GeoAI for National Mapping & Cadastre

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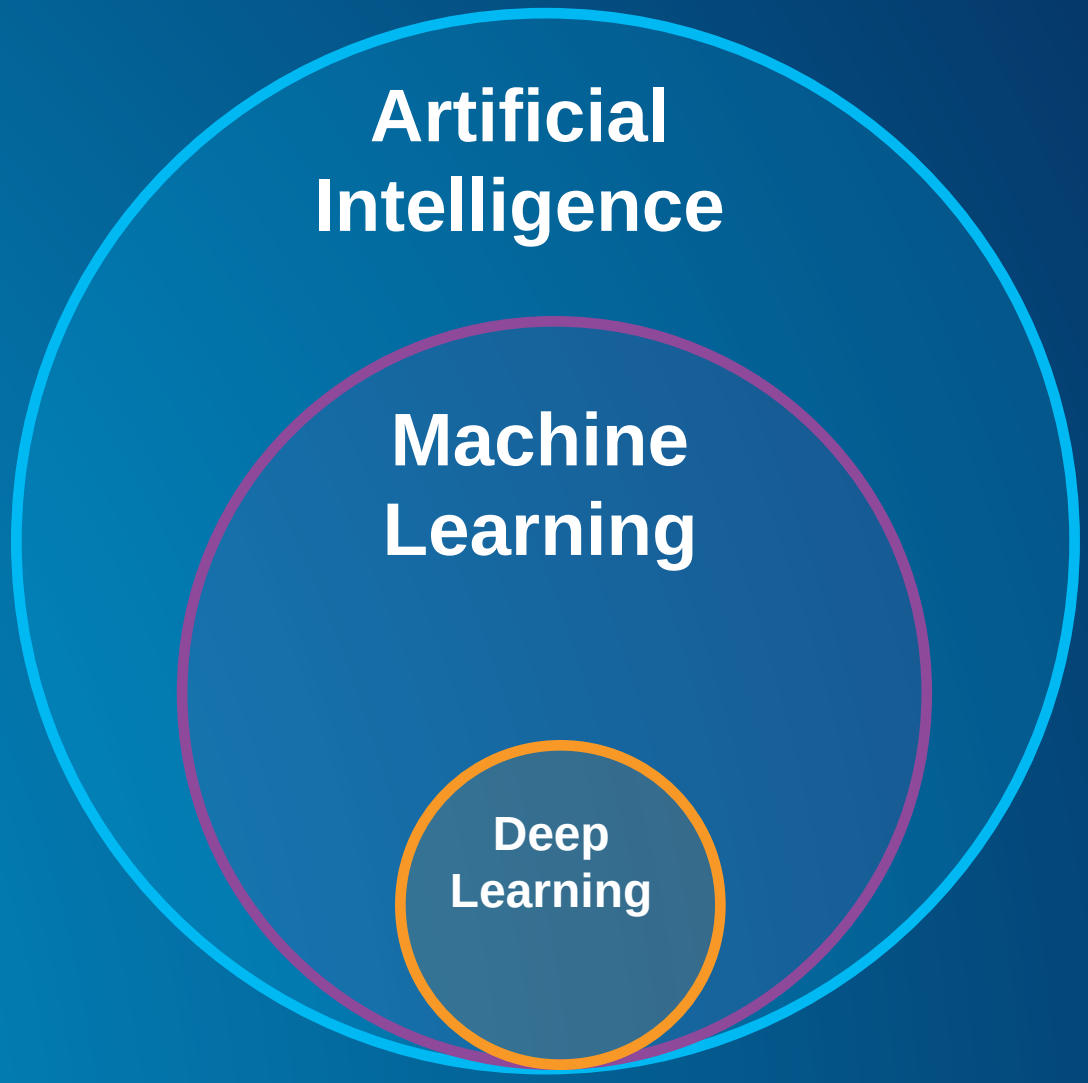
Esri Inc

EuroGeographics/EuroSDR AI Workshop

27 – 28 October 2022

Why are we talking about AI?

