



PyData
Granada

Enriching 3D point cloud data with Artificial Intelligence

Rodrigo Cabello
Research Engineer @ Plain Concepts



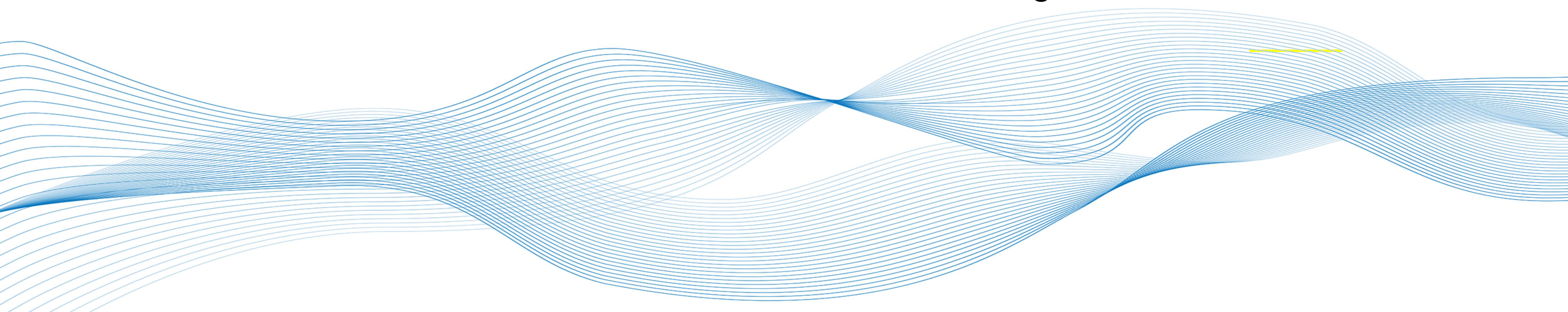
 @mrcabellom

 mrcabellom@gmail.com



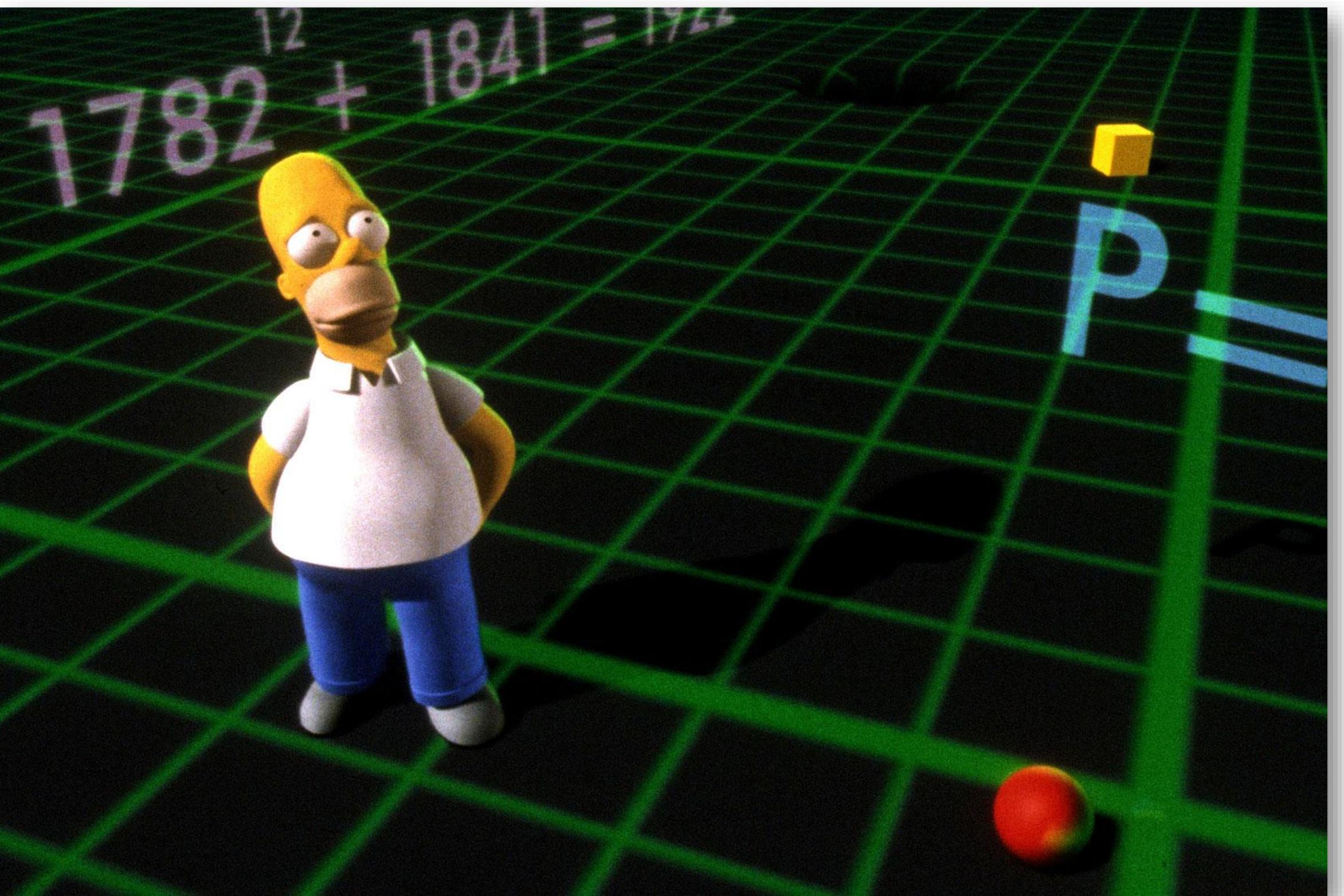


The procedures to convert point clouds into application-specific deliverables are **very costly in time/manual intervention**. It is necessary to develop processes that **extract the essential information automatically** to create valuable data for decision-making.



3D representation

- Better understanding of our environment. 3D data can provide more dimensional information.
- 3D models can:
 - Represent the features of virtually any object.
 - Represent complex objects with a finite number of elements. (Point Cloud)
- Improve the decision-making process.
- Design error reduction:
 - industry and building sector.



Data representation

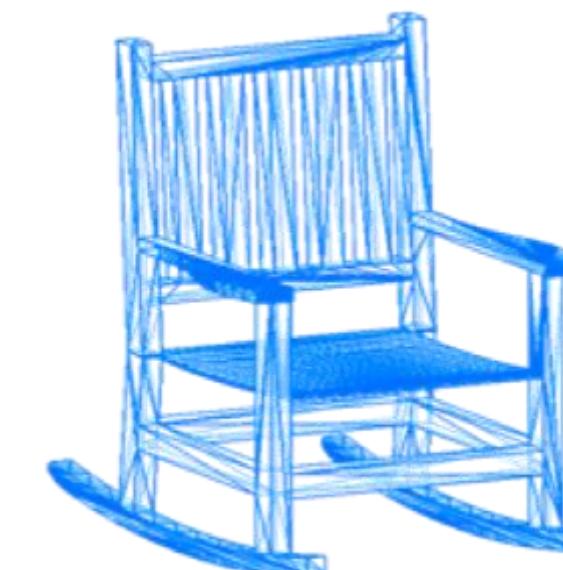
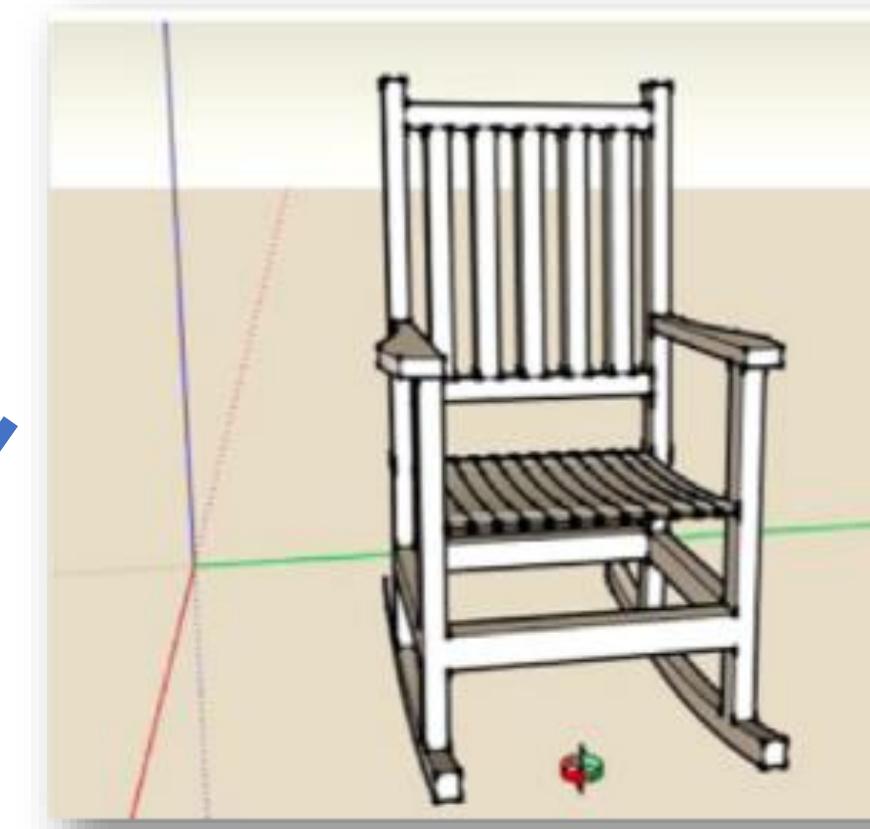
2D image



