gim SMART GEO INSIGHTS

FOSS powering Scalable GeoAI

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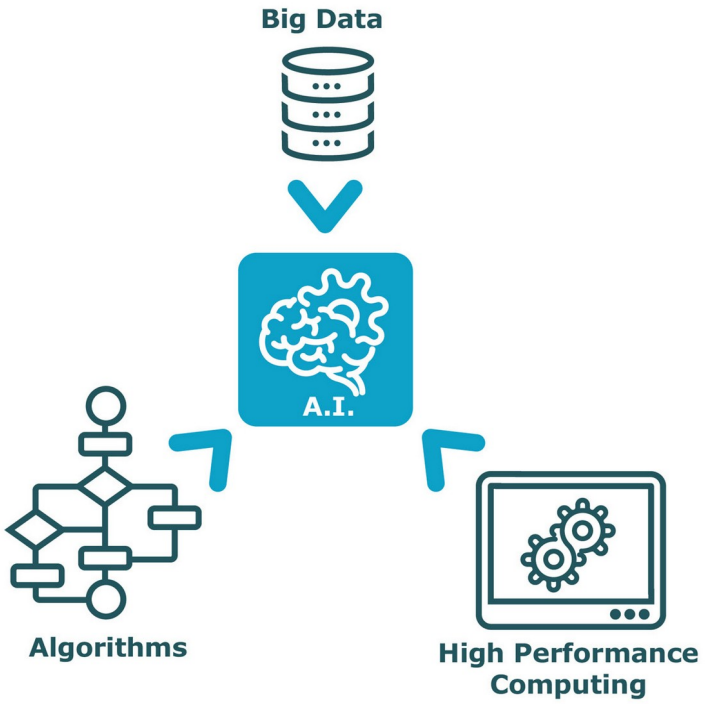
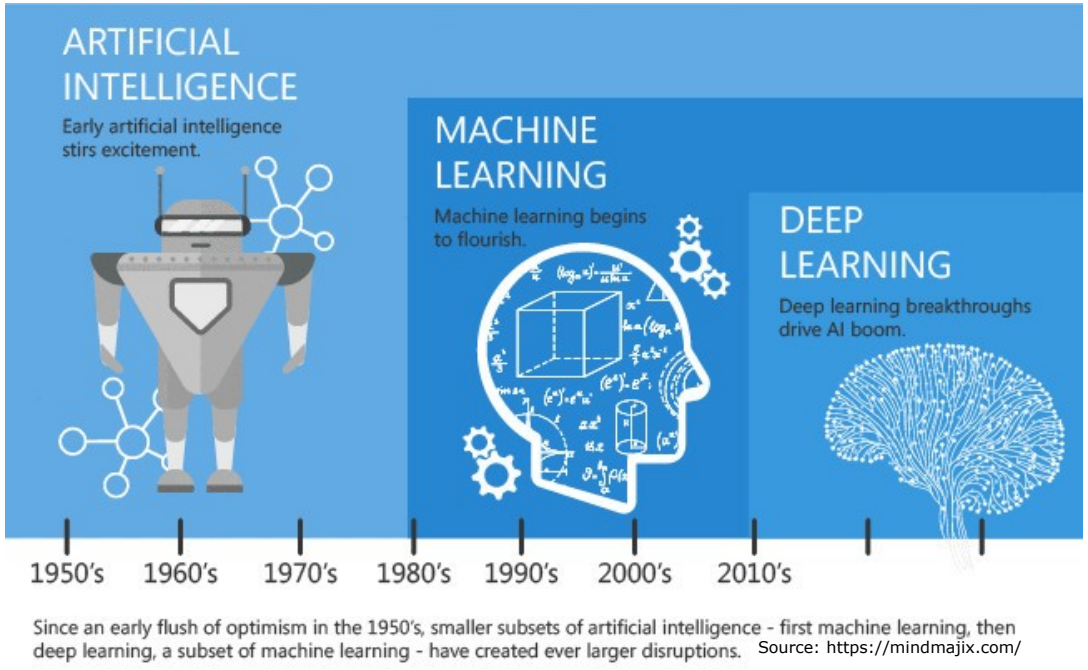
What is Artificial Intelligence?

Artificial intelligence (AI) refers to a wide range of computer science techniques in which applications are trained to make intelligent decisions.



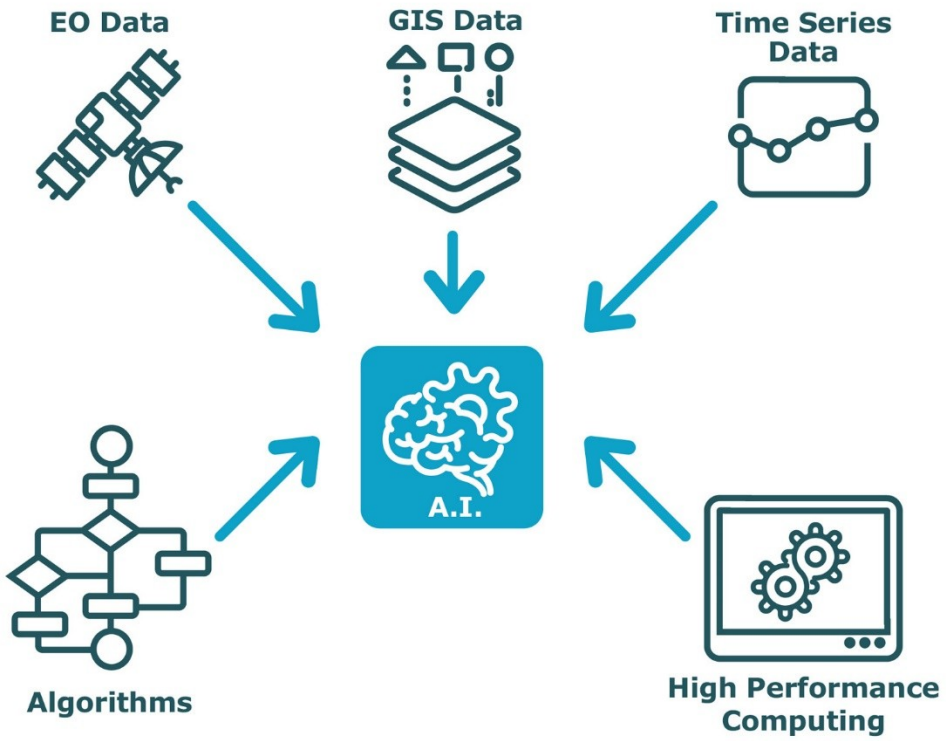


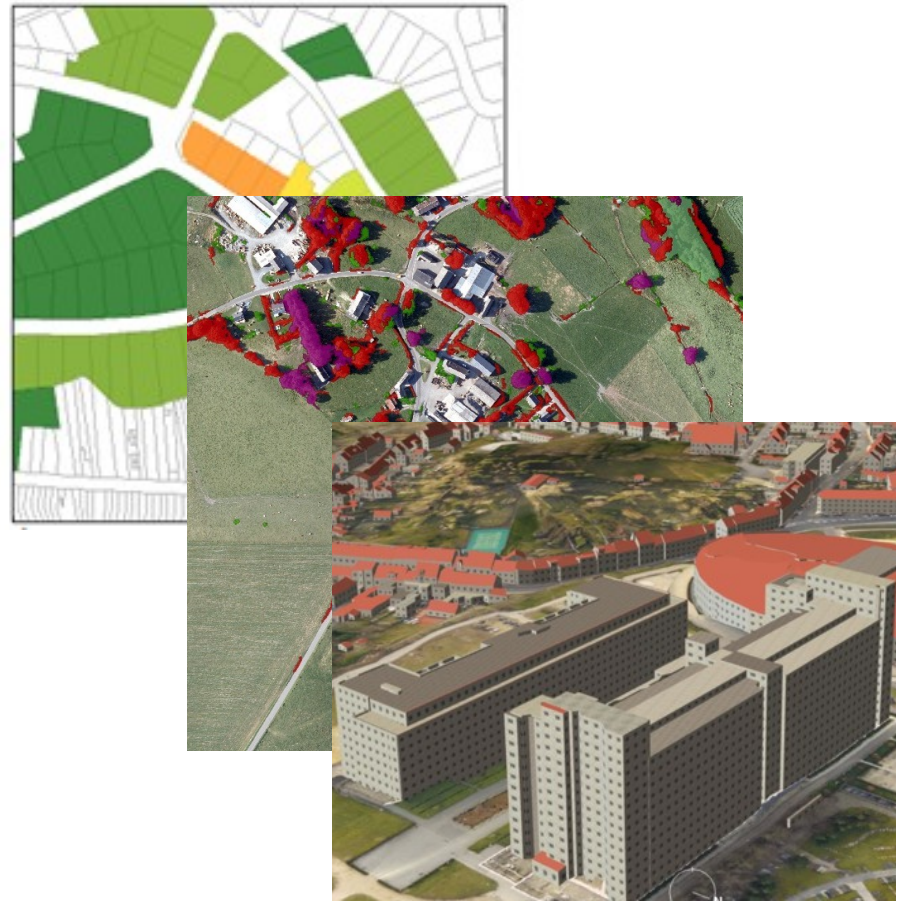
Since an early flush of optimism in the 1950's, smaller subsets of artificial intelligence - first machine learning, then deep learning, a subset of machine learning - have created ever larger disruptions. Source: https://mindmajix.com/

