Computer Vision 3: Detection, Segmentation and Tracking

The Team

Lecturers

Prof. Dr. Laura Leal-Taixé

Dr. Aljosa Osep

Dr. Ismail Elezi

PhDs

Jenny Seidenschwarz

Orçun Çetintas

What this course is:

- A course on Computer Vision
  - Object detection
  - Instance and semantic segmentation
  - Multiple object tracking in 2D and 3D

- Other CV courses:
  - Computer Vision 2: Multiple View Geometry (WS)

What this course is NOT:

- An Introduction to Deep Learning
  - Take "Introduction to Deep Learning" if you are not familiar with basic DL concepts
- A practical project course
  - Take "Advanced Deep Learning for Computer Vision"
- A theoretical introduction into 3D Vision
  - Take "Computer Vision 2: Multiple View Geometry (WS)"

What is Computer Vision?

- First defined in the 60s in artificial intelligence groups
- “Mimic the human visual system”
- Center block of robotic intelligence

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PROJECT MAC

Artificial Intelligence Group
Vision Memo. No. 100.

July 7, 1966

THE SUMMER VISION PROJECT

Seymour Papert

The summer vision project is an attempt to use our summer workers effectively in the construction of a significant part of a visual system. The particular task was chosen partly because it can be segmented into sub-problems which will allow individuals to work independently and yet participate in the construction of a system complex enough to be a real landmark in the development of "pattern recognition".