- Advances in AI
- Compute power (cloud)
- Availability of (big labelled) data
- Accessible
- Relevant
- Automation of workflows



Map Production Automation

From Real World to Digital World

Collect

Manage

Produce

Share

Automated Workflows

1:10K Maps

1:25K Maps

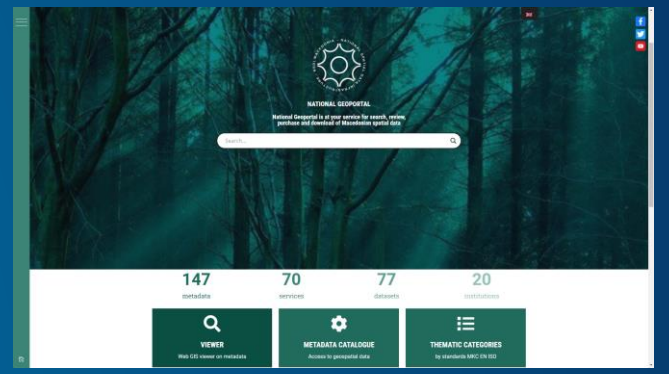
1:50K Maps

1:100K Maps

Mobile

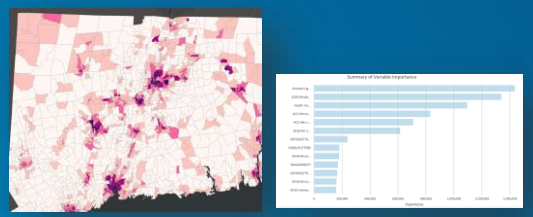
Web Services

Best Scale Authoritative DB

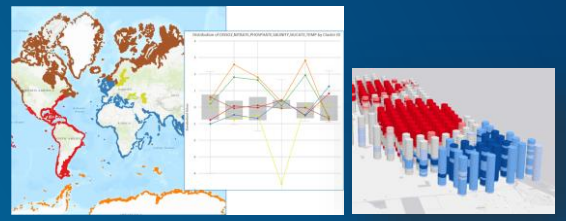


What Can Machine Learning Do?