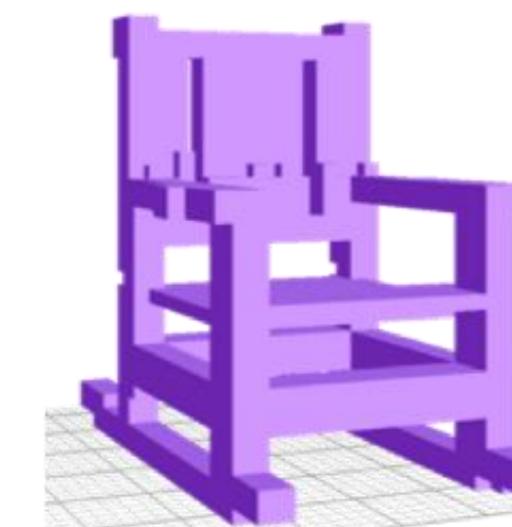
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51	16	40	32	46	48	28	17
29	60	3	63	49	55	36	7
52	22	26	41	38	10	61	53
2	24	19	11	34	43	5	8
57	9	37	42	25	21	27	18
30	56	50	64	4	59	6	13
58	47	45	31	39	15	62	54

Pixels

3D Model



Meshes



Voxels



Point Cloud
(Volumetric Pixels)