Computer Vision

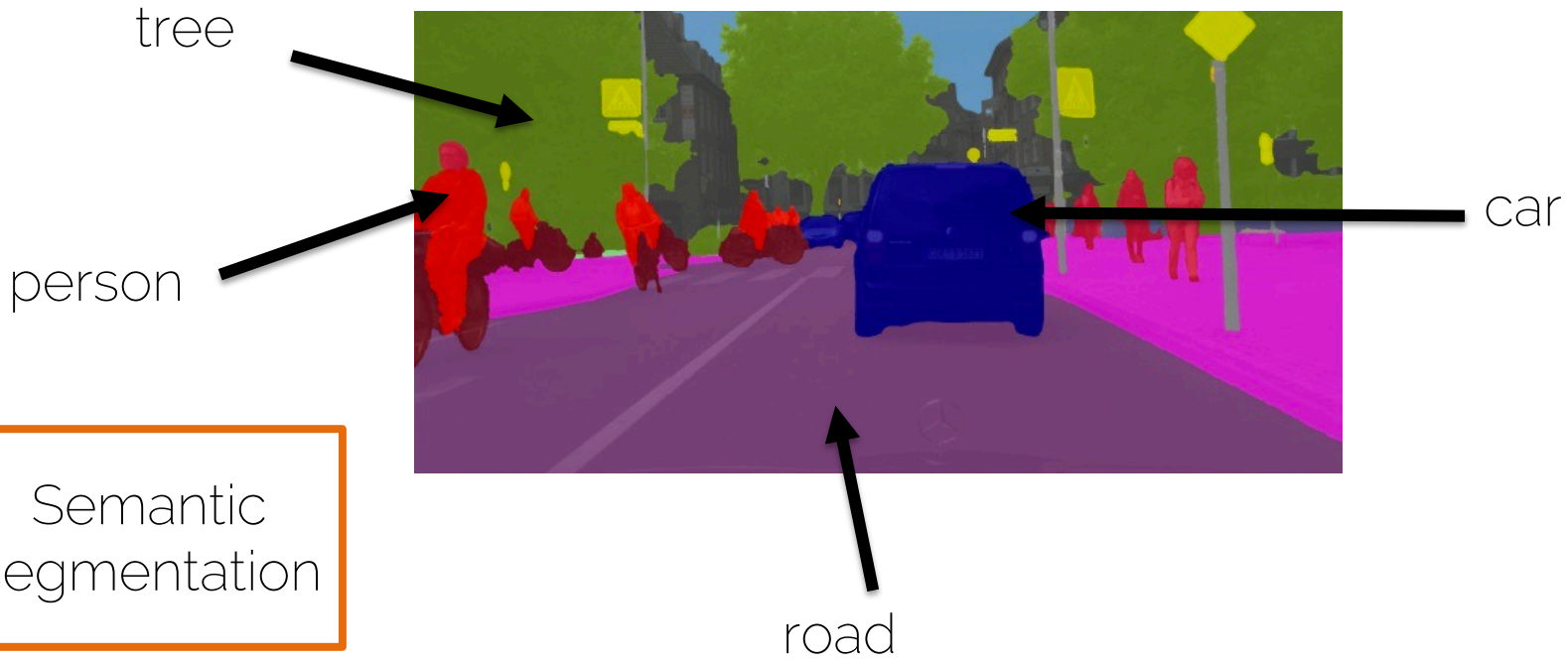
Give eyes to a computer

Computer Vision

Understand every pixel of an image

Computer Vision

Understand every pixel of an image



Semantic segmentation

Computer Vision

Understand every pixel of an image

Instance-based segmentation

Semantic segmentation

Computer Vision

Understand every pixel of a video

Multiple object tracking

Instance-based segmentation