Almost all applications today fall in the scope of **Machine Learning**

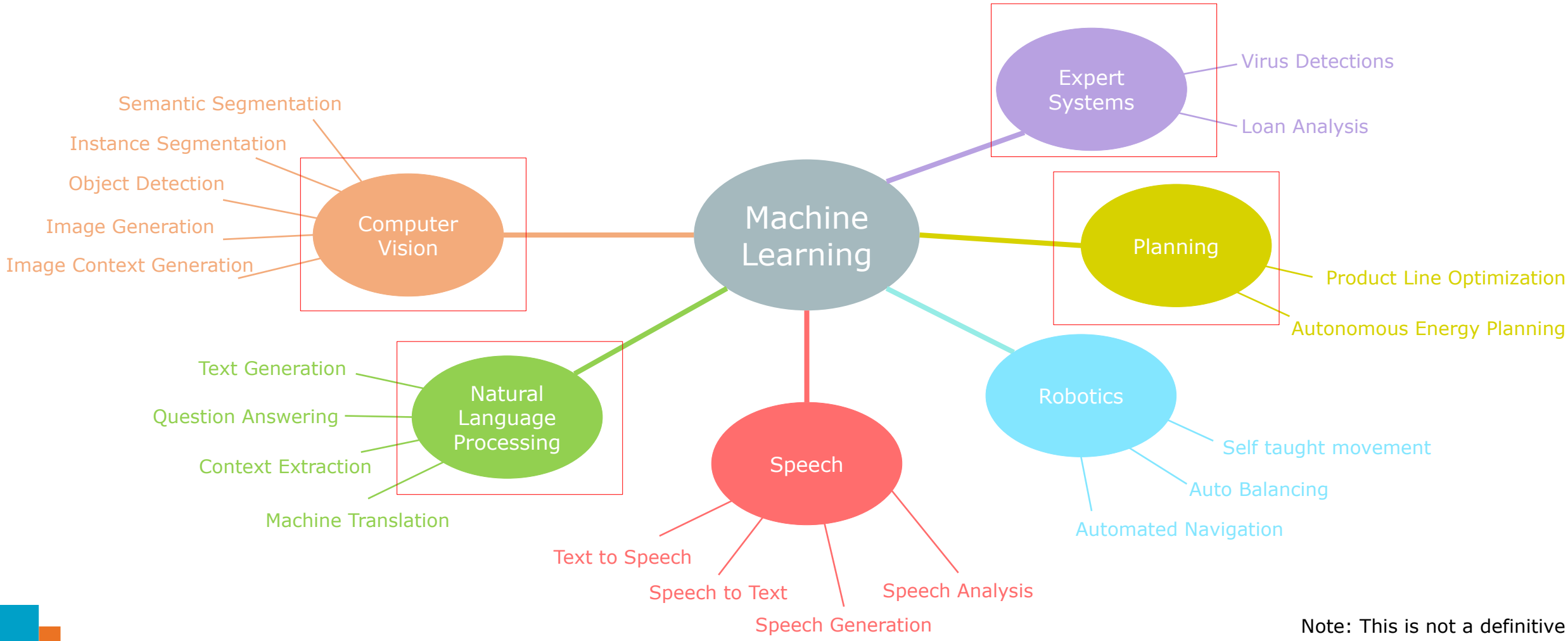
What is Geo-AI?

A subset of AI that deals with geospatial datasets, where data possess spatial and/or temporal characteristics (typical: rasters, vectors, pointclouds,…) and helps solving spatial problems