3D data representation



RGB-D provides a 2,5D information

3D data representation - NERF

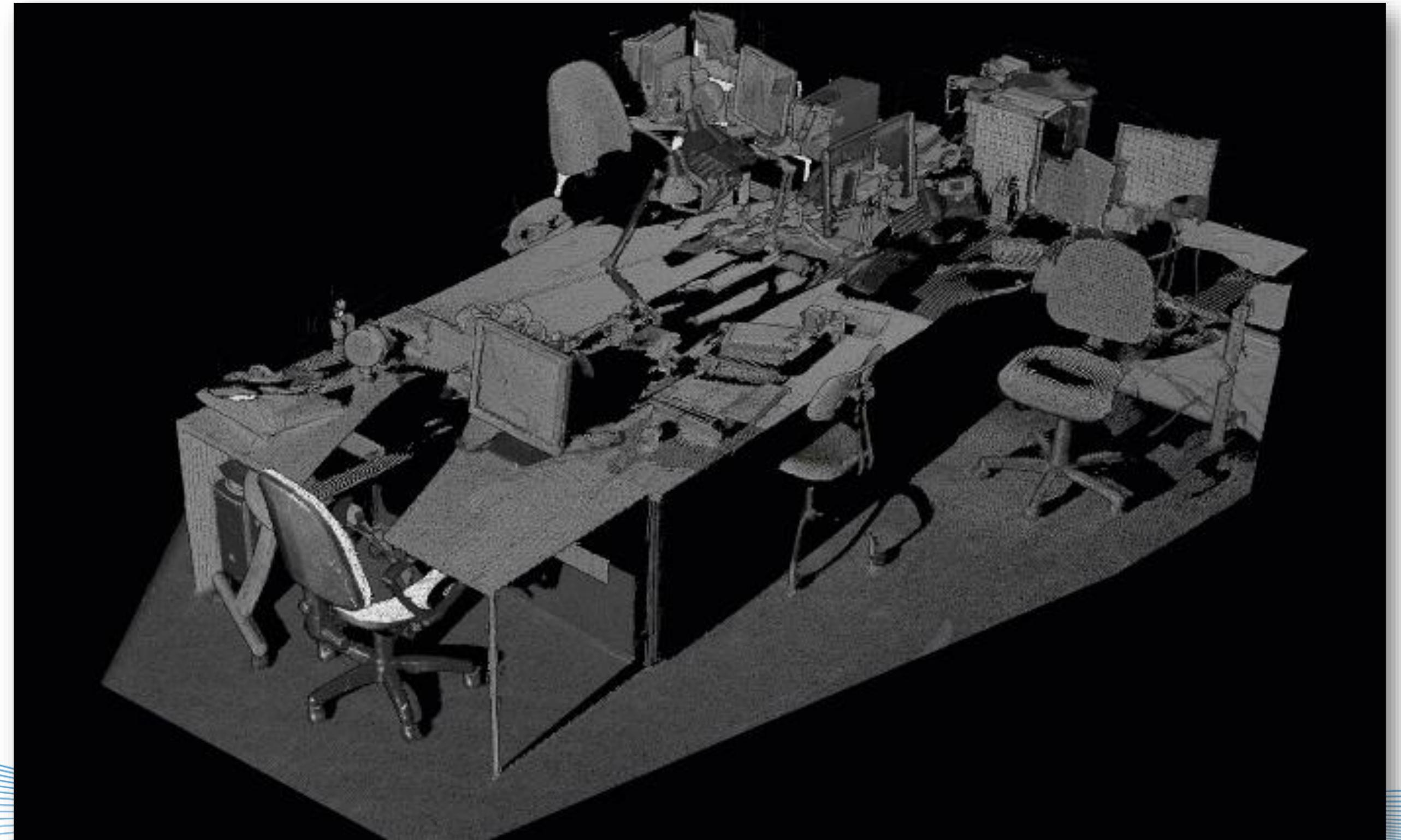


Point cloud





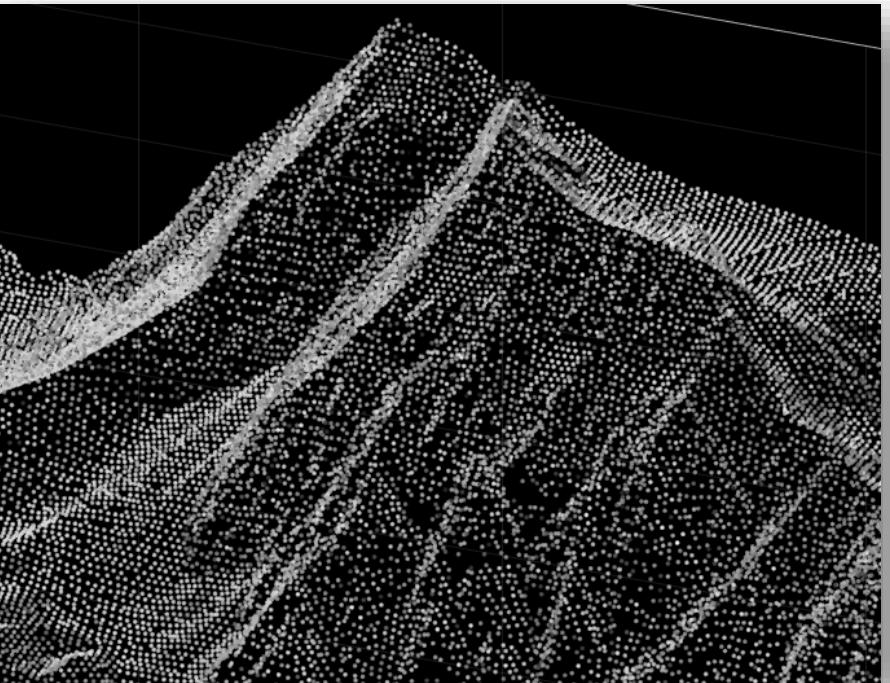
Artificial intelligence in point cloud



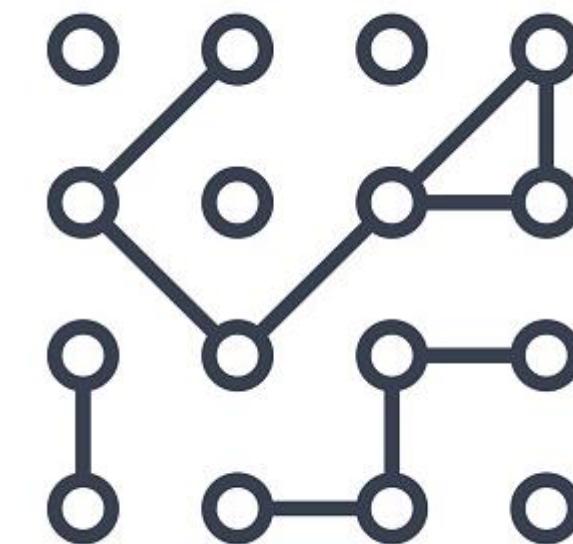
Challenges



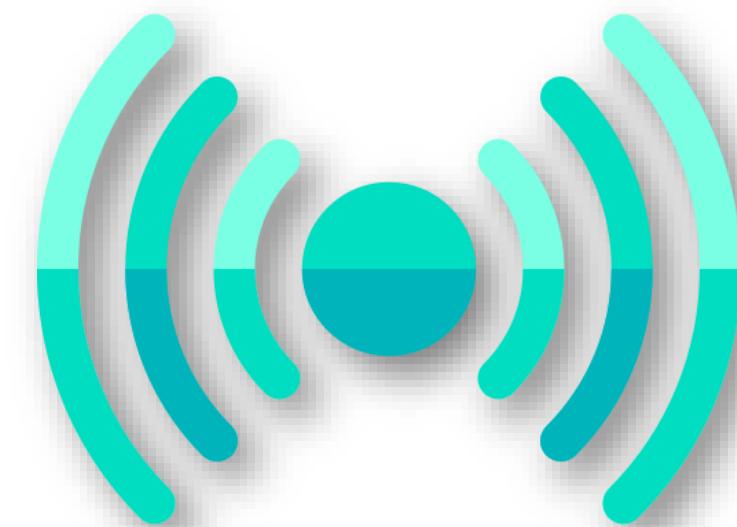
Multiple file formats