Semantic segmentation

Dynamic Scene Understanding

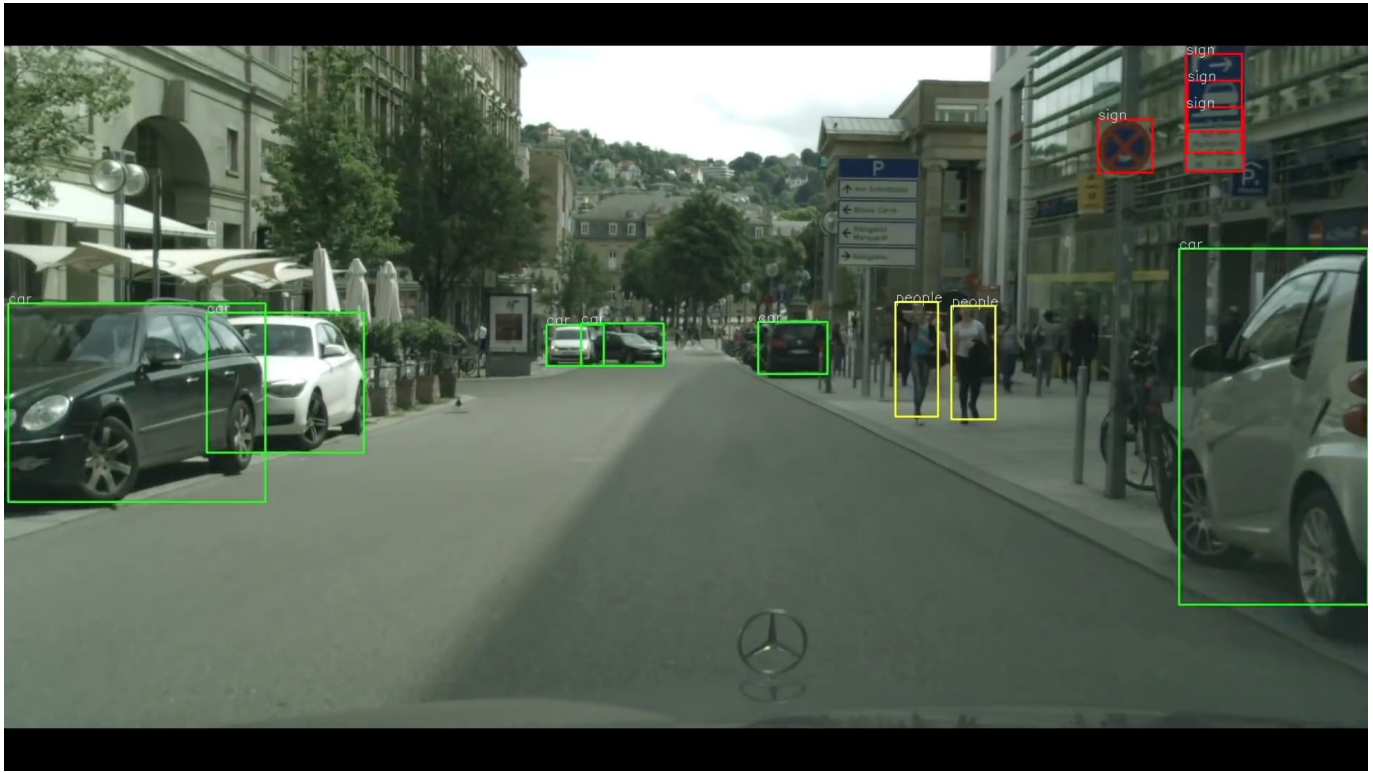
Understand every pixel of a video

Multiple object tracking

Instance-based segmentation

Semantic segmentation

Autonomous driving



Understanding an image

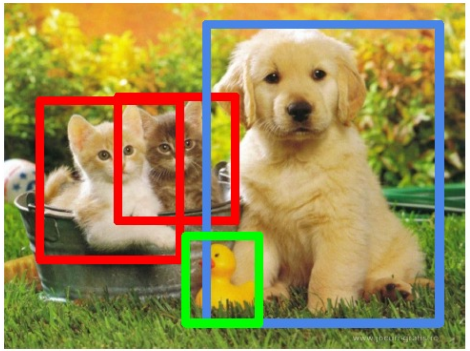
Classification

CAT

Classification + Localization

CAT

Object Detection



CAT, DOG, DUCK

Instance Segmentation

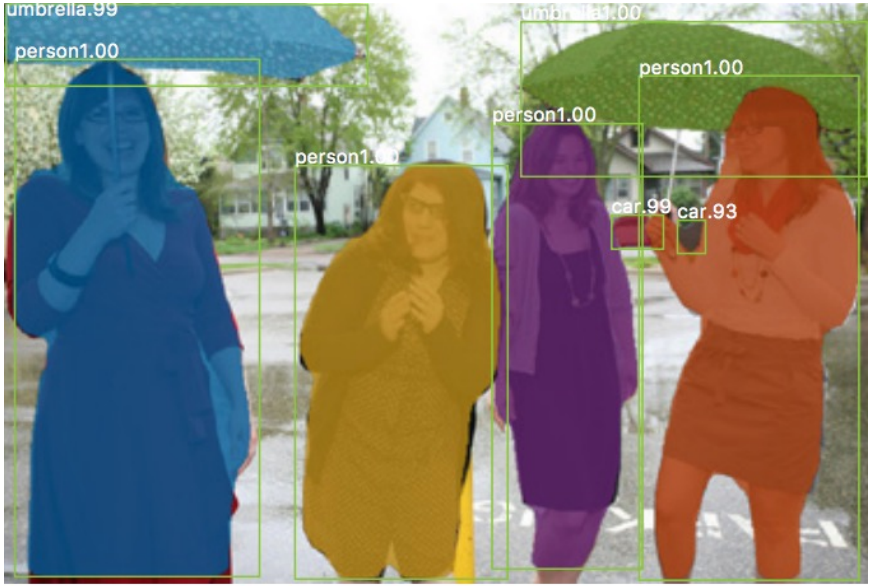
