

# Praktikum on 3D Computer Vision

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# Introduction

- **Computer Vision**

## High-level image understanding

- Object recognition
- Object detection
- Pose estimation
- Depth perception
- Scene understanding

- **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



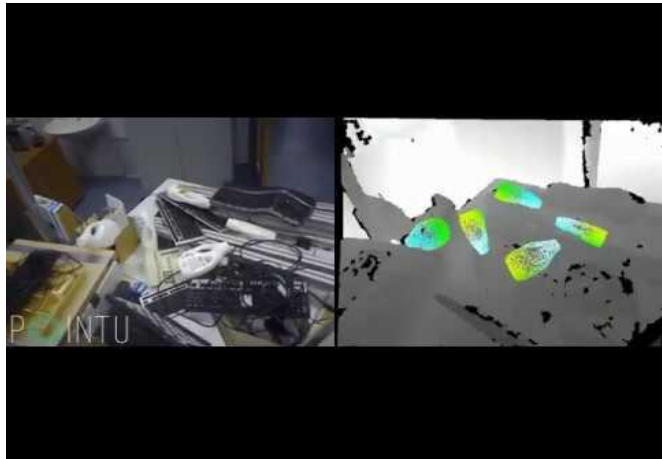
- **Augmented Reality**

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

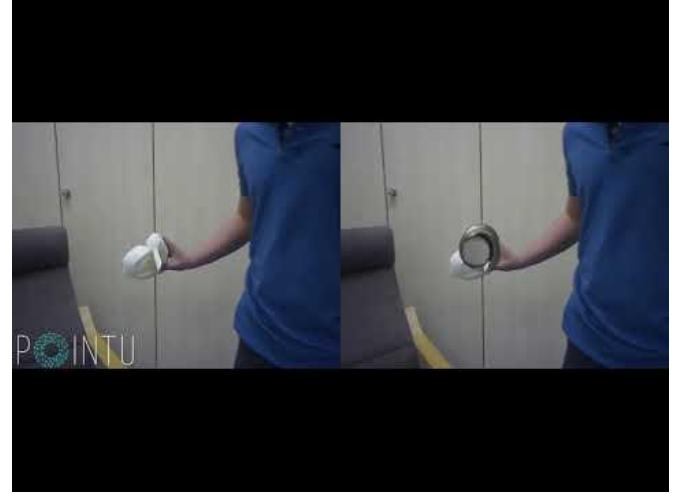




**2D Object Detection**



**3D Object Detection and tracking**



**AR**

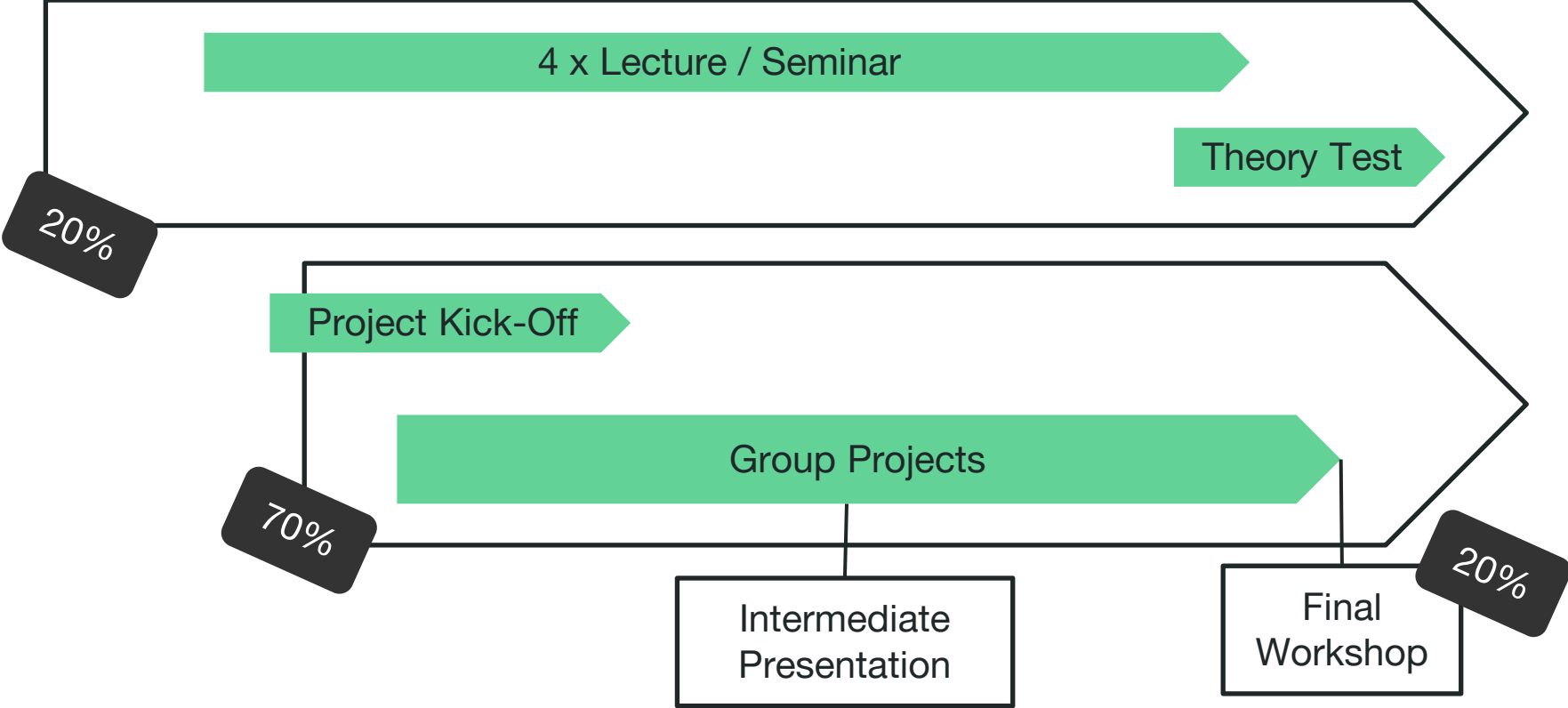


**Robotics**

# Goals of the Praktikum

- Learn about the **state of the art in 3D computer vision**
- Familiarize with **practical aspects and use cases** of typical 3D perception tasks (3D feature extraction and learning, surface matching and 3D reconstruction, 3D object localization and pose estimation, SLAM, ..)
- **Develop an end-to-end project** aiming to solve a relevant and challenging problem in 3DCV
- Learn to **explain and disseminate your results** in tech talks and a scientific report

# Course structure



# Tentative schedule

Lecture period: 18.10.2021 – 11.02.202

22.10	Introductory talk