Millions of points



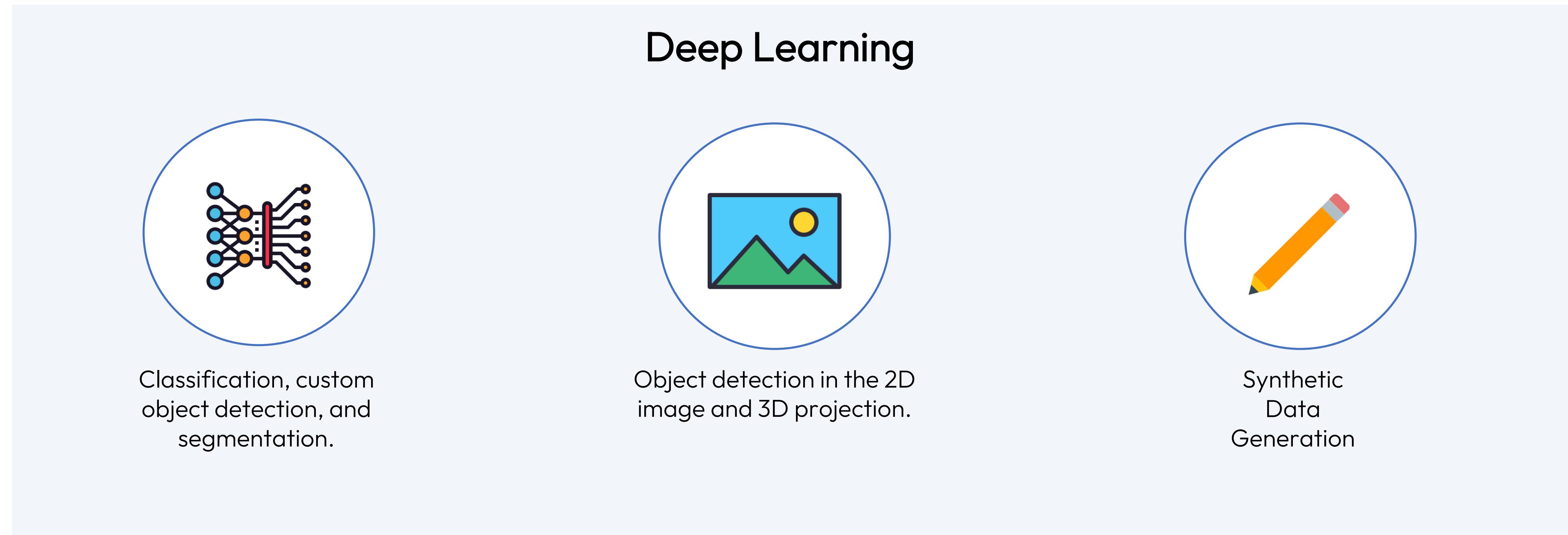
Unstructured data



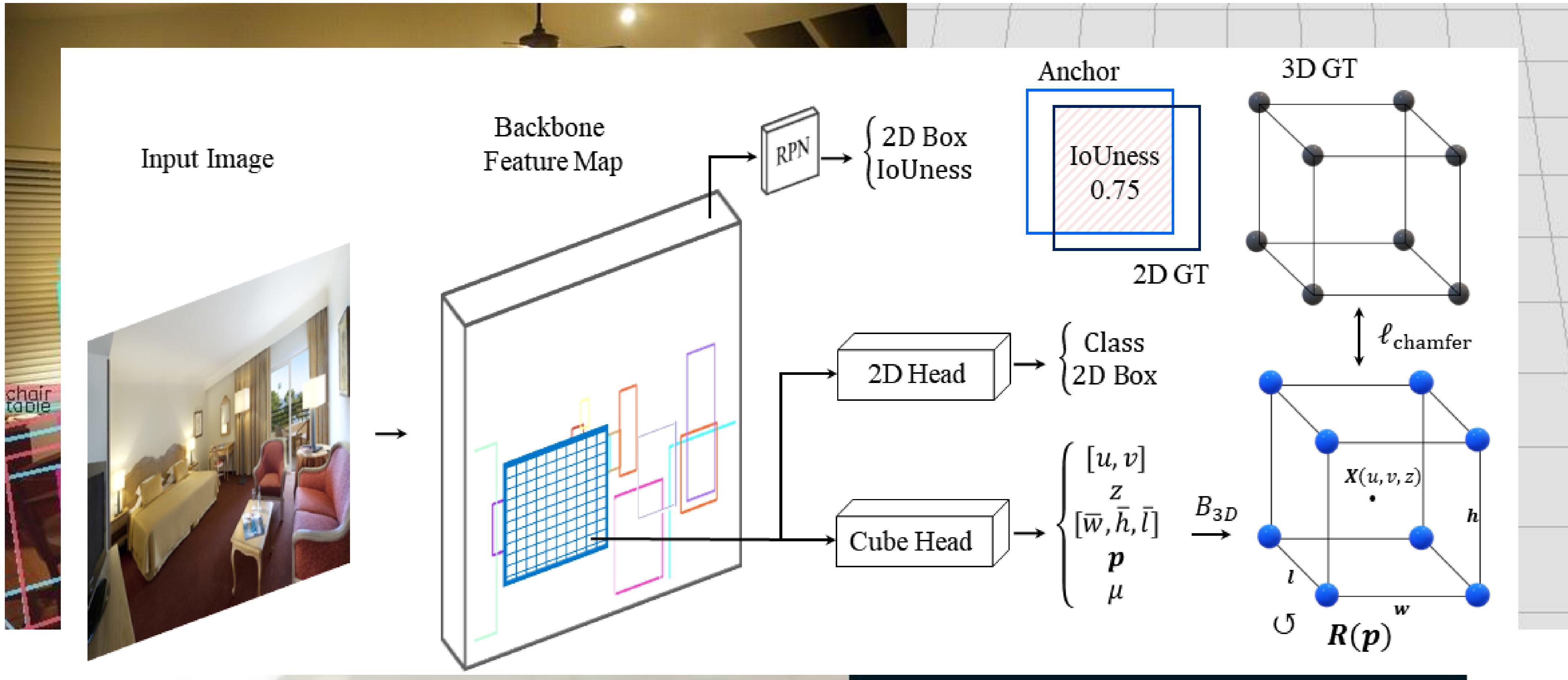
Noisy Sensors

Point cloud + AI

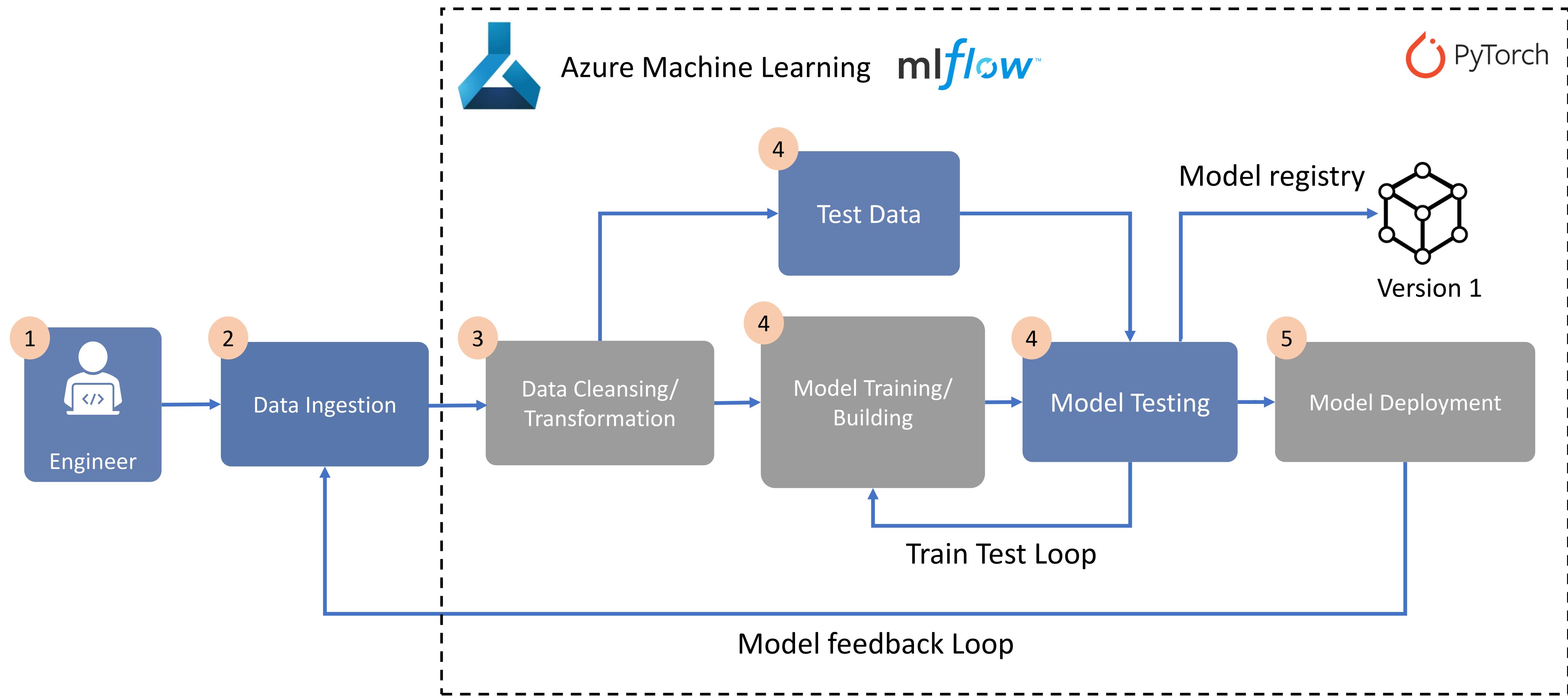
- Automated insights extraction in large point clouds.
- ML-assisted capacity can help reduce human errors by automatically pre-labeling.