CAT, DOG, DUCK

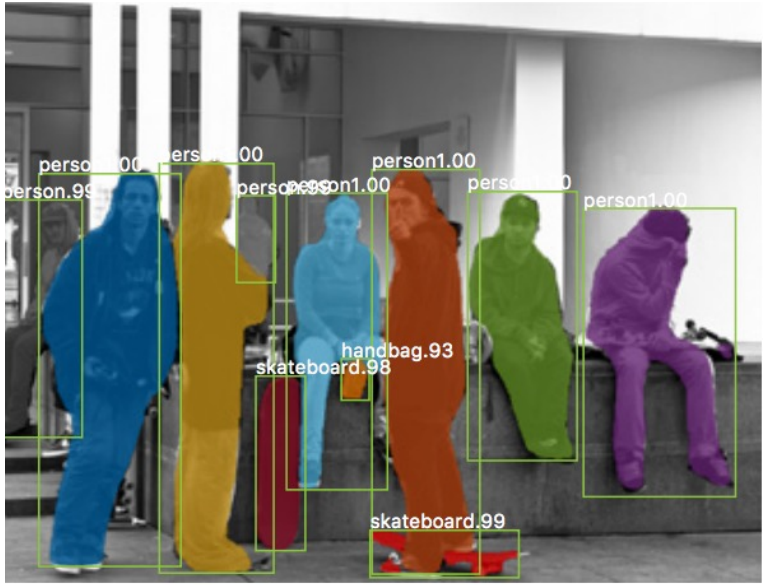
Single object

Multiple objects

Credit: Li/Karpathy/Johnson

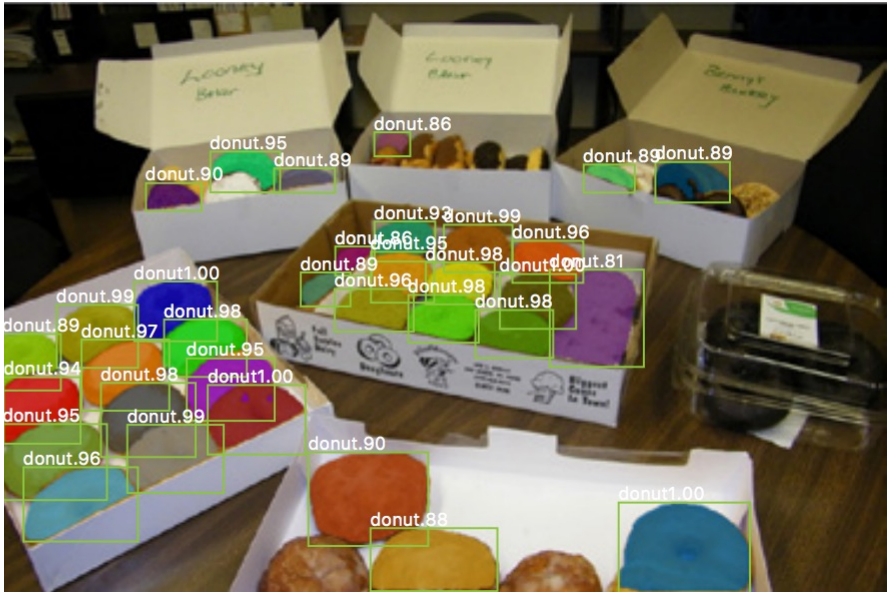
Understanding an image



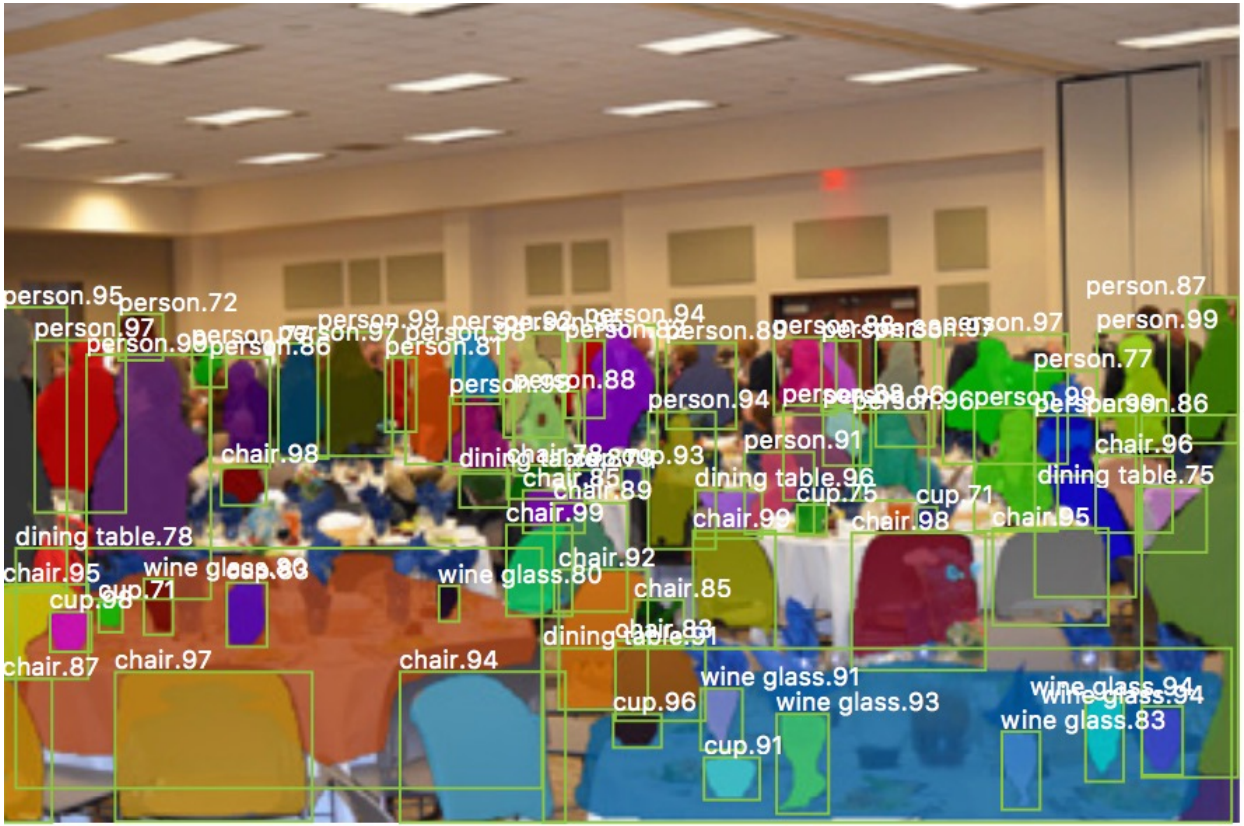


K. He, G. Gkioxari, P. Dollar, R. Girshick. Mask R-CNN. ICCV 2017.

Understanding an image



Understanding an image



Understanding an image

Understanding an image