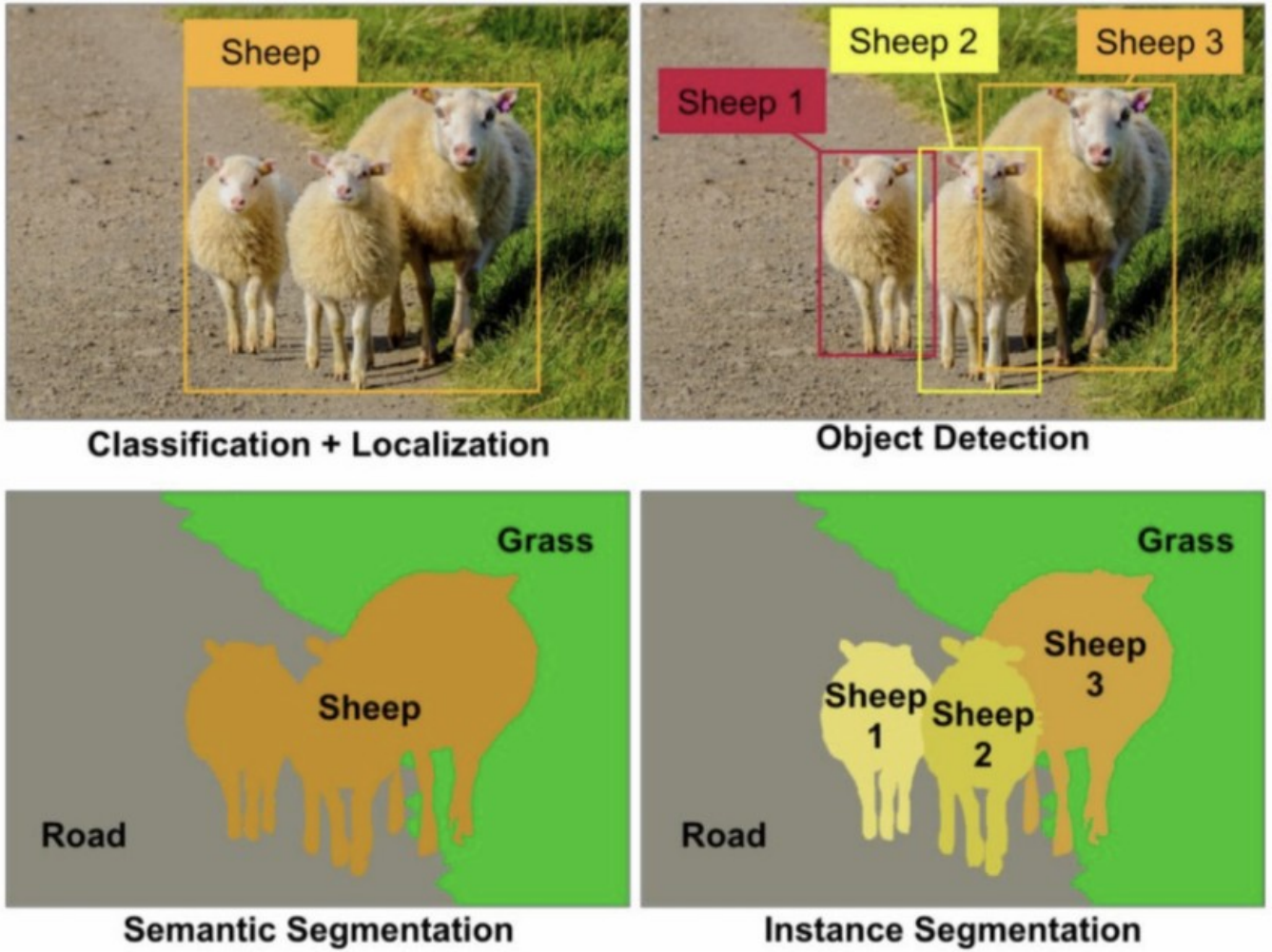


Different fields of machine learning



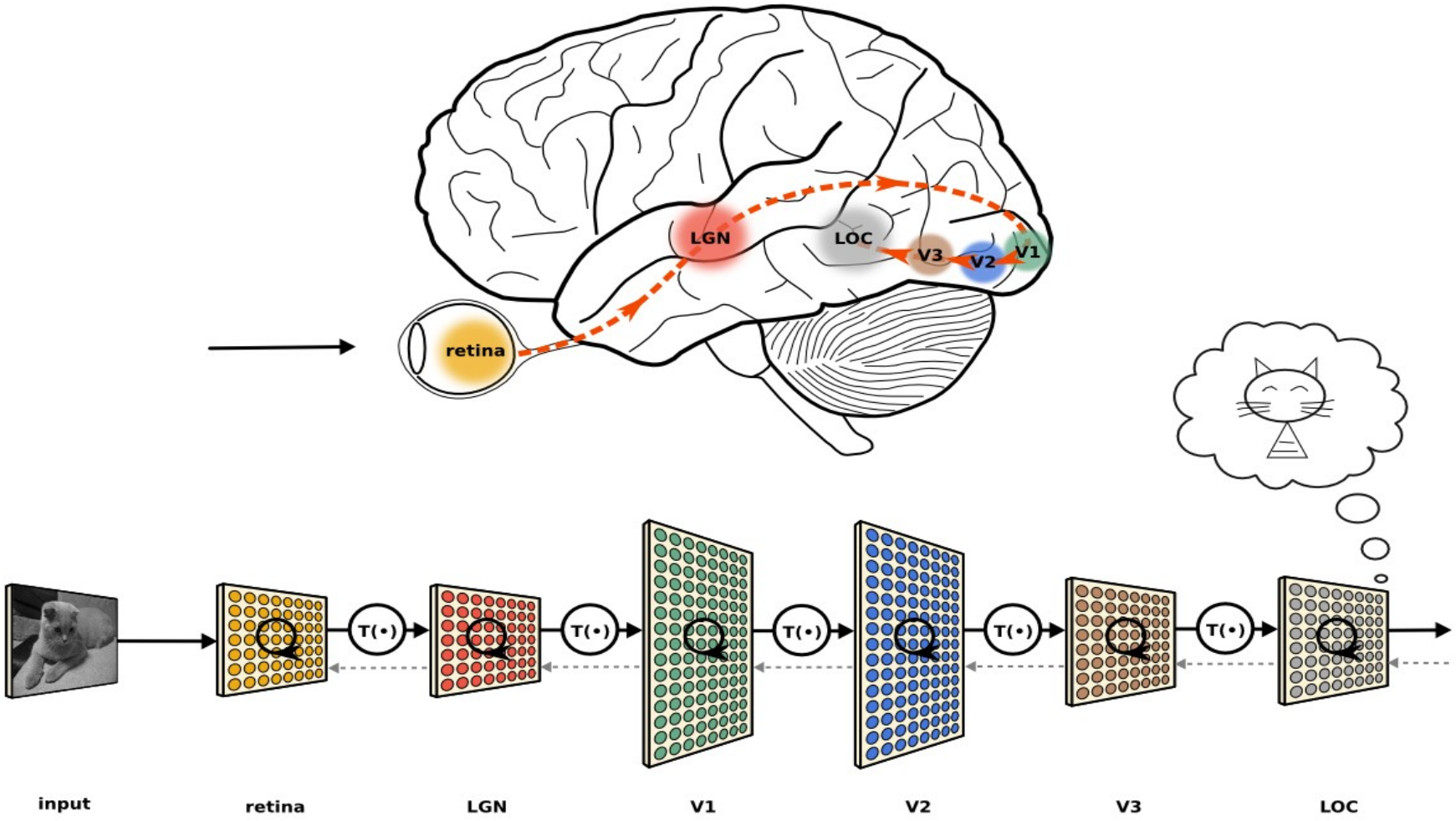
Note: This is not a definitive list

Computer Vision – application types



Source: https://www.oreilly.com/content/introducing-capsule-networks/?cmp=tw-data-na-article-ainy18_thea

Deep Convolutional Neural Networks

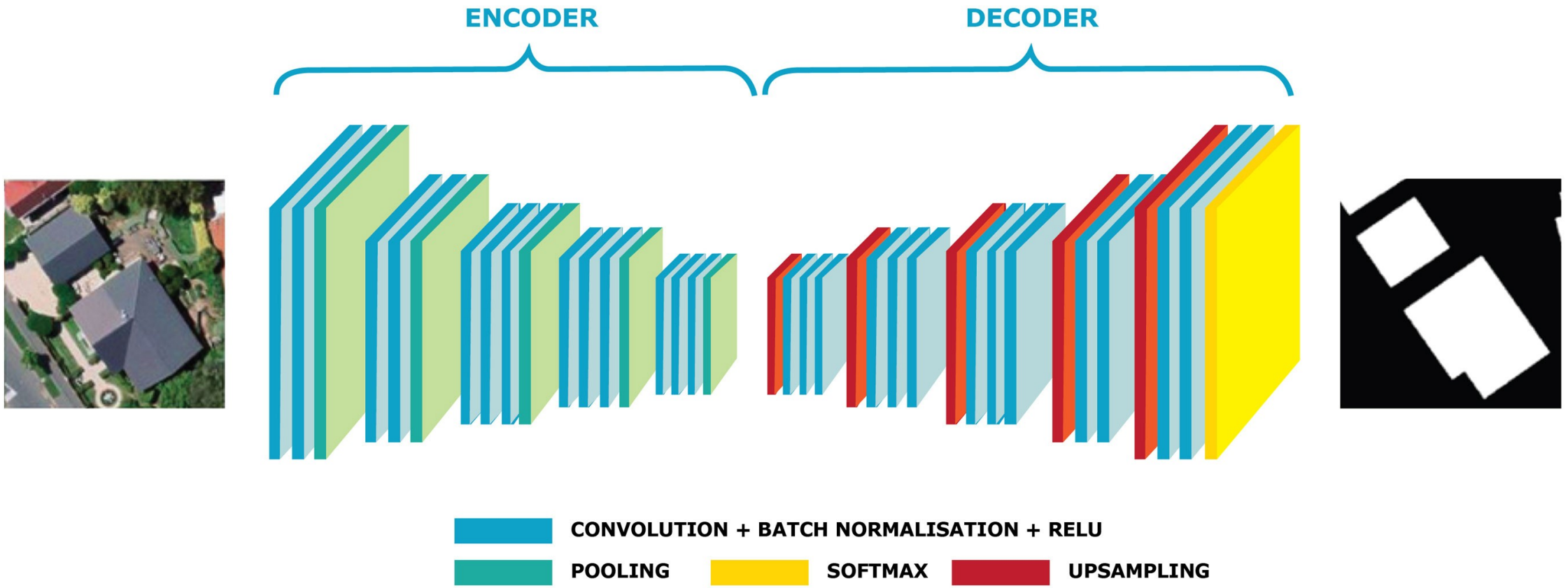


Source: Jonas Kubilius https://neuwritesd.files.wordpress.com/2015/10/visual_stream_small.png

The basics – convolution filters

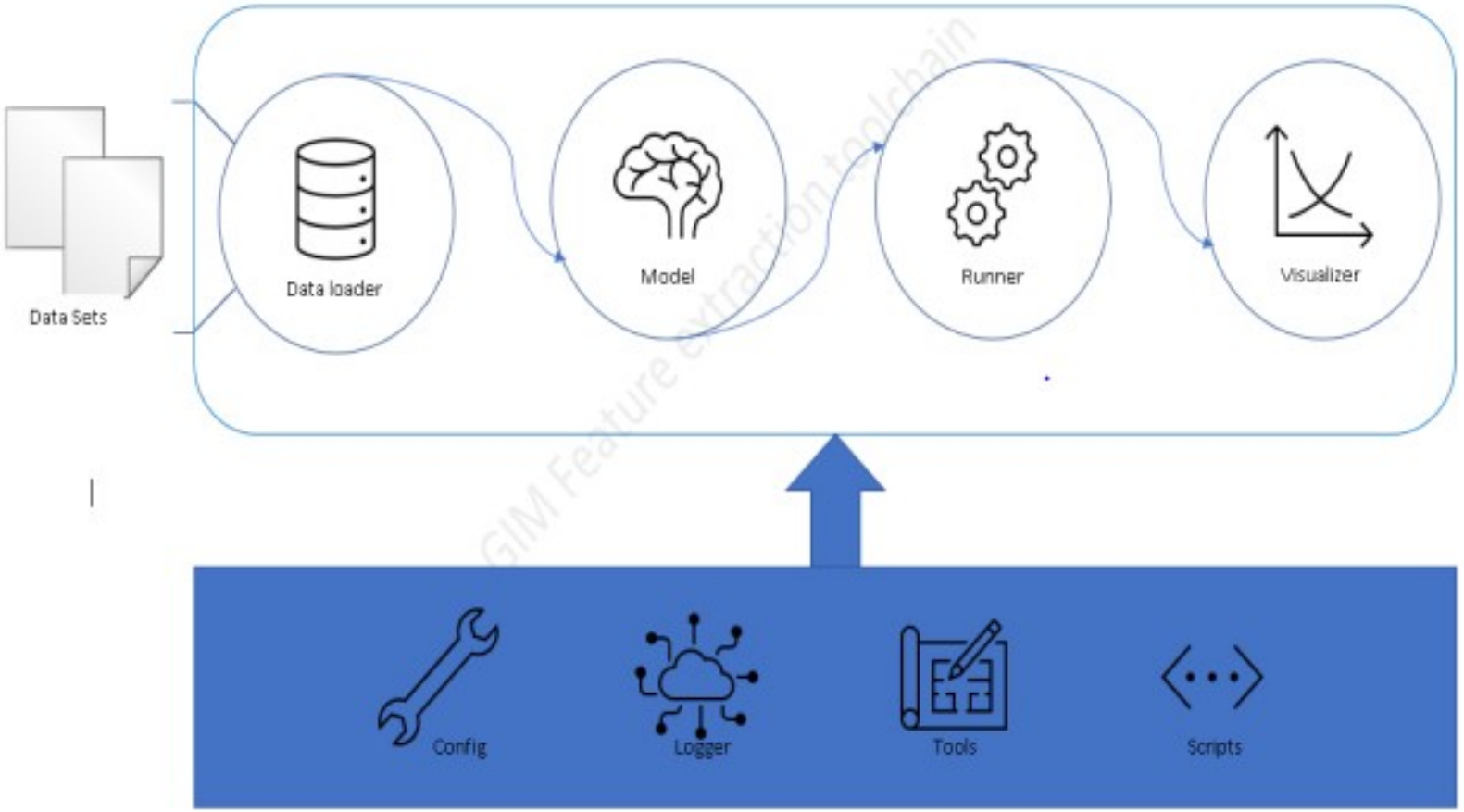
Source: https://cs.nyu.edu/~fergus/tutorials/deep_learning_cvpr12/