Object detection – Cube RCNN

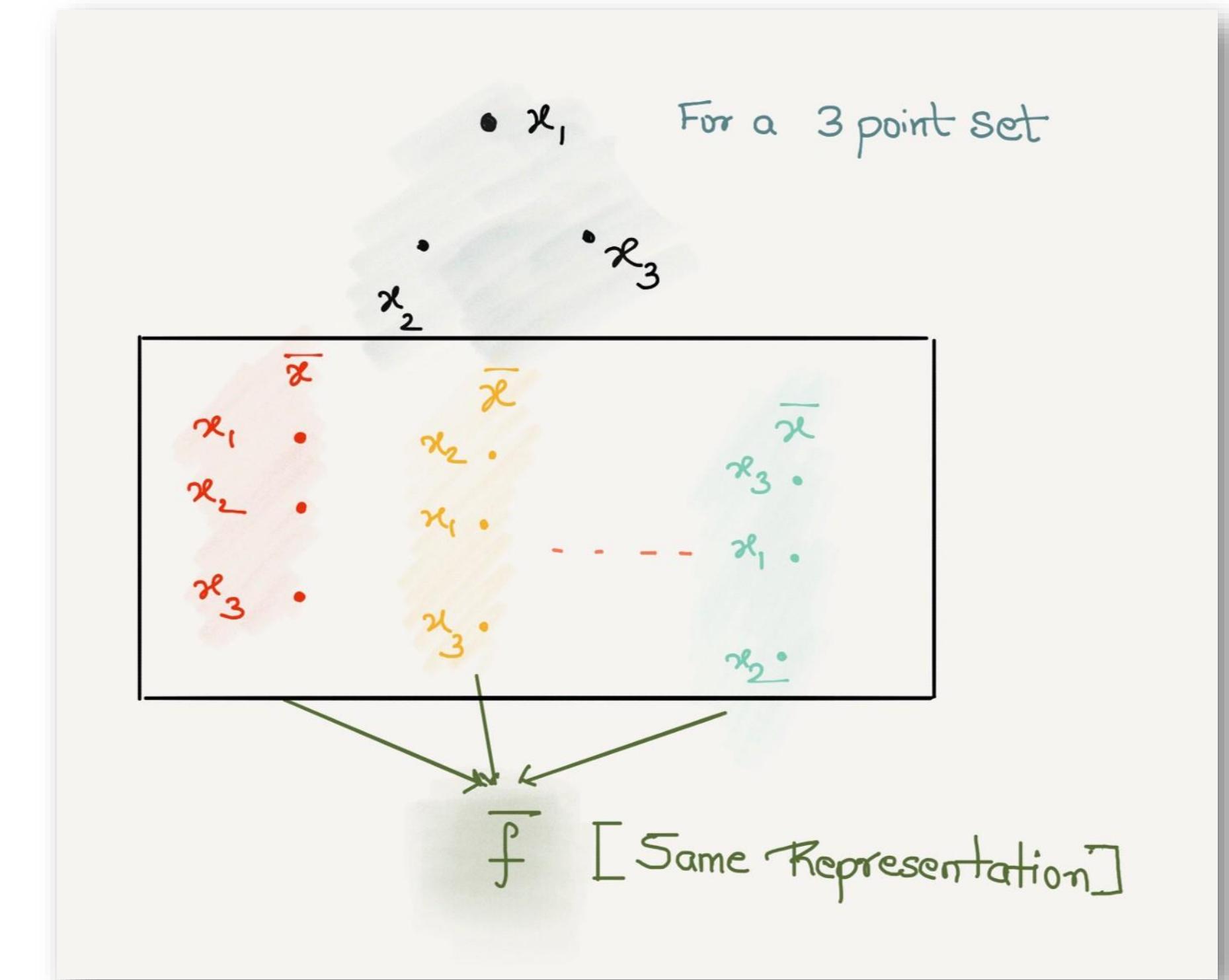


AI Workflow



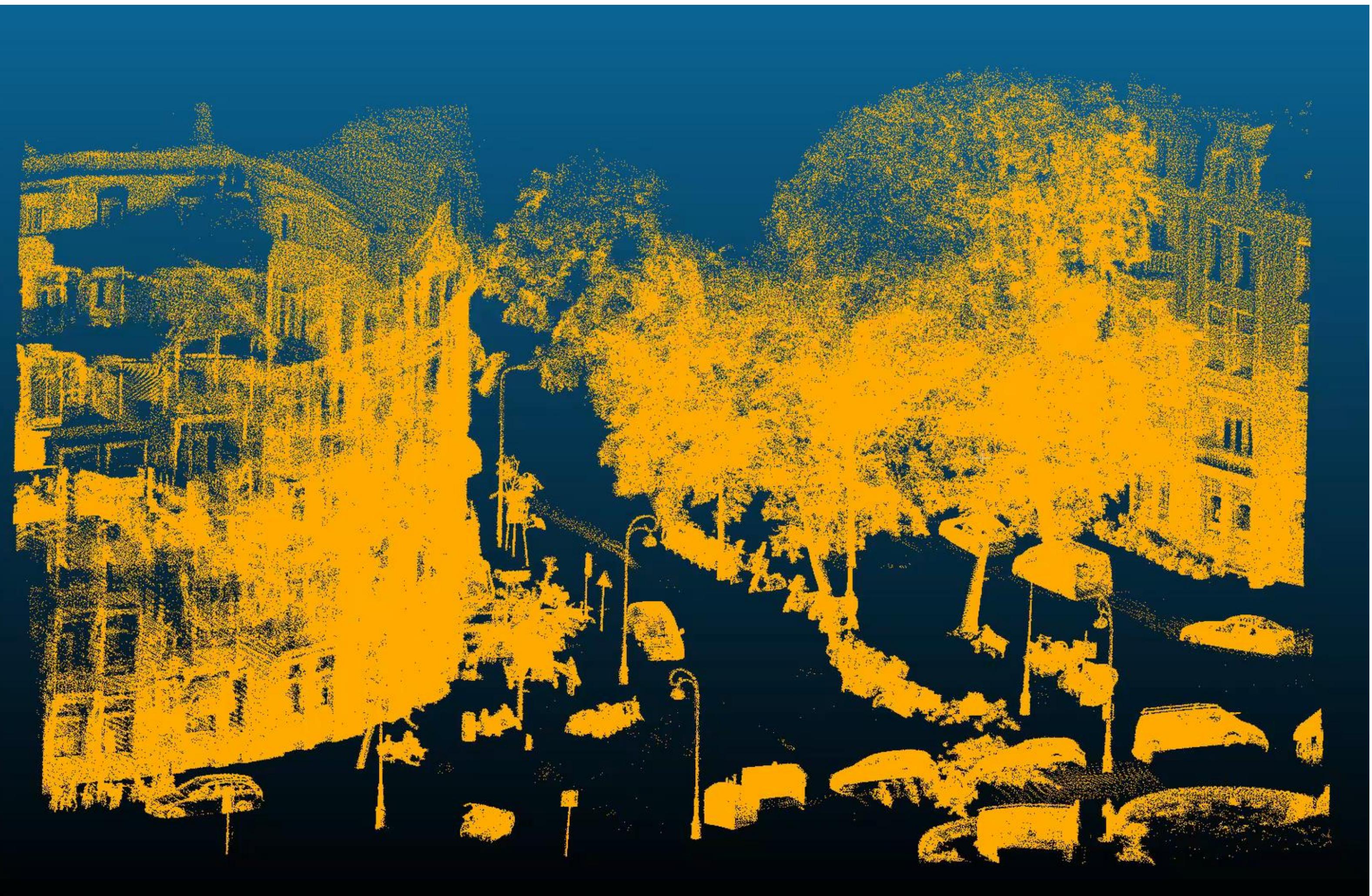
Data preprocessing - Deep Learning

- Point cloud
 - Data transformation to 3D voxel grid projections.
 - Data normalization (scale)
 - Translation, rotation, and permutation invariance.
 - Sort input into canonical order.
- Large point clouds. Memory consumption.
 - Slices, segmentation
 - Downsampling



