challenge I		
06.07	Framework building and challenge II		
13.07	Project development (no lecture)		
17-20.07 (TBD)	Final Challenge and Project Evaluation		

Weekly  
assignments

Challenges