Convolutional neural networks for semantic segmentation

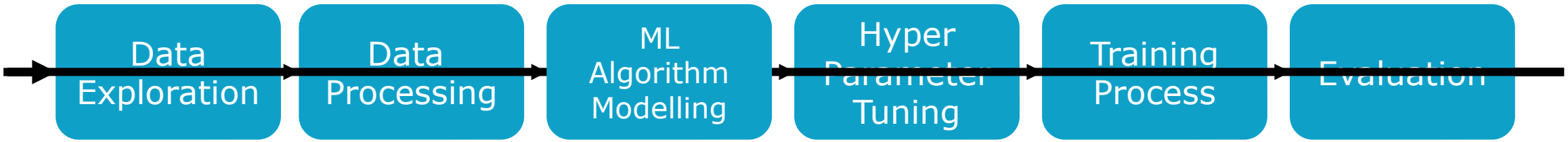


Tools
The Machine Learning ecosystem

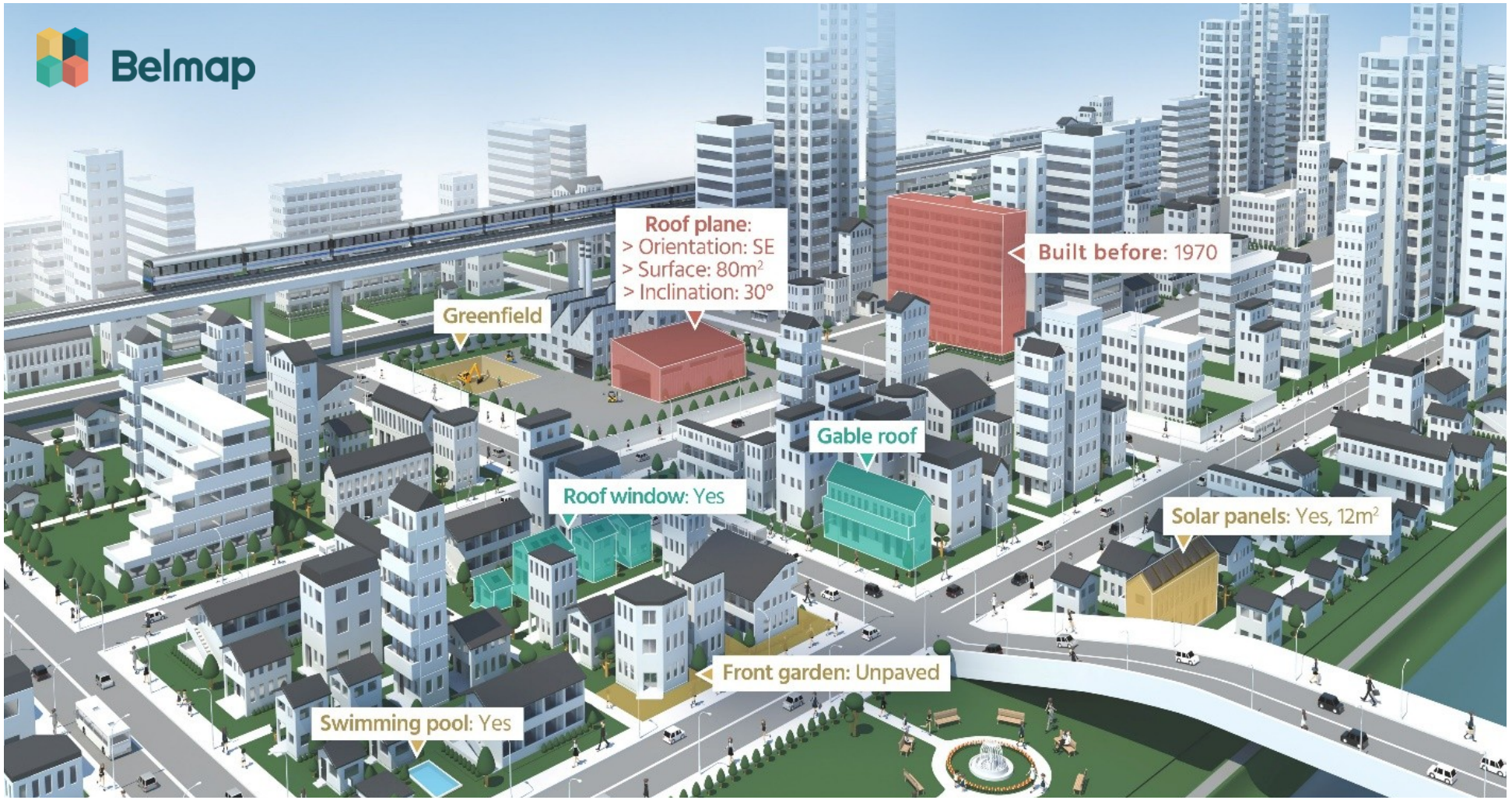
GIM Deep Learning pipeline



Development Process



Use Cases for Belmap
The GeoDigital Twin of the Benelux

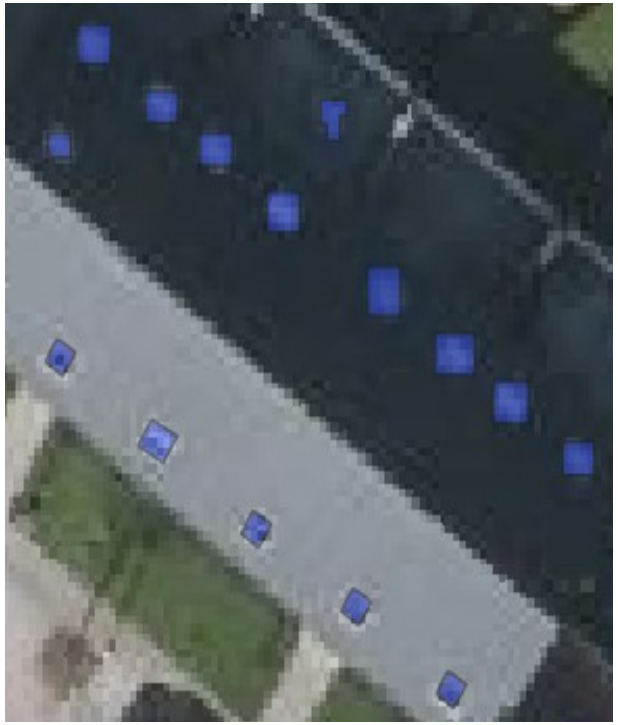


Gardens: Swimming pools

Swimming pools

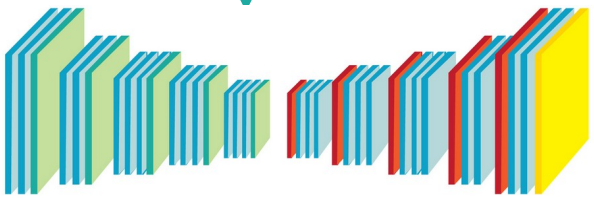
Belmap Roofs: solar panels & roof windows