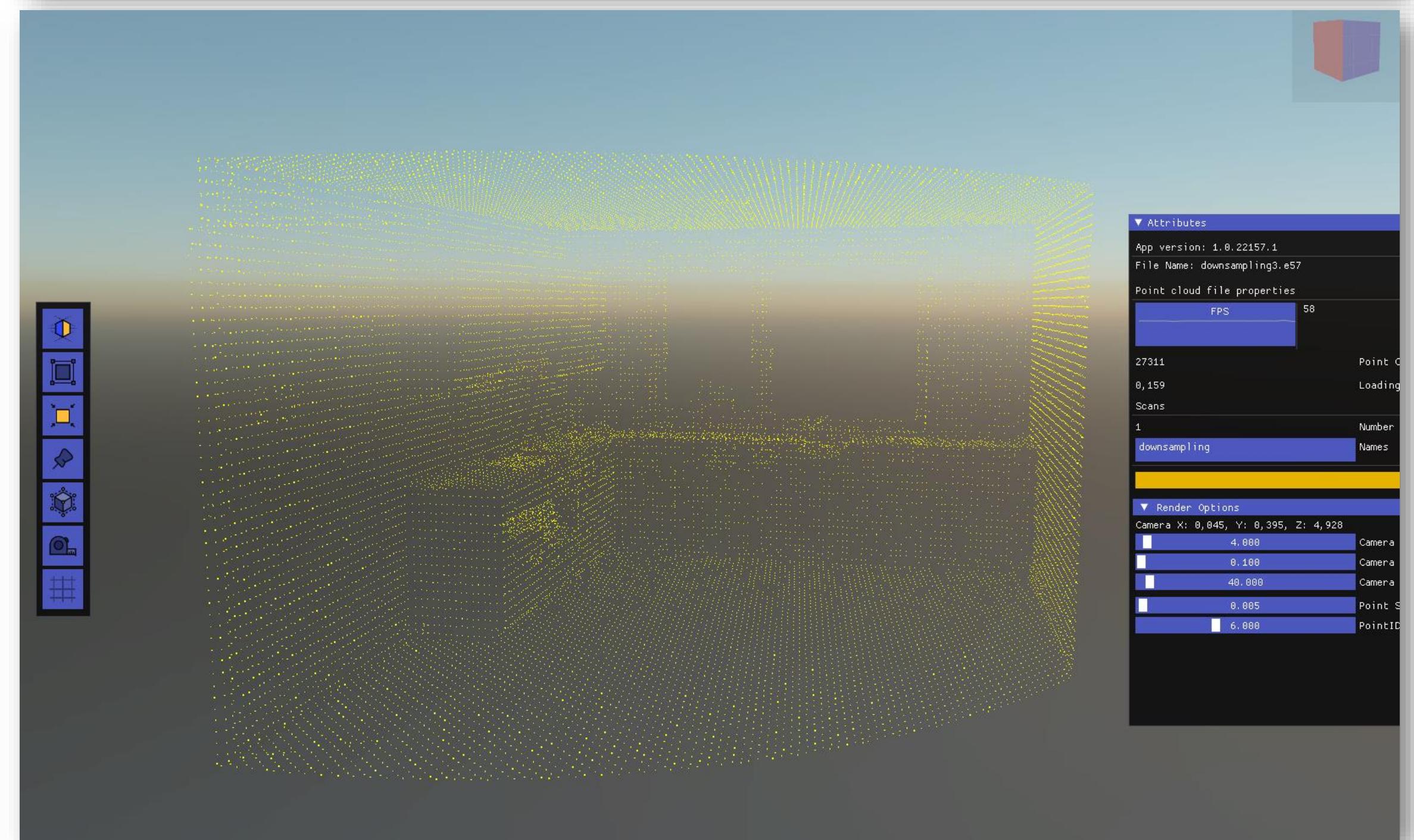
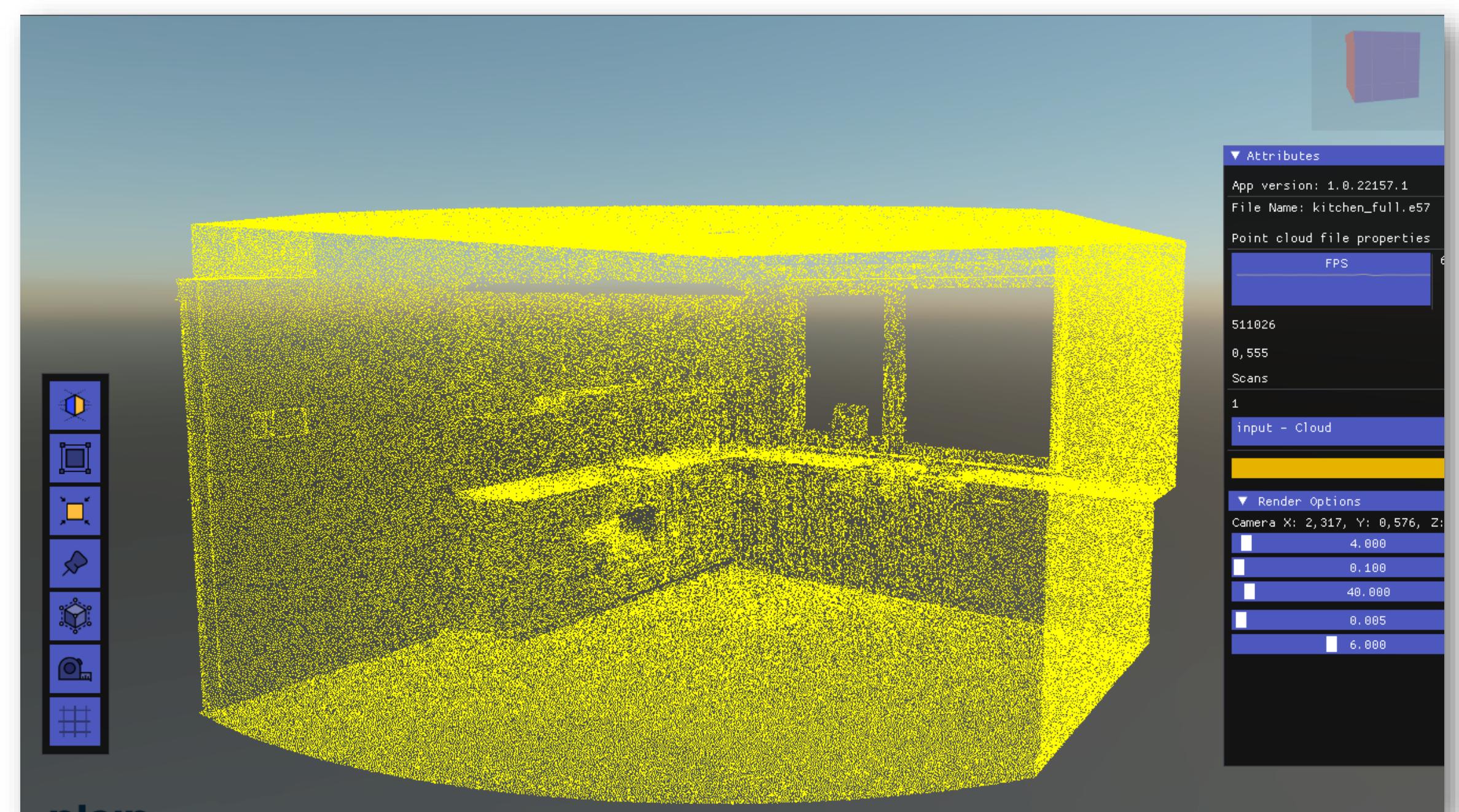
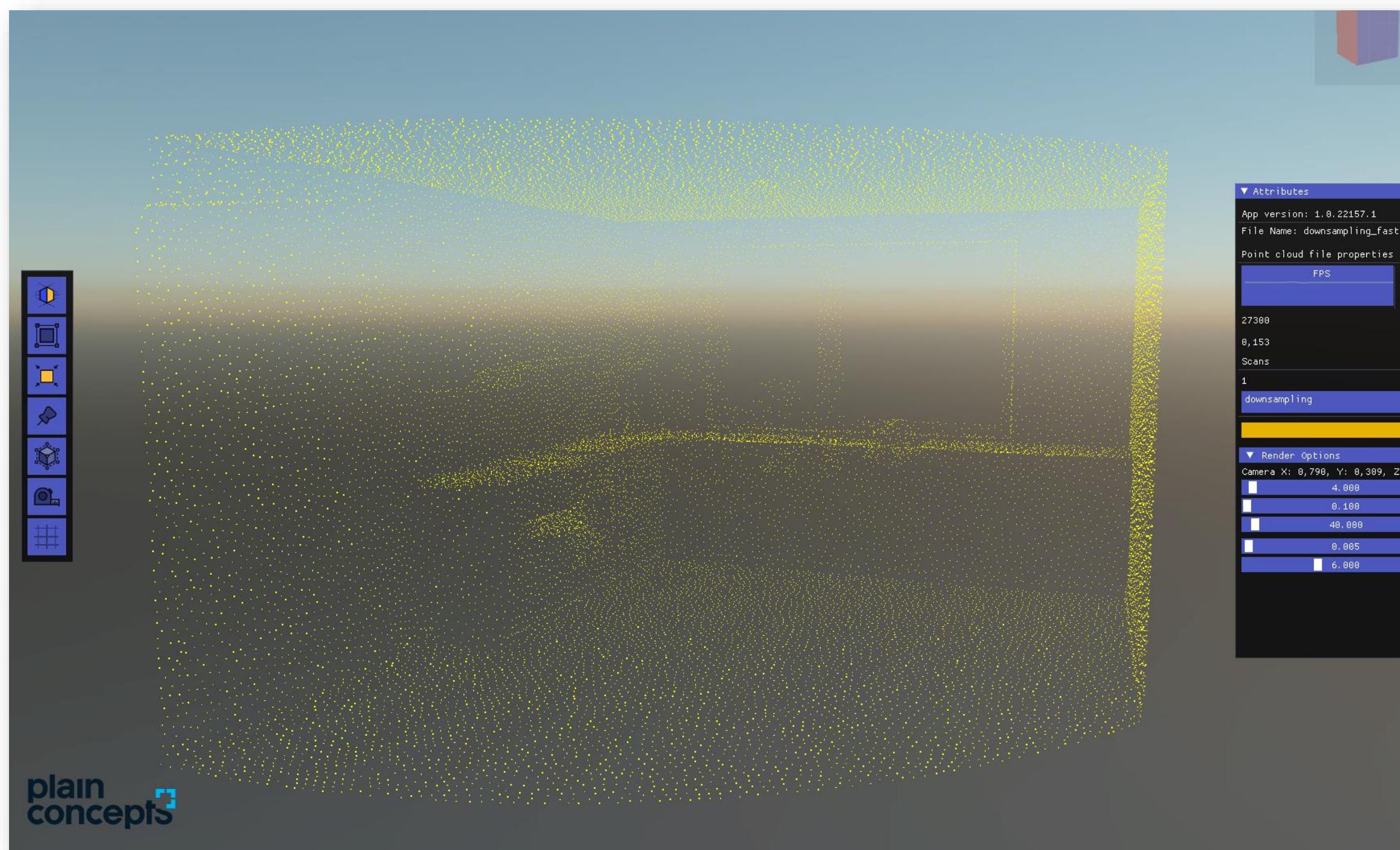
Data cleaning