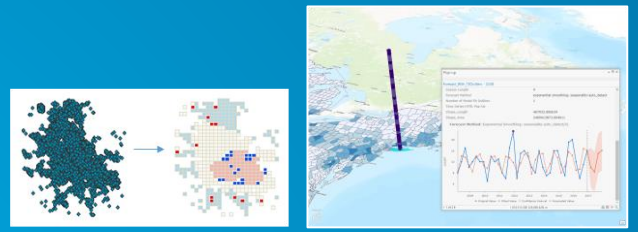
Extract features from Imagery & LiDAR



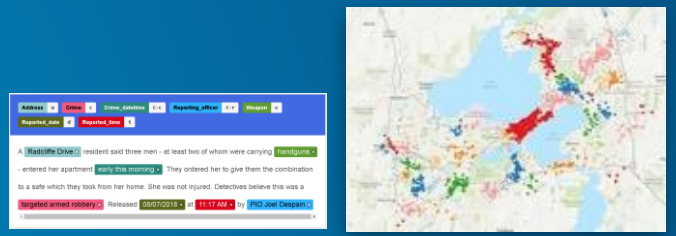
Make predictions



Find patterns & clusters



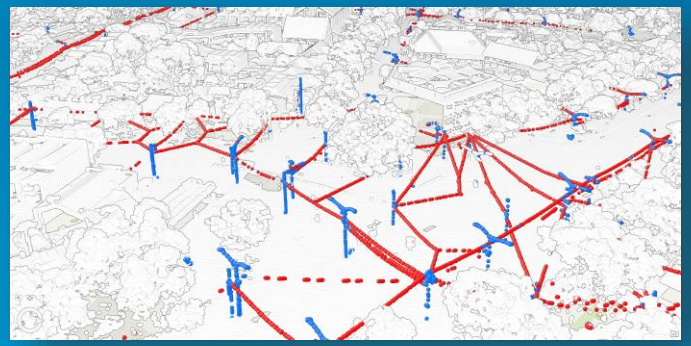
Detect anomalies



Extract insights from unstructured text

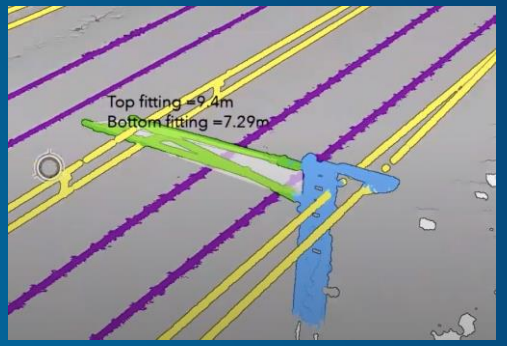
Feature Extraction from LiDAR

Utility poles and lines

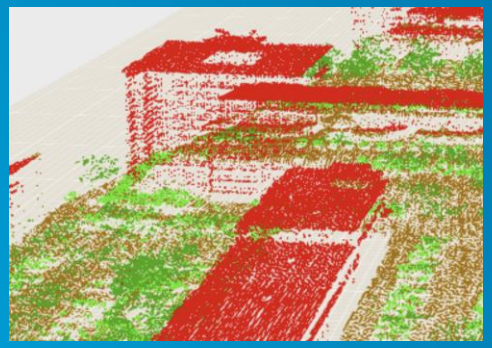


Streetlights