29.10	Project presentation, assignment stage begins
5.11	Lecture/seminar I
12.11	CVPR Break
19.11	Project kick off
26.11	Lecture/seminar II
3.12	Lecture/seminar III
10.12	Mid-term presentations
Christmas Break	
14.1	Lecture/seminar IV
21.1	Tutor meeting
28.1	Tutor meeting
4.2	Final workshop
11.2	Backup class

# Prerequisites

- Required: 1+ computer vision-related course
  - Tracking and Detection in CV (IN2357)
  - Computer Vision I: Variational Methods,
  - Computer Vision II: Multiple View Geometry (IN2228)
  - Numerical Algorithms in Computer Vision and Machine Learning (IN2384)
  - Robotic 3D Vision, Convex Optimization for ML and CV, Probabilistic Graphical Models in CV
  - ...
- Suggested:
  - 1+ Deep Learning or Machine Learning course
  - 1+ projects in the domain of CV/ML

# Prerequisites

- Basic knowledge of Python and C++
- Basic knowledge of Computer Vision

# TUM Matching System

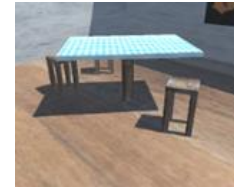
- Send motivation letter & transcript (not mandatory, but highly recommended) to: [p3dcv@mailnavab.informatik.tu-muenchen.de](mailto:p3dcv@mailnavab.informatik.tu-muenchen.de) (until 16.07.)
- Register in Matching-System: <https://matching.in.tum.de> (until 20.07.)

