

# Presentation Task B

Application Cases, Metrics and Data Augmentation

## other competitions (kaggle/codalab)

Cloud classification from satellite images

<https://www.kaggle.com/competitions/understanding-cloud-organization>

Coco Detection Challenge

<https://codalab.lisn.upsaclay.fr/competitions/7384>

SemanticKitti - Semantic Segmentation

<https://codalab.lisn.upsaclay.fr/competitions/6280>

Object Detection (3D Lidar)

<https://paperswithcode.com/sota/3d-object-detection-on-nuscenes>

<https://paperswithcode.com/sota/3d-object-detection-on-kitti-cars-easy>

# Use Case

Problem to be solved:

- Object Detection for autonomous driving
  - accurately detect objects (i.e. pedestrians, vehicles, cyclists)
  - differentiation between drivable vs non-drivable areas

Problems of natural data:

- data privacy
  - faces, license plates

Synthetic data to our help:

- no human individuals
- data gathering less cheap and time consuming

# Datasets

- datasets: nuScene, Kitty, ScanNet, Waymo, S3DIS/Cityscapes, Argoverse, CARLA, Synscapes

Name	Link	License	Year	3D point cloud segmentation	3D object detection & tracking	3D drivable area	2D segmentation	2D freespace	2D drivable area	2D lane markings	Plant Classification	Motion forecasting	Image / Other Annotation Format	Lidar Annotation Format	Relevance	Scene Type	RGB	RGB-E	Lidar	Radar	FLIR / NIR	GPS / IMU	Maps	Details	
DeepScene (Freiburg Forest)	<a href="http://deepscene.cs.uni-freiburg.de/">http://deepscene.cs.uni-freiburg.de/</a>	non-commercial	2016	x									?	?	high	forest	x	x							Bumblebee2 Stereo
FieldSAFE	<a href="https://vision.eng.azd.edu/FieldSAFE/">https://vision.eng.azd.edu/FieldSAFE/</a>	non-commercial	2016		x	x							-	map based + object coordinates	high	grass field	x	x	x	x	x				Velodyne HDL-32E, Delphi ESR Radar, Flir A65,
NREC Human Detection and	<a href="https://www.nrec.ri.ac.uk/">https://www.nrec.ri.ac.uk/</a>	non-commercial	2017		x								Pascal VOC	-	high	off-road (apple/orange field)	x	x				x			
OFFSED	<a href="http://www.dfti.uni-leipzig.de/offsed/">http://www.dfti.uni-leipzig.de/offsed/</a>	non-commercial	2021	x									CVAT rgb/png files	-	high	od, farmland, construction sites	x	x							Stereolabs ZED Camera, some instances labels
OPEDD	<a href="http://www.dfti.uni-leipzig.de/opedd/">http://www.dfti.uni-leipzig.de/opedd/</a>	non-commercial	2021		x								VIA json files	-	high	od, farmland, construction sites	x	x							Stereolabs ZED Camera
RELLIS-3D	<a href="https://unmanned.umd.edu/rellis-3d/">https://unmanned.umd.edu/rellis-3d/</a>	non-commercial	2020	x				x					rgb/png files	SemanticKITTI (label files)	high	off-road	x	x	x				x		Ouster OS1, Velodyne Ultra-Puck 32, Kärmin 2 Stereo
RUGD	<a href="http://rugd.vision.rwth-aachen.de/">http://rugd.vision.rwth-aachen.de/</a>	unknown	2019					x					rgb/png files	-	high	off-road	x		x				x		Velodyne HDL-32E, Proscollia 6 MP camera
SemanticUSL	<a href="https://unmanned.umd.edu/semanticusl/">https://unmanned.umd.edu/semanticusl/</a>	non-commercial	2020	x									-	SemanticKITTI (label files)	high	campus & off-road	x		x						Ouster OS1-64 Lidar
SugarBeets	<a href="http://www.ipb.uni-leipzig.de/sugarbeets/">http://www.ipb.uni-leipzig.de/sugarbeets/</a>	public	2016									x	?	?	high	sugar beets / field	x	x	x			x			2x Velodyne VLP-16, Camera JAI AD-130GE, Kinect
YCOR		unknown	?	x									?	?	high	off-road	x								
KIT MOHA		unknown	2016					x					?	?	mid	construction sides	x								
Manulan	<a href="http://is.dia.acfr.usyd.edu.au/manulan/">http://is.dia.acfr.usyd.edu.au/manulan/</a>	unknown	2009		x	x							-	-	mid	dust, smoke, rain	x		x	x	x	x			Sick LaserStarboard/Port, FMCW Radar, Raytheon
