11LE13P-7302 Laboratory
Deep Learning for Autonomous Driving
Team

Prof. Wolfram Burgard
Instructor

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Tutor

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Organization Details

- Time: Every Friday 4pm-6pm building 082, computer pool R 00 029
- We will be there for questions, but we expect you to work on your own
- Attendance is required every week
- We expect you to have basic knowledge in ML (e.g. heard the ML lecture or did deep learning lab)
- Homepage: http://ais.informatik.uni-freiburg.de/teaching/ss18/driving_lab
Organization Details

- Four lectures
  - Autonomous cars
  - Introduction to deep learning
  - Pytorch tutorial
  - Advanced deep learning
- Group project (2-3 people)
- Four subtasks, submit each subtask within specified time (code, results)
- Final poster session + demo + pitch talk (3min)
Communications & Computing

- We will use Slack for group communications
  - dl4ad.slack.com
- Signup with your university email or contact valada@cs.uni-freiburg.de for access
- We will use the Google Cloud Platform for GPU computing
  - Linux VMs with NVIDIA Tesla K80
- Pool computers for other preprocessing
Contacts (tutors)

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- Johan Vertens: vertensj@cs.uni-freiburg.de
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rAIS Car
Projects

- Semantic free space estimation *(AIS percep car)*
- Semantic 3D object detection *(AIS percep car)*
- Steering angle & speed prediction *(AIS percep car)*
- End-to-end driving *(rAIS car)*
- Vision-based localization *(AIS percep car)*
- Road segmentation *(rAIS car)*

Fill the form on the course website for project assignment ➡️ by Wednesday, 25th April
P1: Semantic free space estimation

- Predict free space & semantic boundaries of objects in free space
- Use images
- FCNs
- At least 6 semantic classes
- Cityscapes, KITTI, ApolloScape, Berkely DeepDrive datasets
- Should run in real-time

Bonus:

- Lane detection
- Get on KITTI leaderboard
P2: Semantic 3D object detection

- Predict 3D bounding boxes & semantic category
- Use images and/or LiDAR
- Region proposal network
- CNN for classification and detection
- Distance to bounding boxes should be an output
- KITTI dataset
- Should run in real-time

Bonus:
- Get on KITTI leaderboard
- Extend to instance segmentation
P3: Steering angle & speed prediction

- Predict steering angles & speed (into the future...)
- Use a sequence of images and/or optical flow
- Model as Sequence-to-sequence prediction
- Recurrent CNN
- Udacity dataset
- Should run in real-time

Bonus:
- Beat Team Komanda
- Improve with prior from other tasks
P4: End-to-end driving for the rAIScar

- Learn to drive from imitation
- Drive around with the rAIScar and record images, steering and acceleration commands, ...
- Train regression network for control behavior from public dataset
- Re-train network on your campus dataset and deploy on rAIScar for autonomous driving
P5: Vision-based localization

- Metric localization \((x,y)\) with AIS perception car
- Multiple dataset collection runs on campus, ground truth from Applanix positioning system
- Deep pose regression: train a deep ConvNet to map from current image to global \((x,y)\) pose
- Data fusion: add visual odometry to improve localization accuracy
P6: Semantic road segmentation for the rAIScar

- Semantic road and lane segmentation
- Fully convolutional neural networks: train a encoder-decoder net to infer pixel-wise road/lane classifications
- Pre-train net on public KITTI dataset
- Transfer vision system to rAIScar
- Fine-tune net with automatic labeling of lanes in indoor motion capture system
Thank you for your attention!