- Different representations depending on the granularity
  - Detections (coarse)
  - Segmentations (precise)
  - Semantic with/without instances (person 1, person 2)

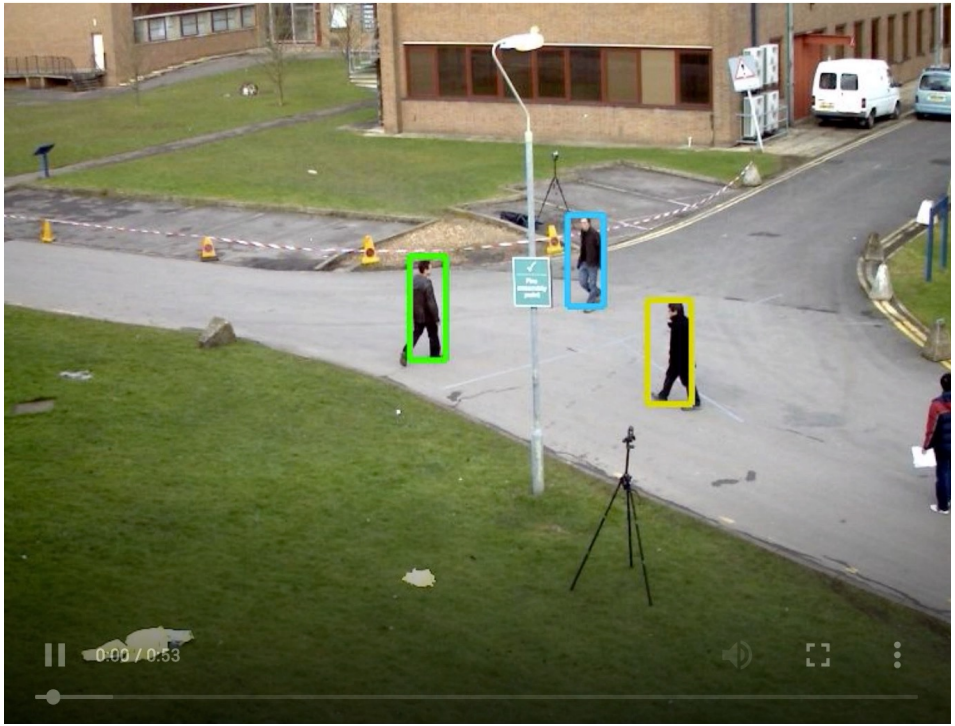
- Goes well with Deep Learning

Understanding a video

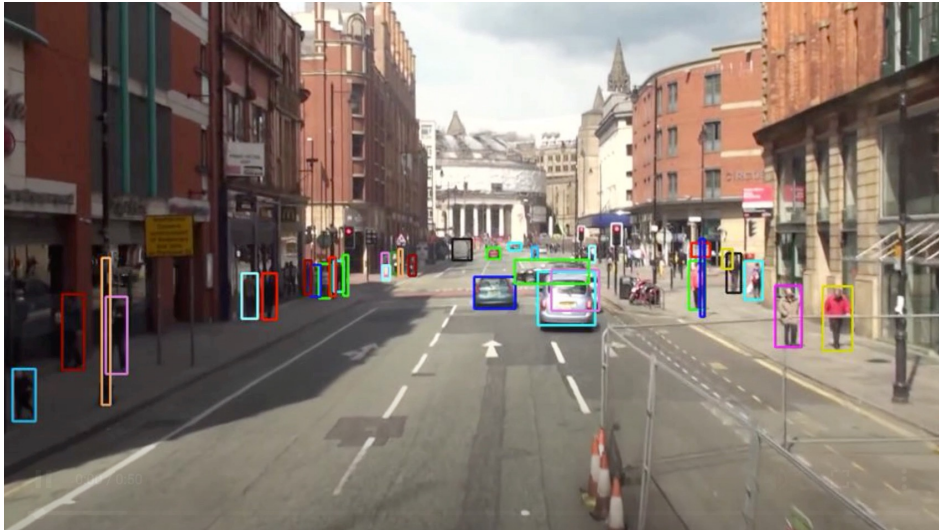
- Temporal domain which brings us advantages
  - A lot of redundancy
  - A smoothness assumption: things do not change much from one frame to another