- Pass-through filter.
- Statistical outlier removal.
- Radius outlier.



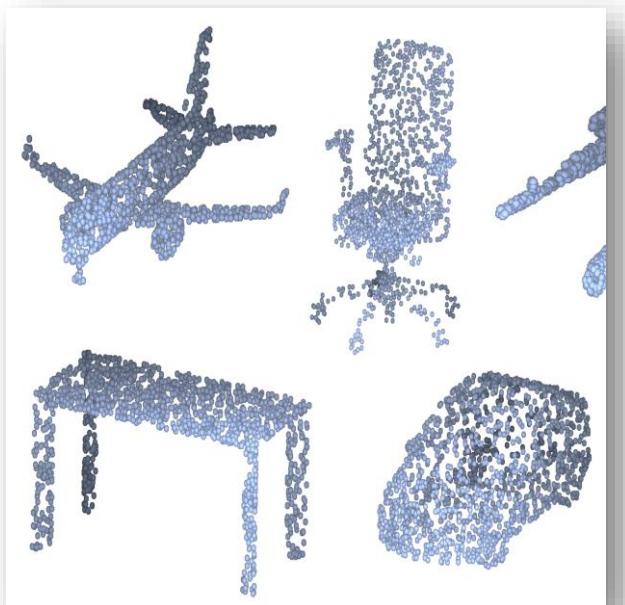
Downsampling

- Voxel Grid Filter. Centroid
- Farthest point sample



Computer vision tasks

Classification

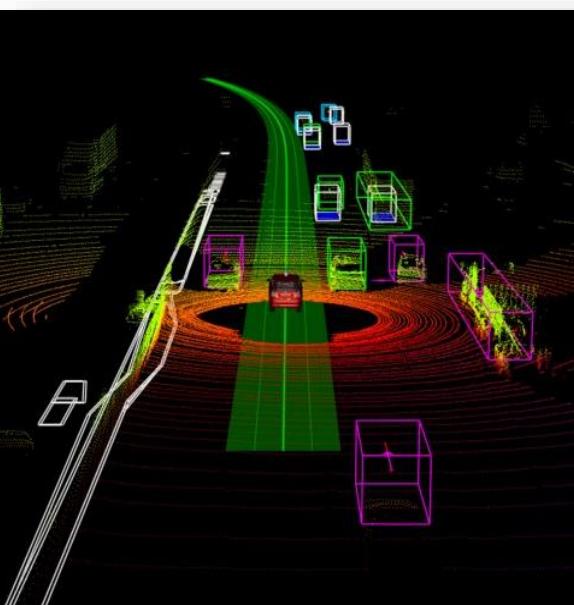


PointNet++

PointCNN

SE-PseudoGrid

Object detection and localization

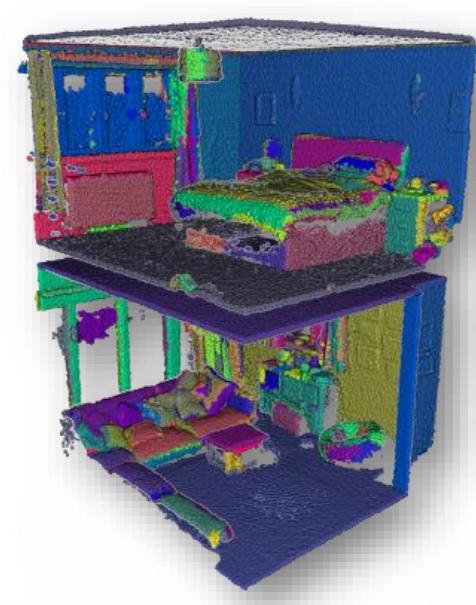


PointPillars

PointRCNN

FCAF3D

Segmentation

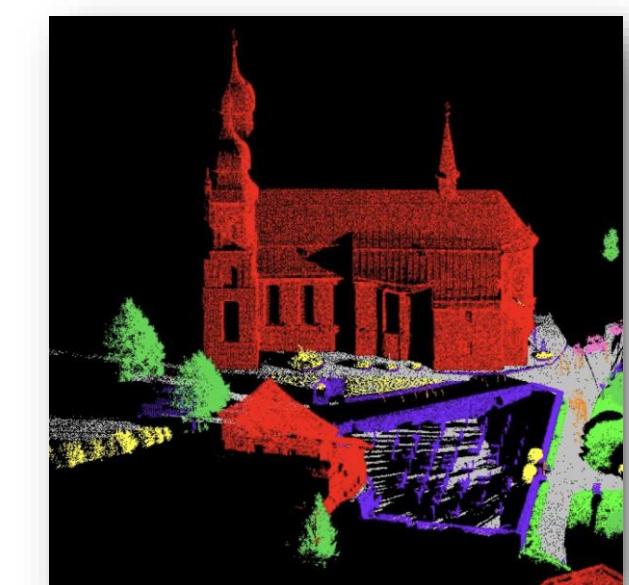


RANSAC

Correspondence Grouping

K-Means, DBSCAN

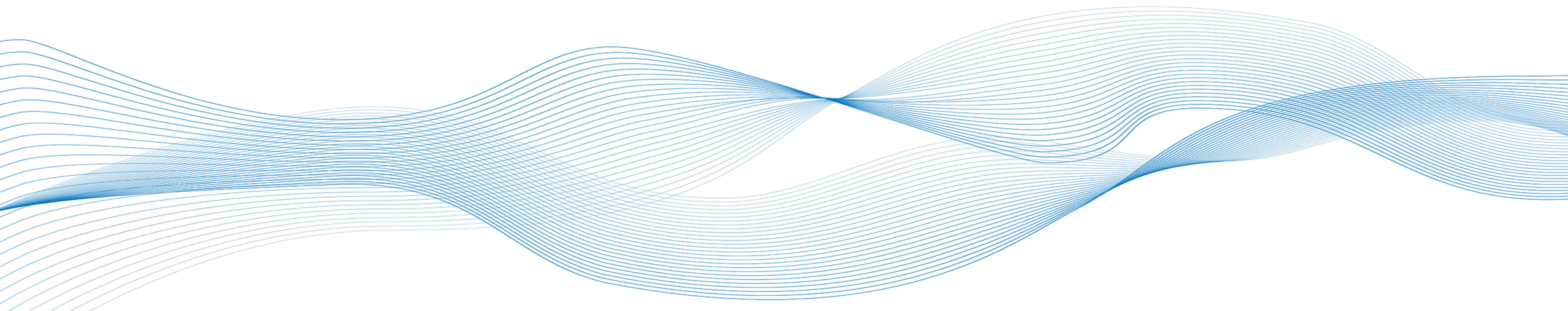
Semantic segmentation



PAConv

PointNetTransformers

Industrial applications



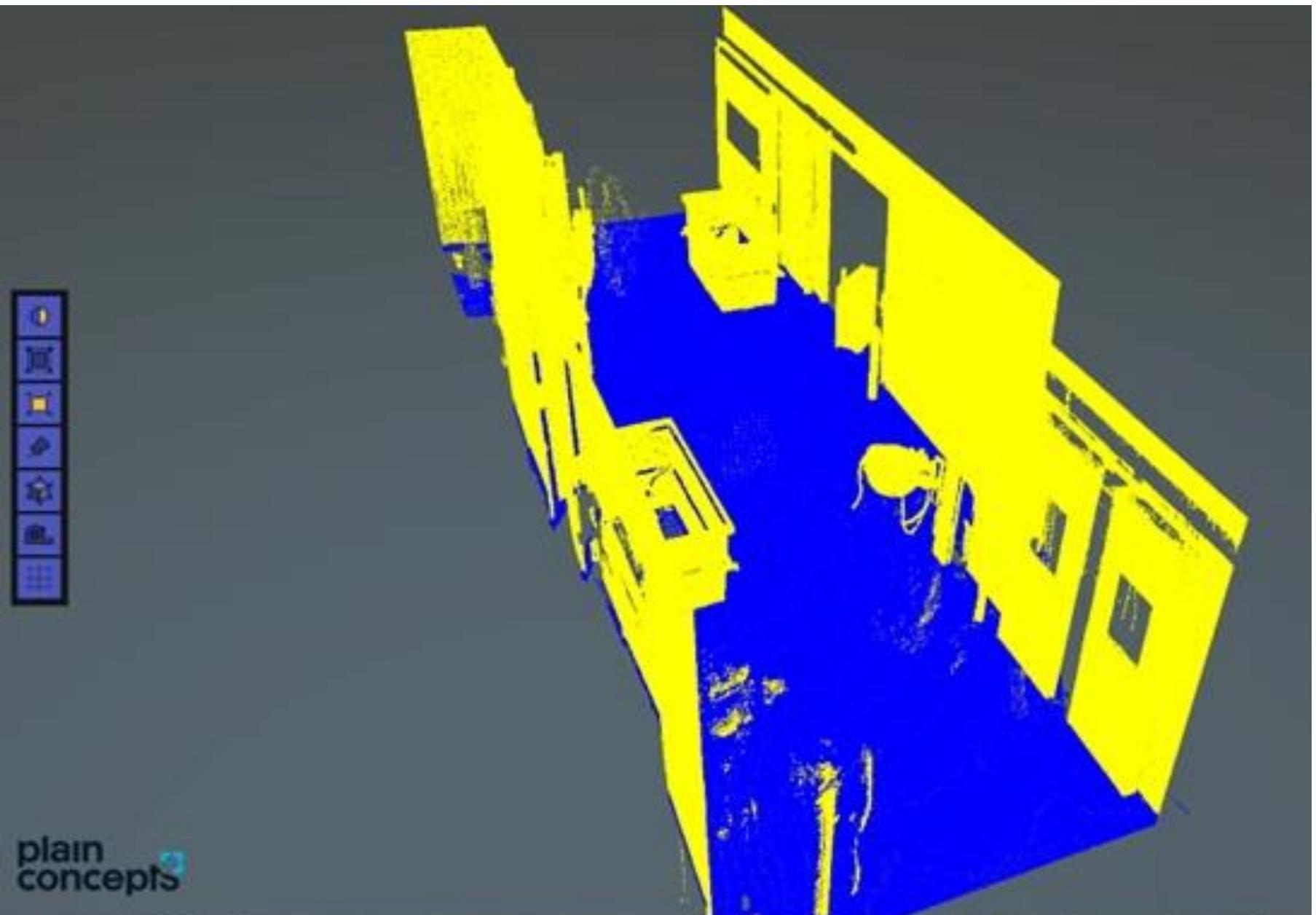
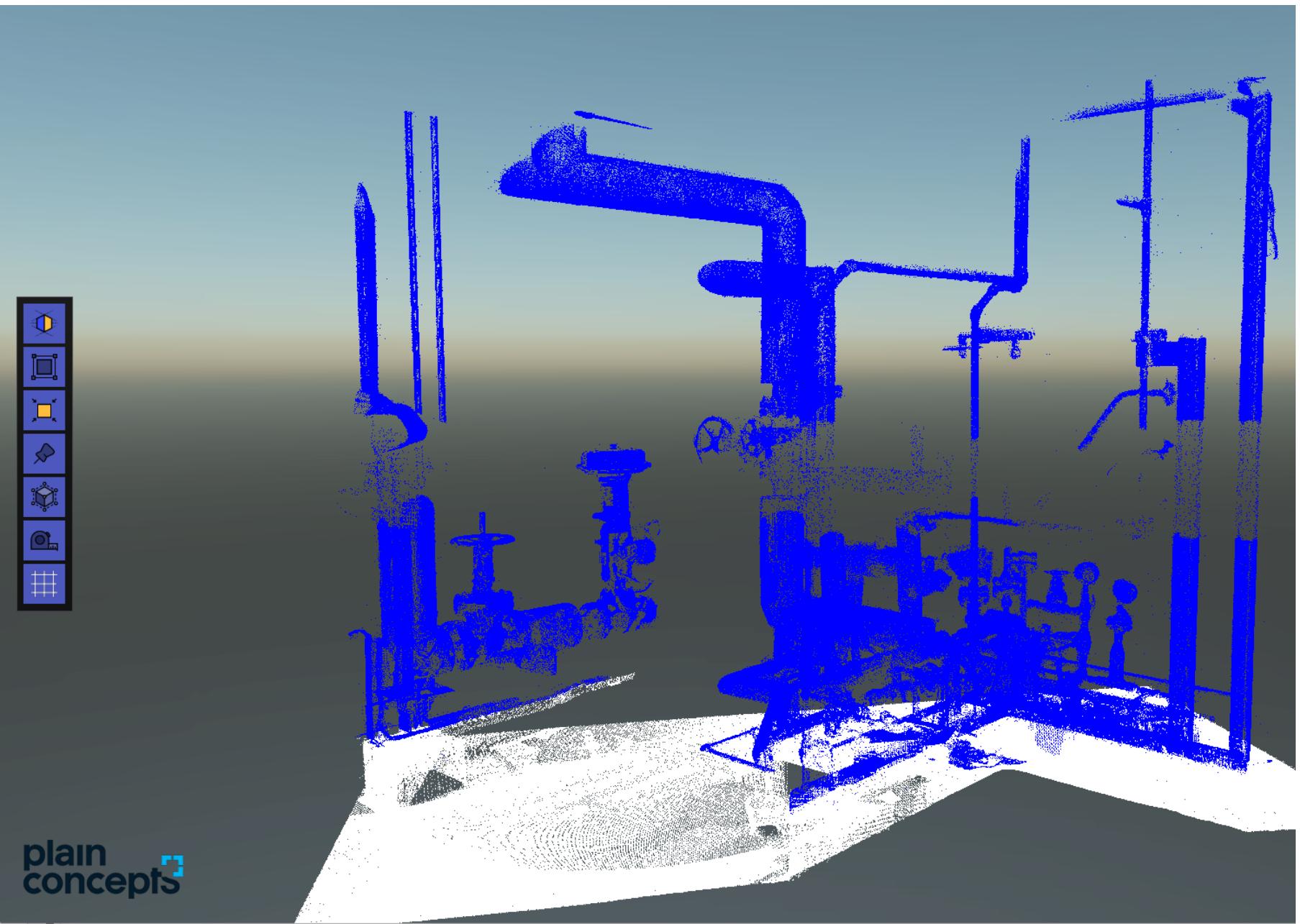
Automatic digital twin

- 01 Create the digital version of the environment.



Automatic digital twin

- 01 Create the digital version of the environment.
- 02 Extract main environment insights.
Wall, ceiling, floor, cylinders...