Solar panels

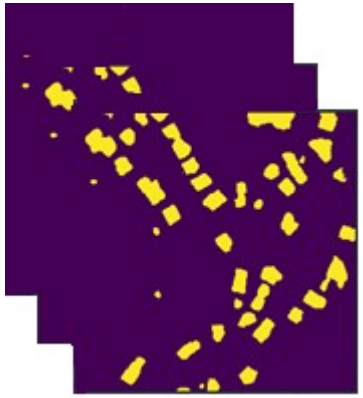


Roof windows

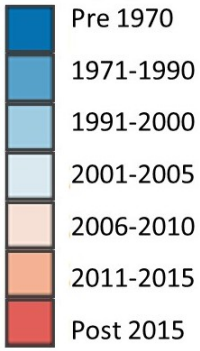
Determining the age of all Belgian buildings



U-Net

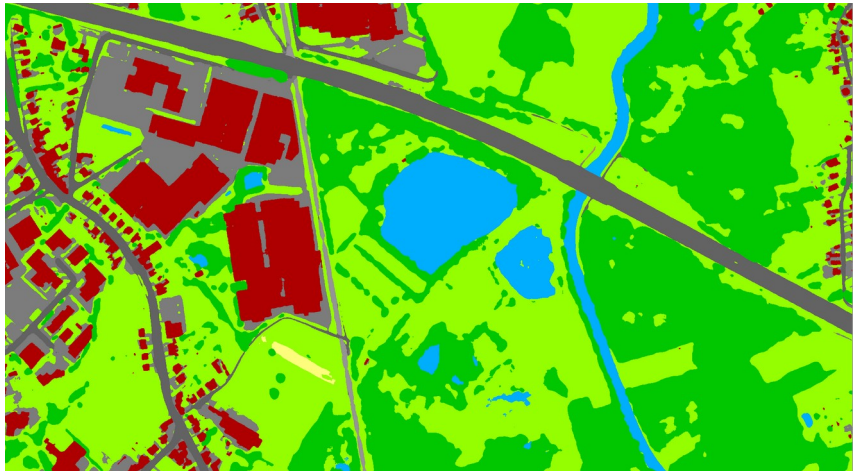


Time series



Gardens: Landcover

RGB Image



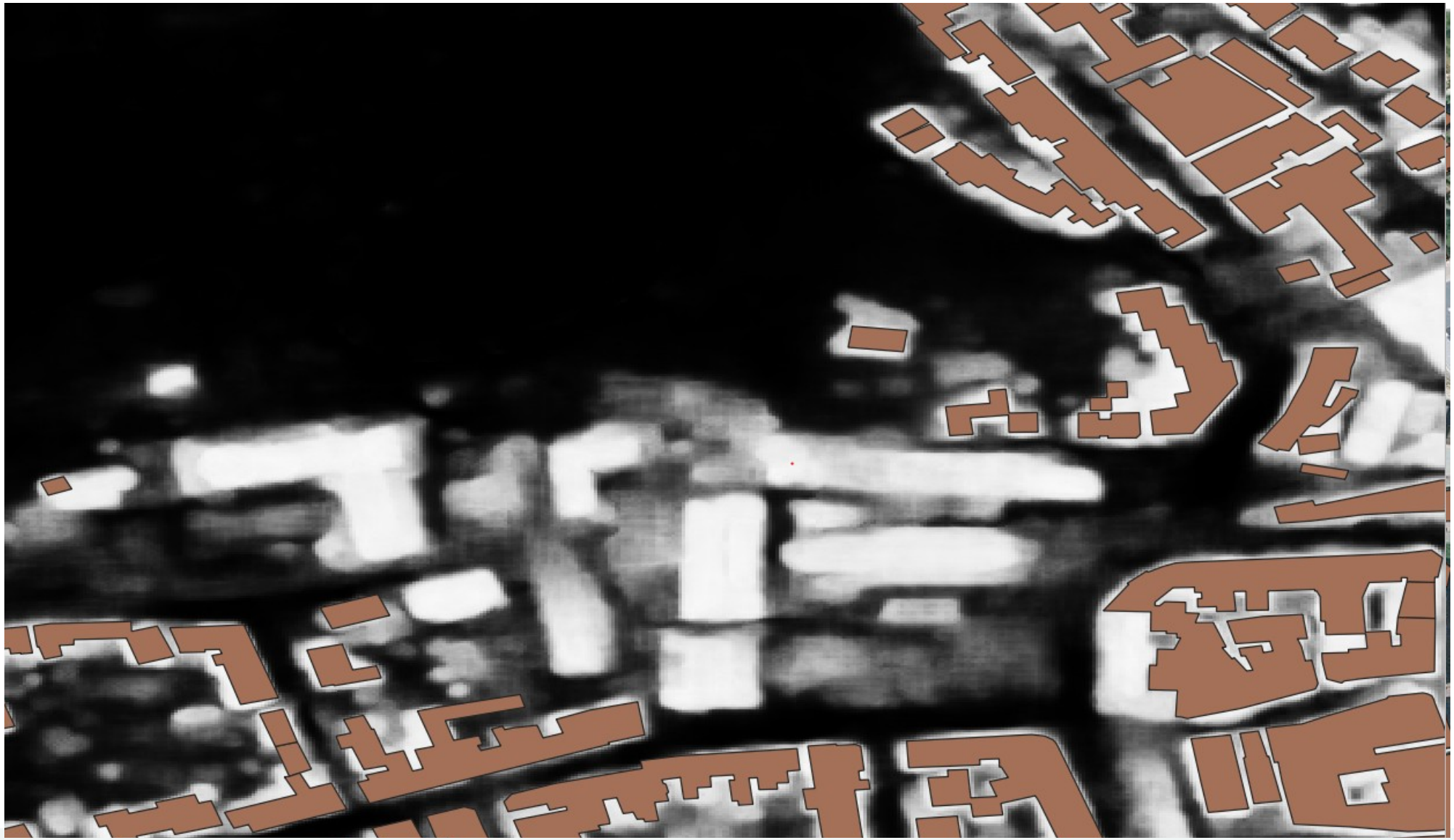
GIMs Land Cover Prediction

- Detection of **9 distinct land cover classes**
- Training on 2018 summer imagery 40cm with 1m landcover map
- Combination of supervised and unsupervised models to allow sharper delineation of road edges
- AI Deep learning model applied on 2020 winter imagery 25cm

Roadsides

Capturing **pervious roadsides** and **covered driveways**

Detecting building changes



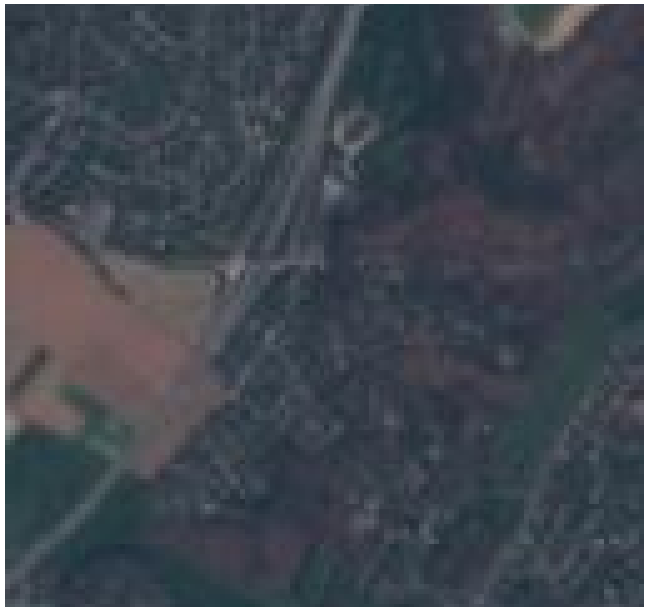
Mapping informal settlements

United Nations Development Program & Inter-American development bank

Super-resolution

Artificially enhance the resolution of imagery using a smart combination of generative adversarial networks and U-nets