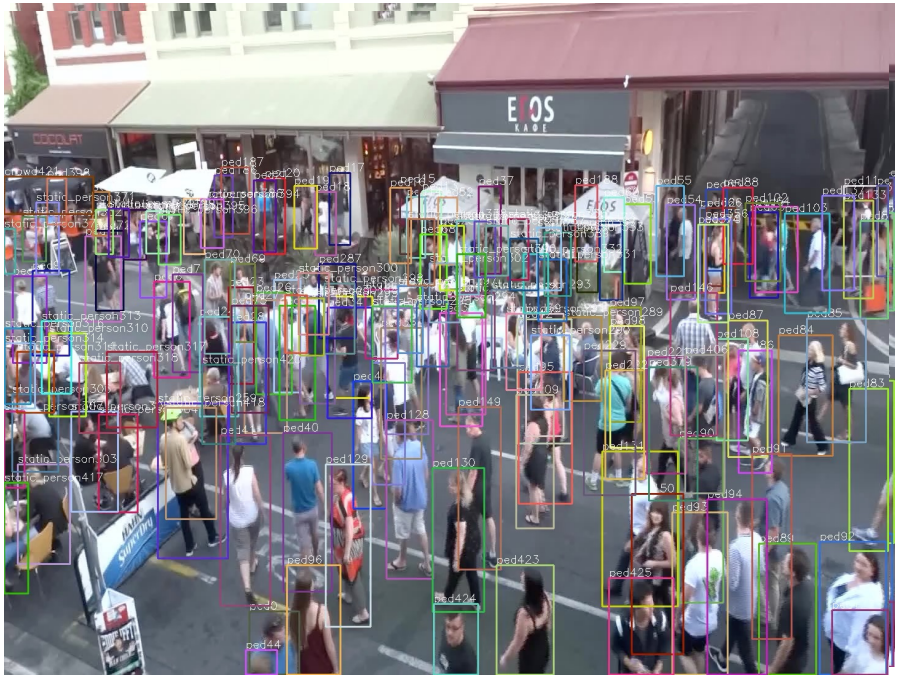
- … but also disadvantages
  - At 30 FPS, image the computation one has to do to process a video….
  - Occlusions, multiple objects moving and interacting…

Understanding a video: then



Understanding a video: now





Understanding a video

- Where is every object going?
- How are objects interacting?
- Get consistent results in the temporal dimension

Rough schedule/content

- 1. Introduction
- 2. Object Detection 1
- 3. Object Detection 2
- 4. Single/Multiple object tracking
- 5. Multiple object tracking
- 6. Transformers and detection
- 7. Semantic segmentation
- 8. Instance Segmentation
- 9. Video object segmentation
- 10. Trajectory prediction
- 11. Going towards 3D tracking and segmentation

Rough schedule/content

- RCNN, Fast RCNN and Faster RCNN
- YOLO, SSD, RetinaNet
- Siamese networks – Person Re-Identification
- Message Passing Networks
- Transformers and DETR
- Network (non-neural) flow for tracking
- Generative Adversarial Networks – trajectory prediction
- Mask-RCNN, UPSNet (panoptic segmentation)
- Deformable/atrous convolutions
- 3D – data, algorithms.

Our Research Lab

Dynamic Vision and Learning Group

https://dvl.in.tum.de/

About the lecture

- Theory: 11 lectures
  - Every Tuesday 10-12h
  - Lectures will streamed/recorded
- Practical:
  - Every Thursday 14-16h → more info in 2 days!

https://dvl.in.tum.de/teaching/cv3dst-ss22/

Moodle

- Announcements via Moodle - IMPORTANT!
  - Sign up in TUM online for access: https://www.moodle.tum.de/
  - We will share common information (e.g., regarding exam)
  - Ask content questions online so others benefit
  - Don't post solutions

Emails & Slides

- All material will be uploaded on Moodle and the web
- Questions regarding the syllabus, exercises or contents of the lecture, use Moodle!
- Questions regarding organization of the course:

dst@dvl.in.tum.de

- Emails to the individual addresses will not be answered.

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