Rosario	<a href="https://www.citg.su.se/rosario/">https://www.citg.su.se/rosario/</a>	unknown	2019									x	3D position GT	-	mid	soybean field			x				x		Sick LaserStarboard/Port, FMCW Radar, Raytheon
SemanticKITTI	<a href="http://semantic-kitti.org/">http://semantic-kitti.org/</a>	non-commercial	2019	x									-	SemanticKITTI (label files)	mid	urban			x						Velodyne HDL-64E
RAGE	<a href="https://download.vision.rwth-aachen.de/data/rage/">https://download.vision.rwth-aachen.de/data/rage/</a>	unknown	2016					x	x				-	-	mid	urban simulator	x								Simulation based semantic labels
DALES	<a href="https://uxdaxton.edu/dales/">https://uxdaxton.edu/dales/</a>	non-commercial	2020	x									-	-	none	arial scans	x			x					airborn laser scanner
IQMUS	<a href="http://data.lgn.fr/bar/">http://data.lgn.fr/bar/</a>	non-commercial	2015	x									-	-	none	urban road scans				x					MLS (3d mobile laser scanner)
ISPRS	<a href="https://www2.isprs.org/">https://www2.isprs.org/</a>	unknown	2012	x									-	-	none	arial scans				x					airborn laser scanner
Oakland 3-D Point Cloud	<a href="https://www.cs.cmu.edu/~pabbe/">https://www.cs.cmu.edu/~pabbe/</a>	unknown	2009	x									-	-	none	urban road scans				x					Sick LMS Laser
Paris-Lille-3D	<a href="https://gm3d.fr/paris-lille-3d/">https://gm3d.fr/paris-lille-3d/</a>	non-commercial	2018	x									-	-	none	urban road scans				x					Velodyne HDL-32E
Paris-rue-Madame	<a href="http://www.cmm.mcgill.ca/paris-rue-madame/">http://www.cmm.mcgill.ca/paris-rue-madame/</a>	non-commercial	2014	x									-	-	none	urban road scans				x					MLS (3d mobile laser scanner)
S3DIS		unknown	2017	x									-	-	none	indoor	x		x						
ScanNet	<a href="http://www.scan-net.org/">http://www.scan-net.org/</a>	unknown	2017	x									-	-	none	indoor	x		x						
ScanNetV2	<a href="http://www.scan-net.org/v2/">http://www.scan-net.org/v2/</a>	unknown	2018		x								-	-	none	indoor			x						
Semantic3D	<a href="https://www.semantic3d.org/">https://www.semantic3d.org/</a>	non-commercial	2017	x									-	-	none	urban / rural scans	x		x						Terrestrial Laser Scanner
SUN RGB-D	<a href="https://rgbd.cs.princeton.edu/">https://rgbd.cs.princeton.edu/</a>	unknown	2015		x								-	-	none	indoor			x						
Toronto-3D	<a href="https://github.com/utias/rsf/">https://github.com/utias/rsf/</a>	unknown	2020	x									-	-	none	urban road scans				x					MLS (3d mobile laser scanner)
Drive&Act	<a href="https://www.driveandact.org/">https://www.driveandact.org/</a>	non-commercial	2019										-	-	none	driver seat	x	x				x			
A*3D	<a href="https://github.com/autonomousvision/a3d/">https://github.com/autonomousvision/a3d/</a>	non-commercial	2020		x								-	-	unknown	urban	x		x						Velodyne HDL-64E, 2x PointGrey Chameleon2 cameras
ApolloScape	<a href="http://apolloscope.com/">http://apolloscope.com/</a>	non-commercial	2018				x	x			x	x	-	-	unknown	urban	x		x						
Argoverse	<a href="https://www.argoverse.org/">https://www.argoverse.org/</a>	non-commercial	2019		x					x			-	-	unknown	urban	x		x	x			x	x	Velodyne Pucks, Stereo and Mono Cameras, HD-253C
BOK100K	<a href="https://bair.berkeley.edu/projects/bok100k/">https://bair.berkeley.edu/projects/bok100k/</a>	unknown	2020				x	x		x	x		-	-	unknown	urban	x								HD video
Cityscape	<a href="https://www.cityscapes-dataset.net/">https://www.cityscapes-dataset.net/</a>	non-commercial			x				x				-	-	unknown	urban	x		x						
Cityscape 3D	<a href="https://www.cityscapes-dataset.net/3d/">https://www.cityscapes-dataset.net/3d/</a>	non-commercial	2020		x								-	-	unknown	urban	x		x	x				x	
Ford Autonomous Vehicle Data	<a href="https://avdata.ford.com/">https://avdata.ford.com/</a>	university only	2020										-	-	unknown	urban	x		x					x	4x Velodyne HDL-32E, 6 Point Grey 1.3 MP Cameras