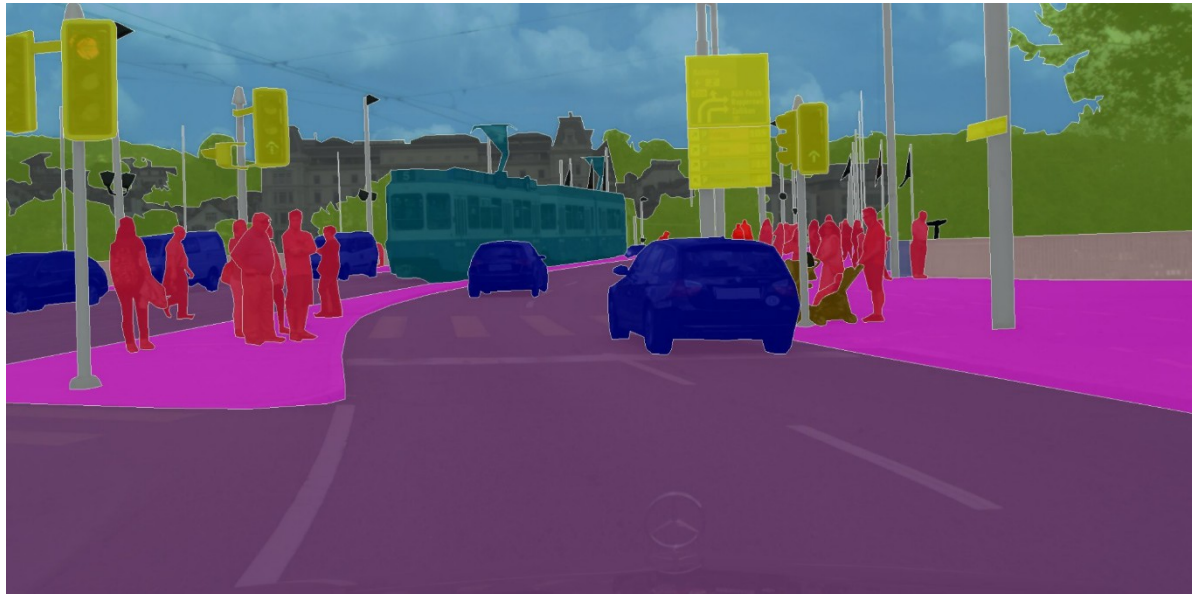
High Resolution Image



Low Resolution Image

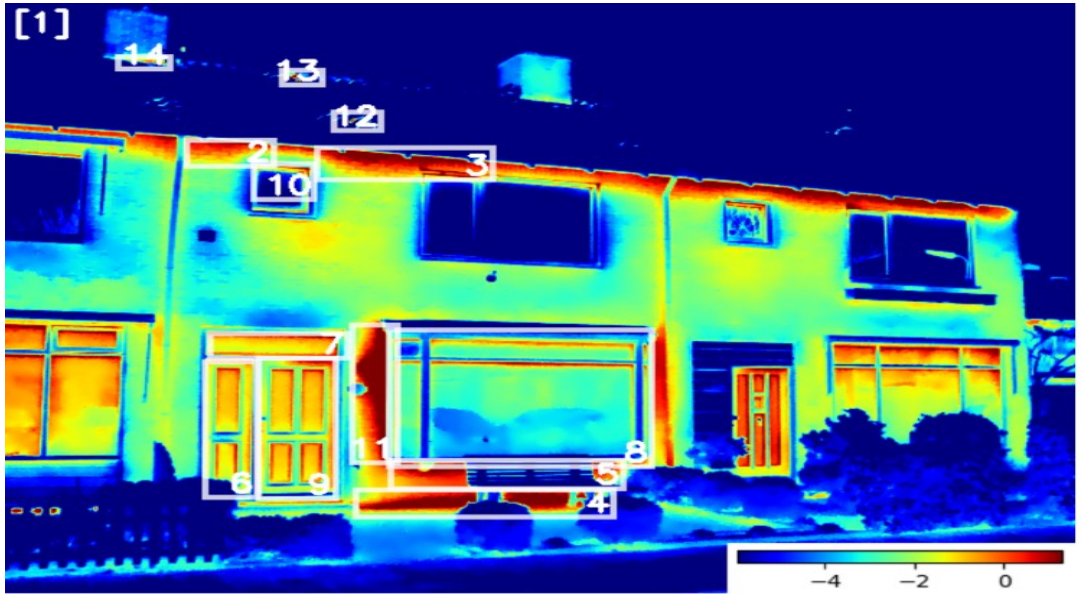
Super Resolved Image

Also applicable to mobile mapping and other imagery



Source: Image segmentation using U-net (Olaf Ronneberger et. al 2015

Optical

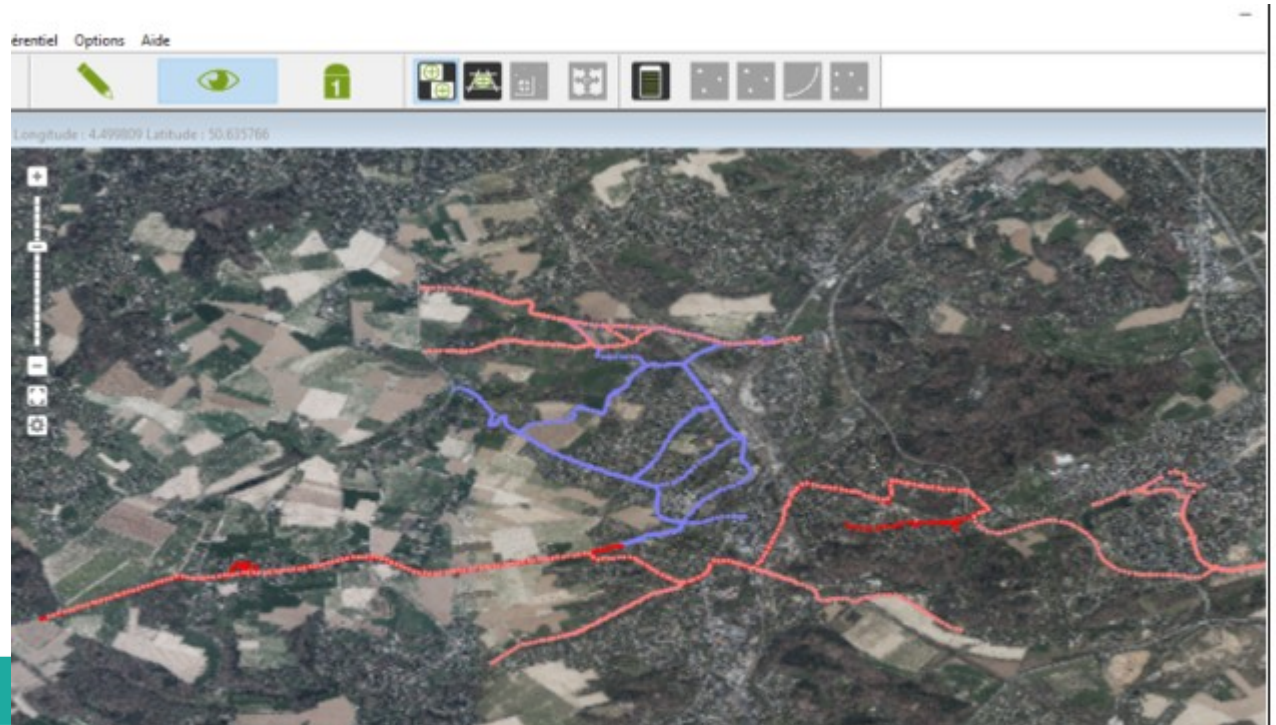


source:sobolt.ai

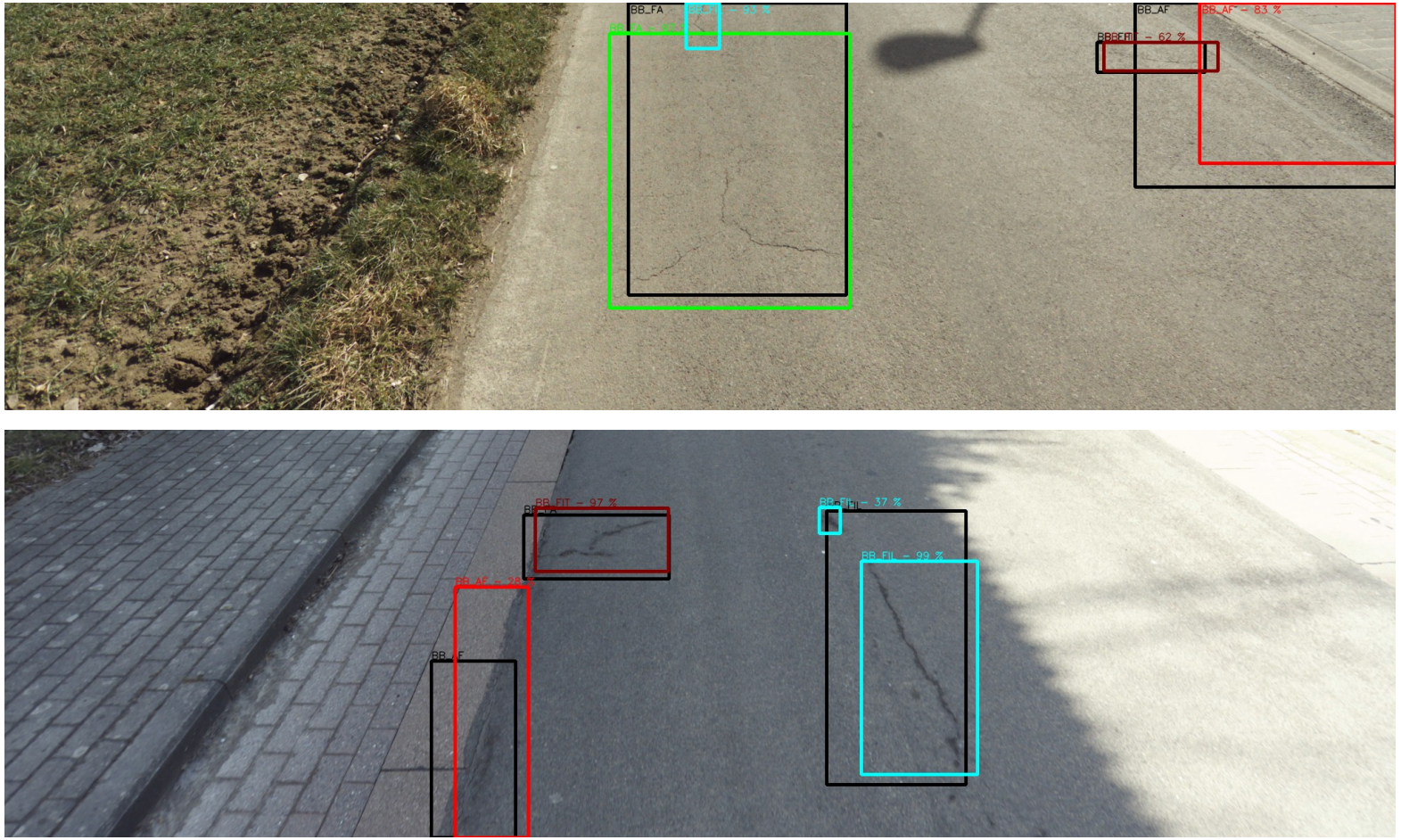
Hyperspectral - thermal

Road defect detection

- **Municipalities & regional government** need to optimize their road work spending's :
  - **Save money** by picking the right road repairs at the right time
- Methodology of Belgian Road Research Centre – classification of defects