# Schedule

- Friday afternoon, 14.00-15.30
- Seminar Room 01.07.014 (most sessions)



# Example projects from previous years



Object Detection and Manipulation: *Garbage Evaporating Autonomous Robot*  
a.k.a.

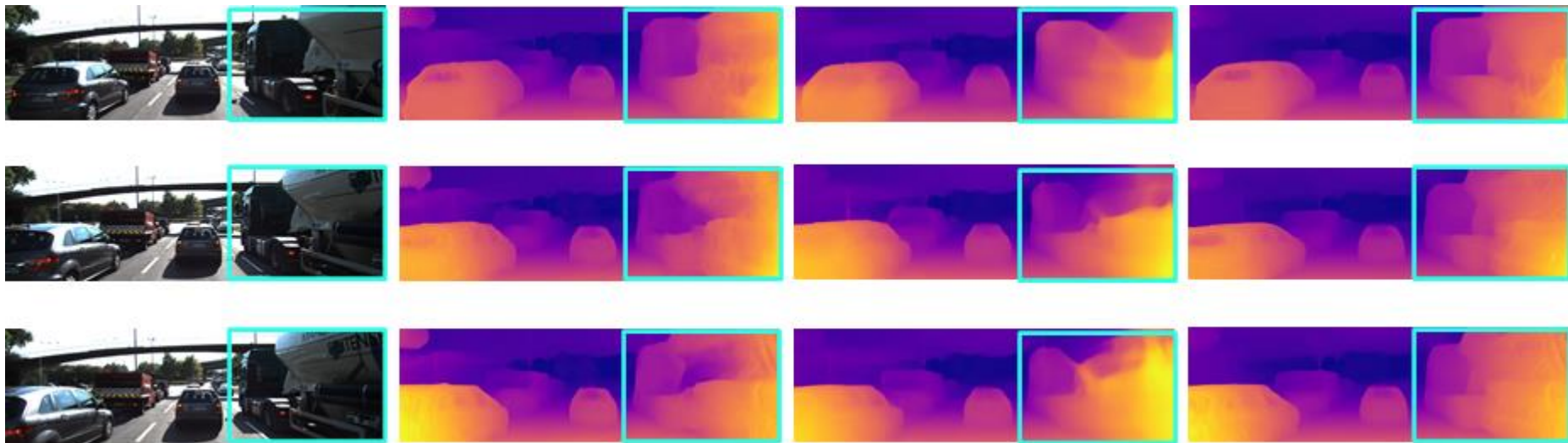
*“Trash Hugger”*

# Example projects from previous years

MonoDepth2 [1]

ManyDepth [2]

Ours



Temporally Consistent Depth Prediction

[1] Godard, Mac Aodha, Firman, Brostow. Digging into self-supervised monocular depth estimation. ICCV 2019.

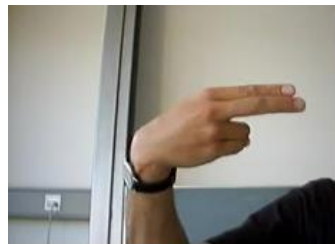
[2] Watson, Mac Aodha, Prisacariu, Brostow, Firman. The Temporal Opportunist: Self-Supervised Multi-Frame Monocular Depth. CVPR 2021.

## Example projects from previous years



Black Mirror: *Make people disappear from an image*

## Example projects from previous years



*H*



*A*



*L*



*L*



*O*

Human-Robot Interaction: *Sign Language From RGB Images*

# Topics and projects this semester

- Project tracks and lectures will be in the following contexts:
  - 3D scene understanding and SLAM
  - 3D object/scene reconstruction and completion
  - 6DoF object pose estimation
  - Applications in Autonomous Driving and Robotics
  - Applications in Augmented Reality and gaming
  - Applications to Medical

# Teams

- Students are grouped **in teams of 3** and evaluated jointly
  - However, we will check for balanced workload in the team
  - Registered students can indicate project preference and preferred team partner after project announcements
  - Students will be assigned to a team and project that best fit the indicated preference & vision background
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- 8 teams
  - Each team will be **assigned to a tutor expert on the topic that will assist the team during project development**



# Questions?

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Web. <http://campar.in.tum.de/Chair/TeachingWs21P3DV>

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