# Datasets

KITTI [https://www.cvlibs.net/datasets/kitti/eval\\_object.php?obj\\_benchmark=3d](https://www.cvlibs.net/datasets/kitti/eval_object.php?obj_benchmark=3d)

## Data collection and privacy

- Funding: KIT, TTI-C
- Privacy: academic use only (registration required, Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License)
- Footprint: equipped with Radar, LiDAR, camera data
- classes: building, tree, sky, car, sign, road, pedestrian, fence, pole, sidewalk, bicyclist
- 73.7km driving distance
- 7481 training images; 7519 test images (80256 labeled objects)
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# Datasets

## Virtual KITTI

Data generation:

- Unity game engine with 5 different virtual worlds under different lightning and weather conditions
- Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License - restrictions on commercial use and distribution
- corresponds to real KITTI scenes
- “measuring the real-to-virtual gap, deep learning with virtual data, and measuring the generalization performance under changes in imaging and weather conditions”

[https://github.com/VisualComputingInstitute/vkitti3D-dataset/blob/master/tools/download\\_raw\\_vkitti.sh](https://github.com/VisualComputingInstitute/vkitti3D-dataset/blob/master/tools/download_raw_vkitti.sh) (try out for download)

- Radar, LiDAR, camera data
- classes: building, tree, sky, car, sign, road, pedestrian, fence, pole, sidewalk, bicyclist
- 7481 training images; 7519 test images (80256 labeled objects)

# Datasets

## NuScene

- <https://www.nuscenes.org/download>
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# Datasets

## Waymo

- `tfds.load('waymo_open_dataset/v1.0', data_dir='gs://waymo_open_dataset_v_1_0_0_individual_files/tensorflow_datasets')`
- Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License - restrictions on commercial use and distribution; registration required for download
- objects in motion: vehicle, pedestrians, cyclists and more
- Footprint: LiDAR, Camera with annotations for scene understanding in 2D and 3D
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# Metrics

- Mean Average Precision
- Intersection over Union
- Standard accuracy measures

Virtual KITTI: MSE and Edge-Aware Smoothing loss  
(<https://arxiv.org/pdf/2006.04080v2>)

# AI models

- Models: PointNet, SalsaNext, Faster R-CNN

# GANs for mixed datasets

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**THANK YOU FOR YOUR  
ATTENTION!**

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# Sources

1. Lightning NeRF: Efficient Hybrid Scene Representation for Autonomous Driving <https://arxiv.org/pdf/2403.05907>
- 2.