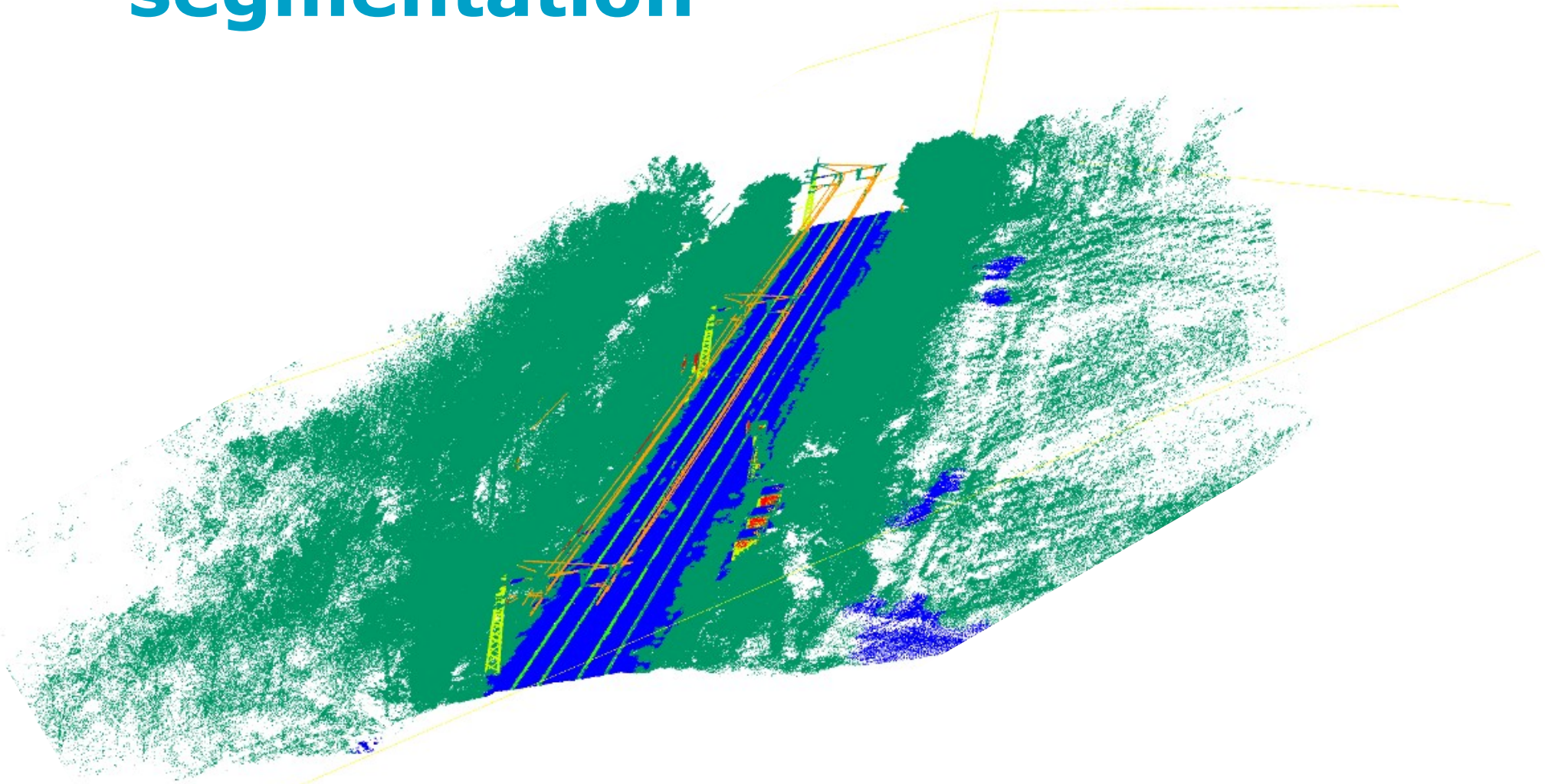
Results



— Ground-Truth
Detected Defect of a Specific Class

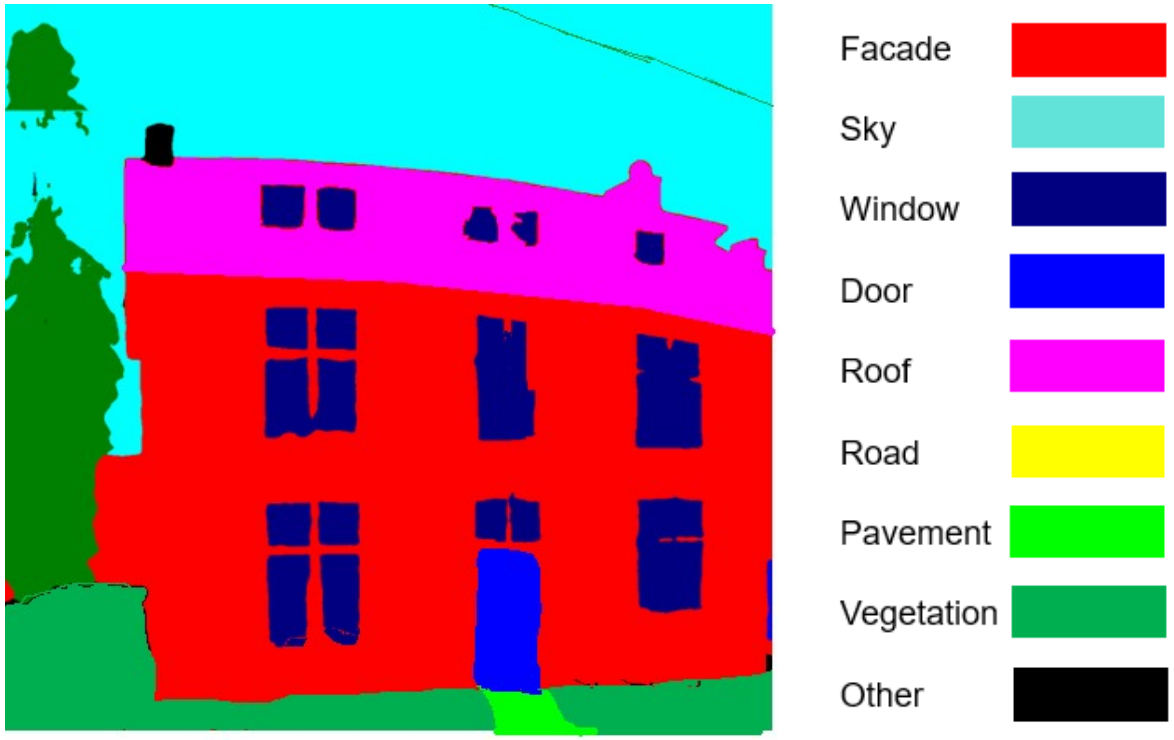
Utility Poles detection

Mobile mapping LIDAR point cloud segmentation

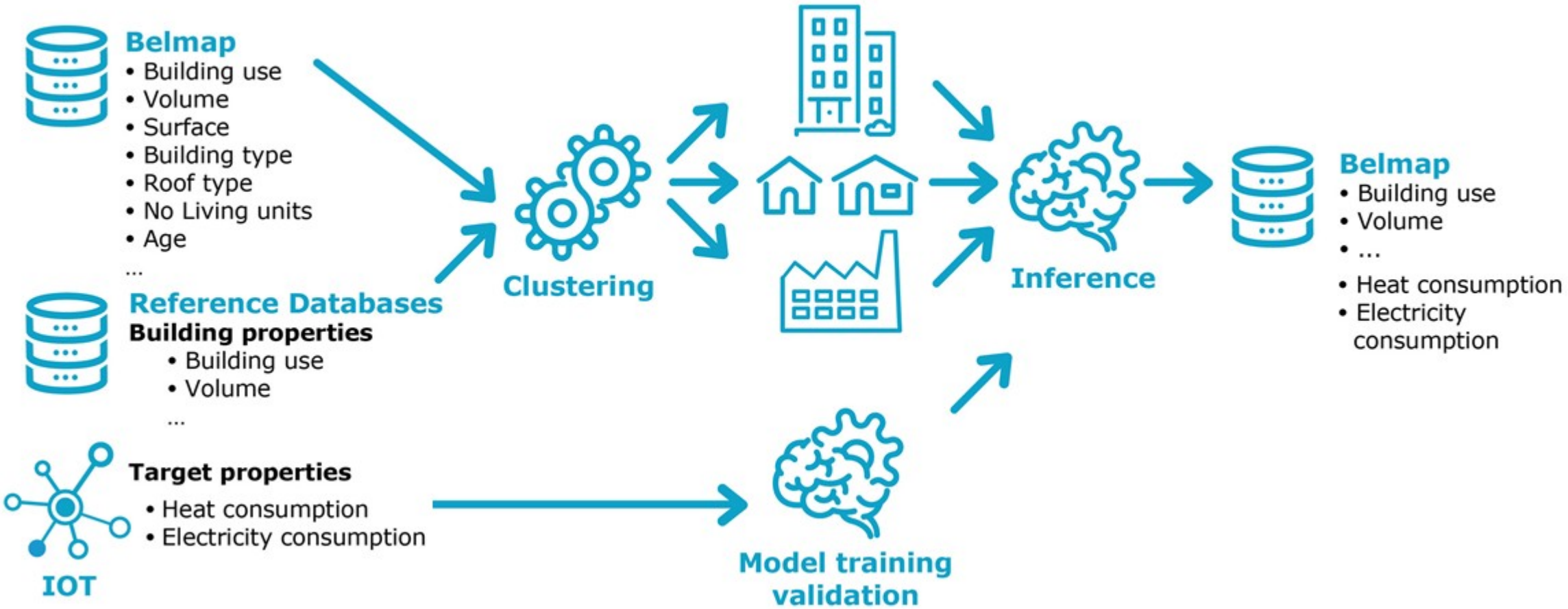


Mobile mapping façade schematisation

Apply supervised DCNNs on façade imagery to determine the number of floors, windows, doors, sills, panels, road cover, …



Estimating building properties using unsupervised and supervised machine learning



More use case: Utilities

DIGITISATION OF OLD MAPS

Classification complexity
Semantic segmentation

DATA QUALITY CONTROL AND CLEANING

Anomaly detection/flagging

PREDICTIVE MAINTENANCE

Predicting chance of failure based on past failures and spatial context: underground, type and age of equipment, …

AUTOMATING REPETITIVE TASKS

Accept/Reject data modifications