Automatic digital twin

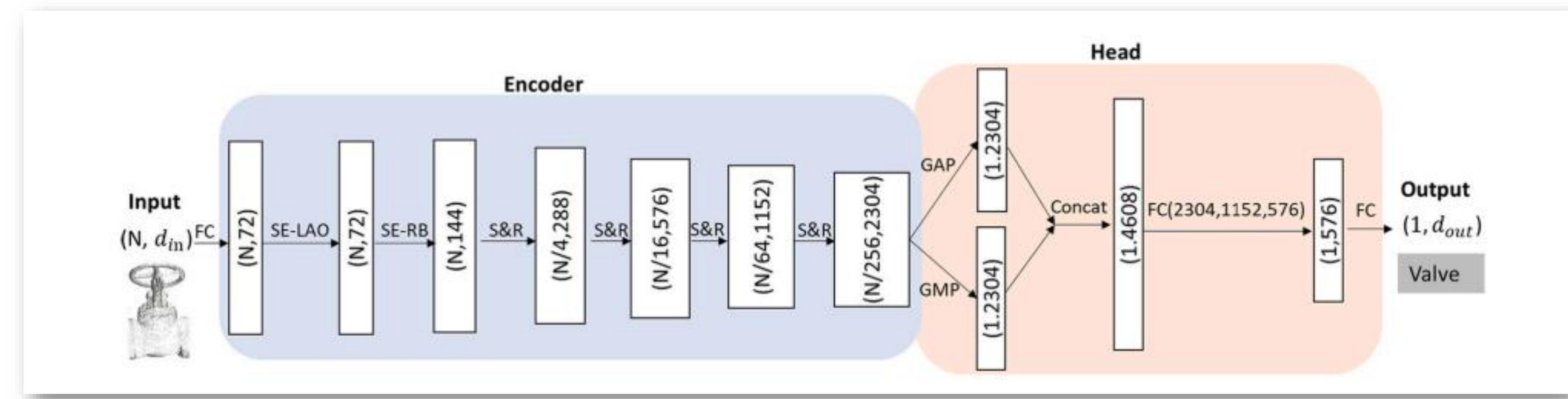
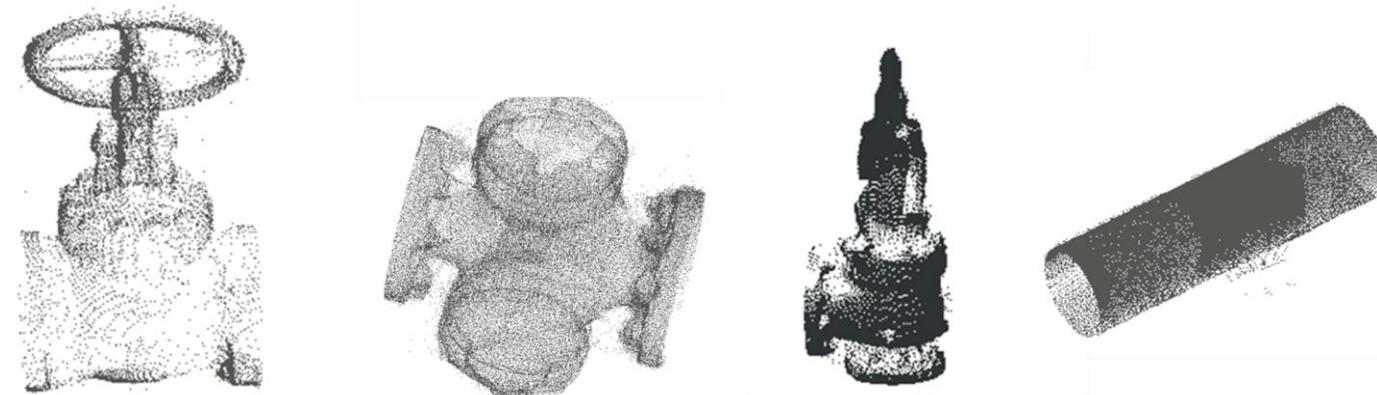
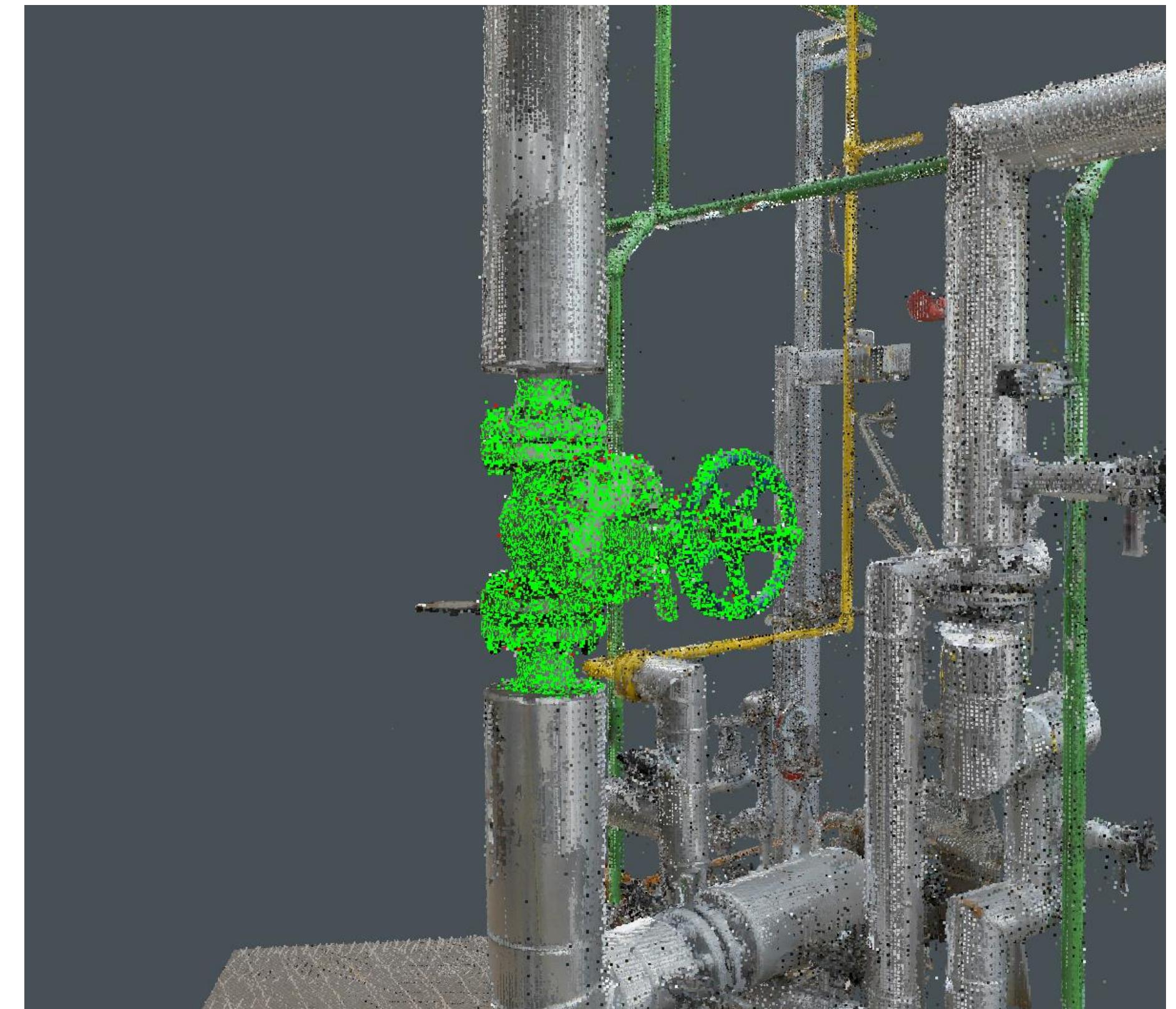
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Wall, ceiling, floor, cylinders...

03 Detect and recognize specific objects.

Machines, piping systems...



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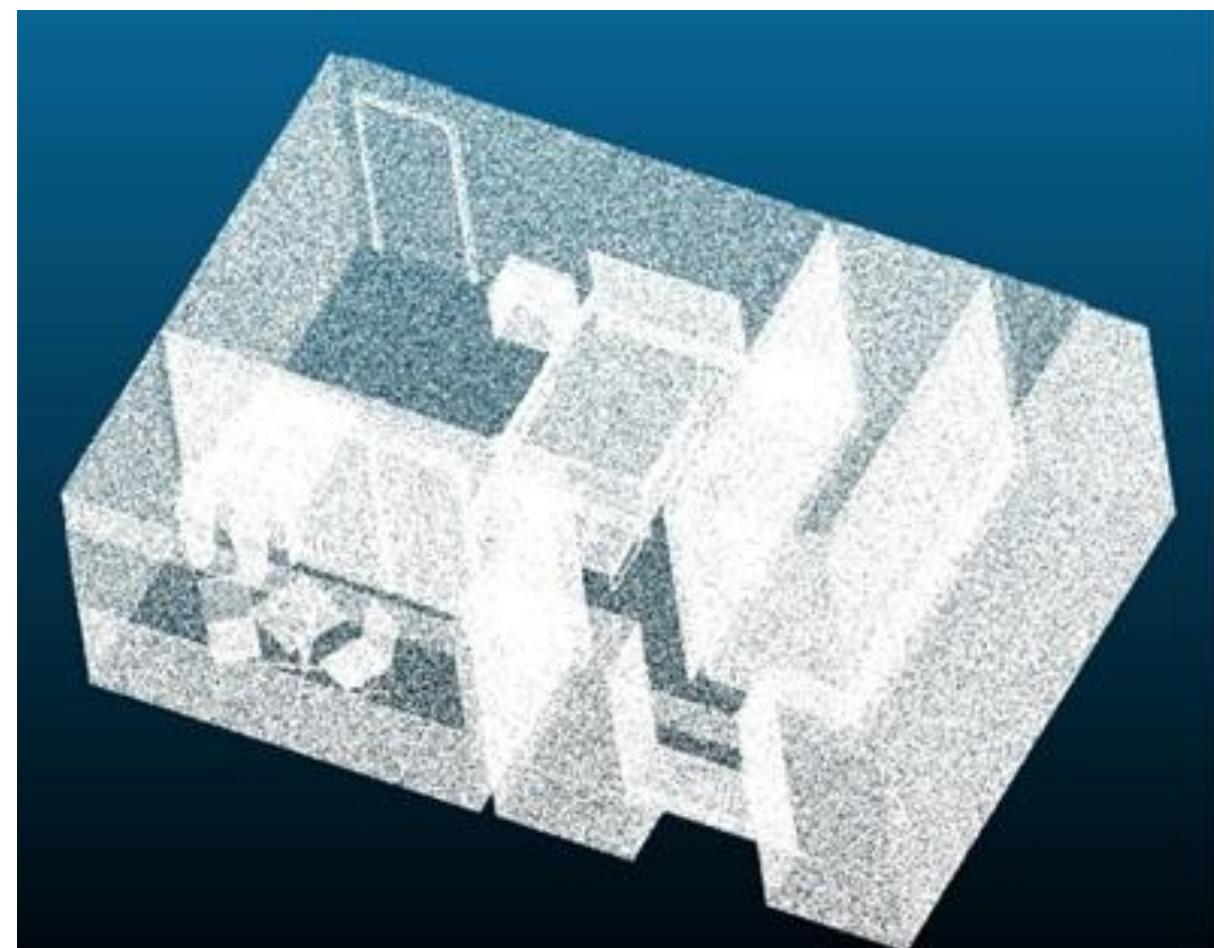
Wall, ceiling, floor, cylinders...

03 Detect and recognize specific objects.

Machines, piping systems...

04 Transform environment and insights
into 3D objects.

BIM modeling, mesh



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Machines, piping systems...
- 04 Transform environment and insights
into 3D objects.
BIM modeling, mesh
- 05 IoT devices simulator
Temperature, humidity, pressure...



Questions?

 @mrcabellom

 mrcabellom@gmail.com



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