Learning For Self-Driving Cars and Intelligent Systems

Practical Course
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Winter Semester 2022

Course webpage:
https://vision.in.tum.de/teaching/ws2022/intellisys_ws2022
Structure

- Masters practical course
- Data modalities: images, GNSS, IMU, point clouds, sets, graphs etc.
- Programming assignments in the initial weeks
- Research oriented projects
- max. 2 persons per each group
- Dynamic research goals
- One-on-one meetings with supervisors for updates and resolving issues
- Final Presentations
- Weekly summaries of the work progress
- Tuesday, 11 am - 1 pm [Online]
- You will be provided remote access to compute resources via ssh for this course.
- Final Evaluation will be a combination of the programming assignments, weekly/final reports, presentation, viva, project code and results etc.
Prerequisites

- Proficient in python programming
- Familiar with version control (git)
- Comfortable with DL frameworks: PyTorch, Tensorflow etc.
- Good knowledge of basic mathematics, linear algebra, probability, numerics, analysis etc.
- Participation in at least one of the offered deep learning lectures at TUM, e.g. [1, 2, 3 ...]
- Or participation in at least one of Multi-View Geometry courses / labs, e.g. [1, 2, 3 ...]
- We may consider other courses offered outside of TUM if the contents match with the example courses referenced above. Please highlight the content of those courses in your application.
Application

- Assignement to the course done via the matching system: [https://matching.in.tum.de/](https://matching.in.tum.de/)
- Select your preference of the lab course between 22 to 27 July on the system
- Application documents to be sent separately
- **Send your CV and Transcripts by 28 July 2022 to:** [intellisys-ws21.vision.in@tum.de](mailto:intellisys-ws21.vision.in@tum.de)
  
  Please see the email format on the next slide
- **We only** consider the candidates who applied to the matching system **AND** sent their application documents
In order to easily evaluate your profile for matching, we ask you to follow the format below:

Subject: Application [Your Matriculation Number]

In the body please give at least the following details:

- **Matriculation #:**
- **Name:**
- **Name of Degree:**
- **Masters Semester #:**
- **Average Grade:**
  - Bachelor:
  - Master (For the previous semester, if available)
- **List of Relevant courses taken with grade**

Please remember to also attach your CV and transcripts(Bachelor + Master) with the email. Feel free to share any additional documents, information (for eg. link to git, past research projects) that could support your application. **Optional:** If you also have a project suggestion matching the theme of the lab course, please briefly describe.
Projects

- Practical project experience with real-world problems
- Novel application-oriented research challenges
- Project Assignment to be done after the initial weeks of programming tasks
- Projects specifics will be decided later
- However, if you have project proposals prior to beginning of the semester. It may be considered
- Nevertheless, some general research areas can be found in the next slides
Projects

- **SLAM**
  - Deep depth $D$, deep pose and deep uncertainty $\Sigma$ based on a single view $I_t$ [1]
- **3D reconstruction**
  - Dense reconstruction using a deep neural network [2]

Top: [https://vision.in.tum.de/research/vslam/d3vo](https://vision.in.tum.de/research/vslam/d3vo)

Bottom: [https://vision.in.tum.de/research/monorec](https://vision.in.tum.de/research/monorec)

[Accessed on 15.07.2022]
Projects

- 4D dynamic scene reconstruction
- 4D panoptic segmentation

points as from frame 1, frame 2 or as translated points (point cloud 1 + scene flow)

Bottom: https://mehmetaygun.github.io/4DPLS.html
[Accessed on 15.07.2022]
Projects

- Multi-Object Tracking
- Object detection and segmentation

Top: Gladkova et al. “DirectTracker: 3D Multi-Object Tracking Using Direct Image Alignment and Photometric Bundle Adjustment” (to appear)
Bottom: https://ps.is.mpg.de/uploads_file/attachment/attachment/468/motion_segmentation_tracking_clustering.pdf
[Accessed on 18.07.2022]
Projects

- Perception for self-driving cars
- Scene understanding
- Global localization

Top: https://vision.in.tum.de/research/vslam/tirdso
Bottom: https://vision.in.tum.de/research/vslam/gn-net
[Accessed on: 15.07.2022]
Projects

- Robot control
  - Embodied agents (Next slide)
  - Robustness to noisy data
  - Multiple Input Modalities
Projects

- Testing control algorithms on embodied agents
- Interaction with the environment
- Supervised, self-supervised, reinforcement learning

Reference: https://arxiv.org/pdf/2103.11204.pdf,
[Accessed on 15.07.2022]
Projects

- Control using Point clouds

BEV of the vehicle trajectories in the point cloud
https://vision.in.tum.de/_media/spezial/bib/pccontrol_2022.pdf
[Accessed on 18.07.2022]
Projects

- Vehicle platooning
  - Multiple vehicles autonomously following the first target vehicle
Projects

- Global localization / Place recognition using Graph Neural Networks (GNN)

Projects

- Trajectory prediction for multiple vehicles using GNNs

[Accessed on 15.07.2022]

Projects

- Optimal path finding using GNNs

QUESTIONS