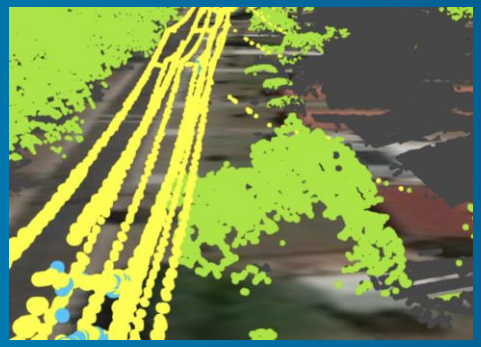
Rail assets



Buildings



Encroachments and trees



Object Detection, Pixel Classification, Object Classification from Imagery

Building footprints

Roads

Land cover

Parcel boundaries

Palm trees

Oil pads

Swimming pools

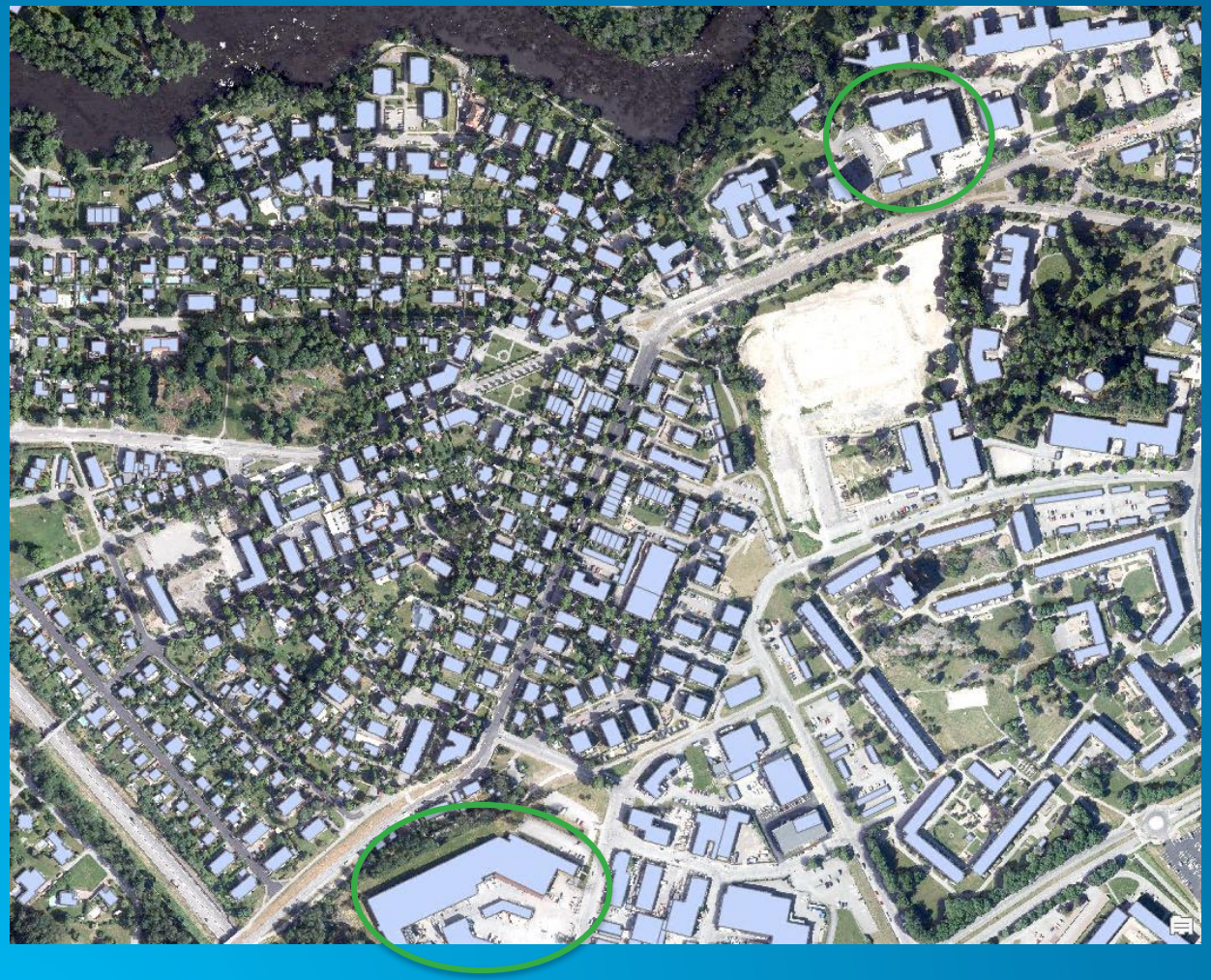
Damaged structures

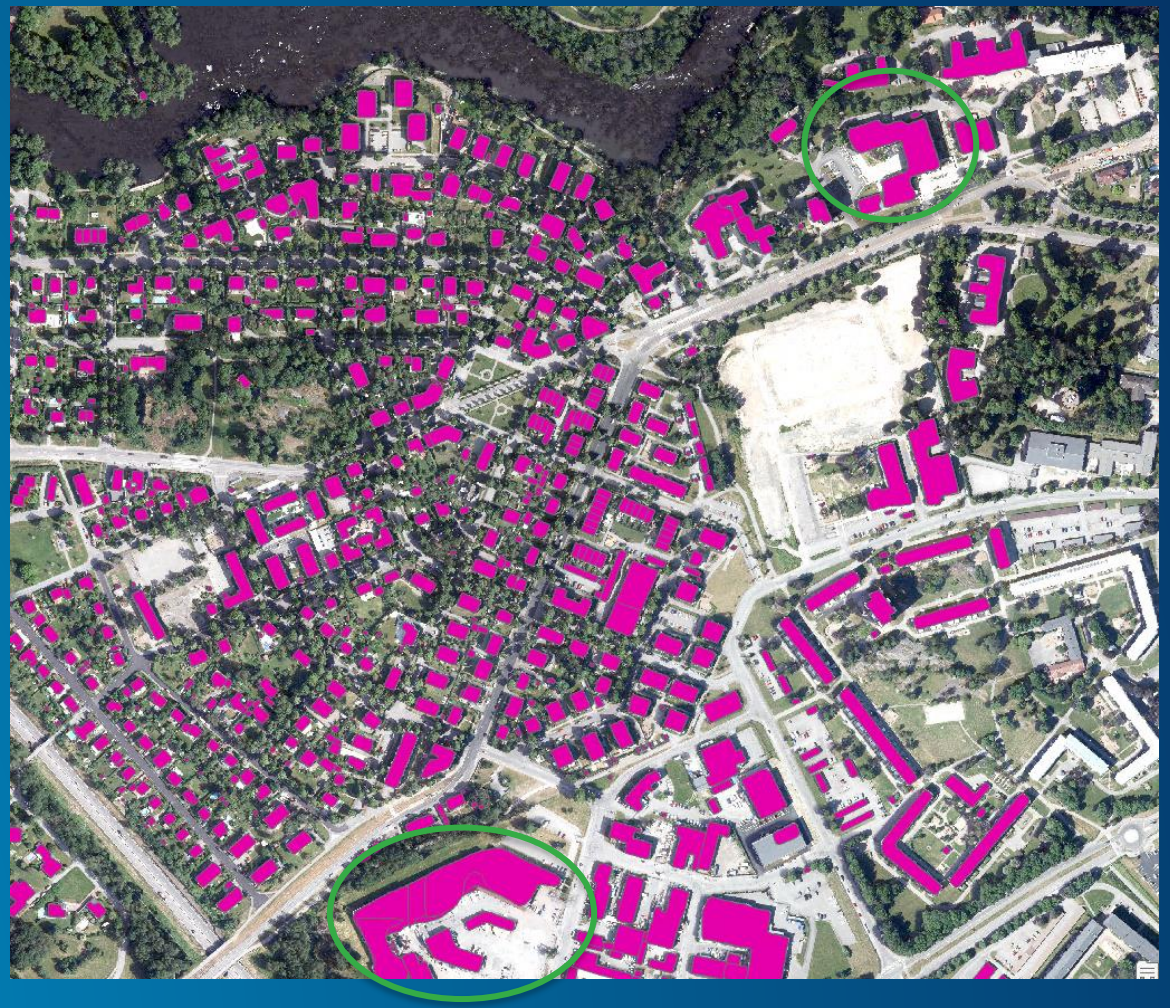
DL will detect what you can see in the imagery ……