Validate excavation/construction permits

ASSET INVENTORY

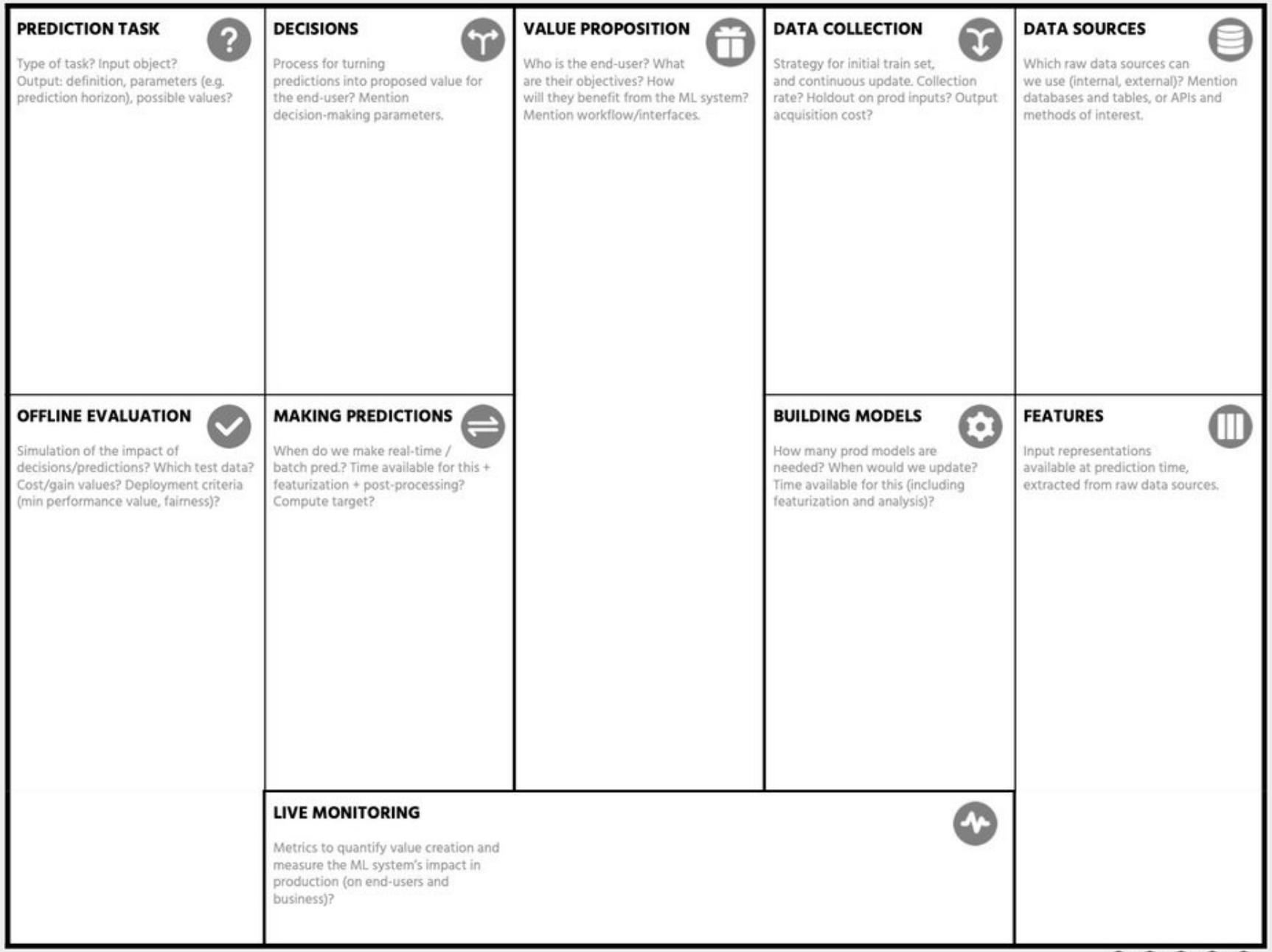
Classification of equipment types on photographs

More Use Cases – Local Government

PARKING MANAGEMENT	Parking occupancy prediction based on historic parking occupancy/event data
	Computer vision on scanning cars or fixed cameras
WASTE MANAGEMENT	Computer vision on photographs that report dumping sites
PUBLIC DOMAIN INFRASTRUCTURE	Computer vision on photographs that report infrastructure issues or report on reparation works
RECREATION	Determination of ideal walking, cycling routes and safe routes based on crowd sourced data
TRAFFIC MANAGEMENT	Predicting and optimizing traffic flows

THE MACHINE LEARNING CANVAS (V1.0)

Designed for: | Designed by: | Date: | Iteration:



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Questions?

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