Applying DL

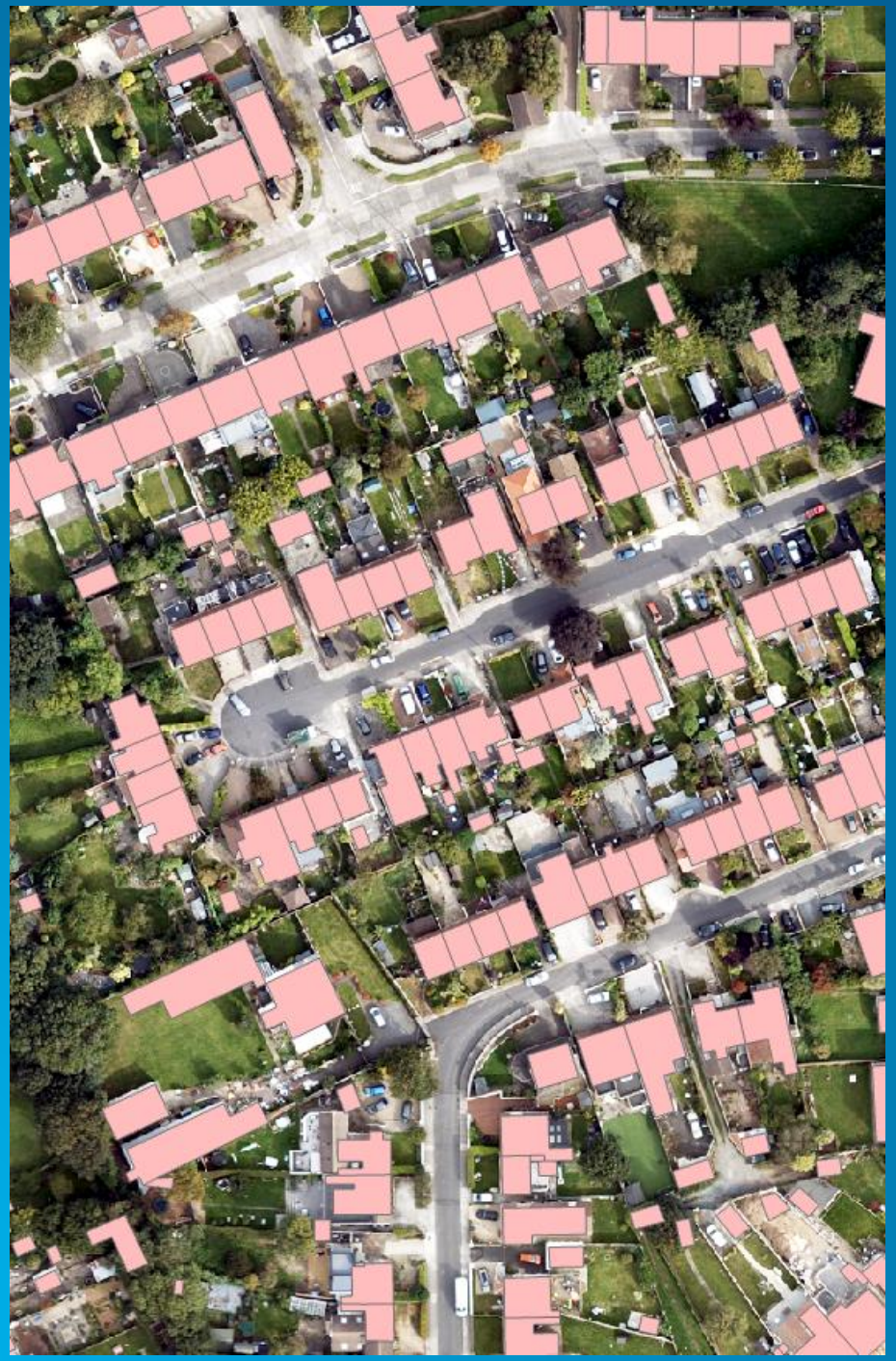
Topographic Mapping

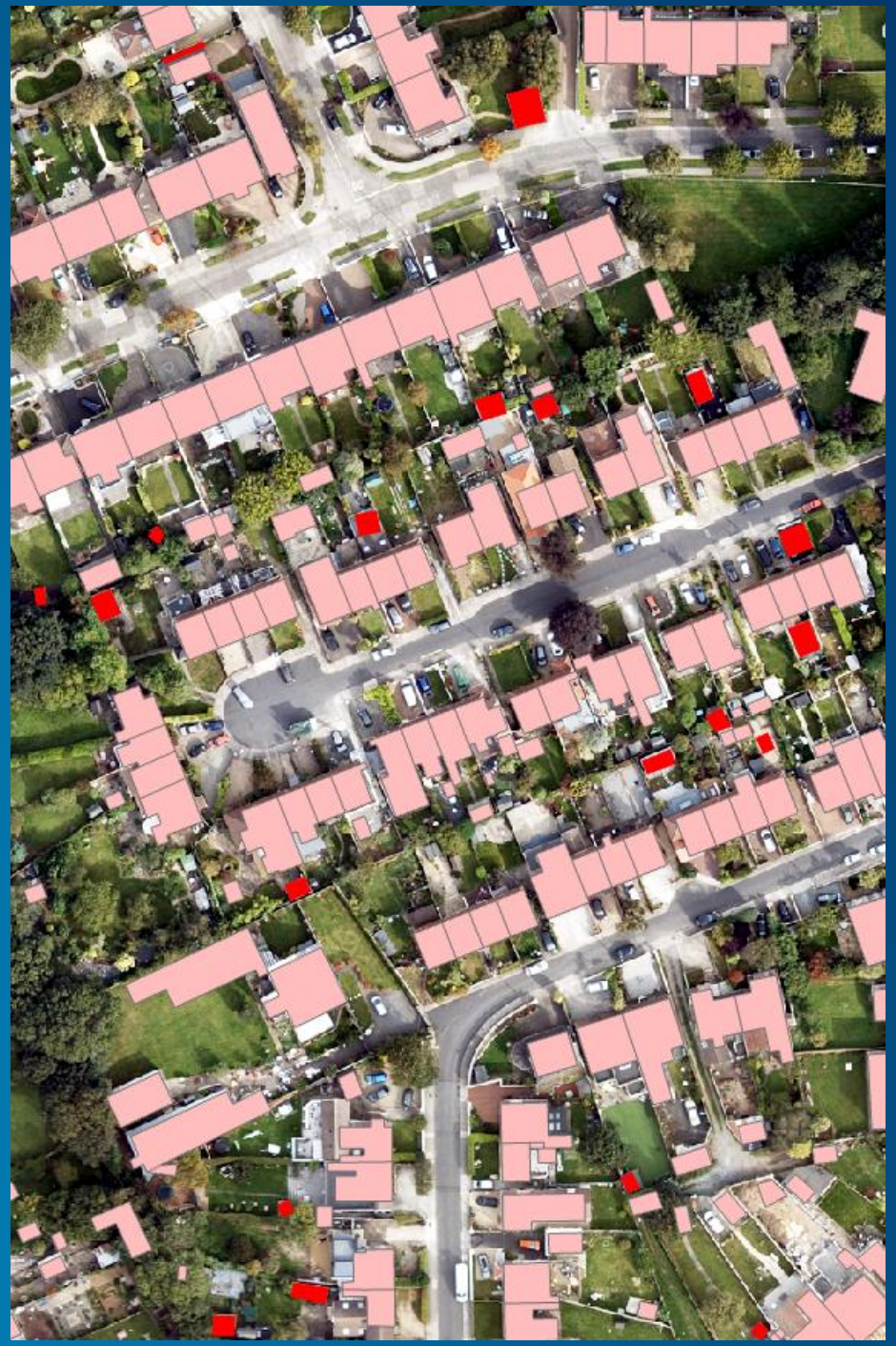
Lantmateriet, Sweden





OS Ireland





Czech Mapping Agency

Imagery with
Existing Building Footprints

DL Detected Buildings*

Green = Existing
*Red & Orange = New

Applying DL

Cadastre

Cadastre Use Case

DLS Cyprus

- Unregistered buildings
- 90%+ Buildings Detected
- Less than 5% false positives

- Land Parcels?

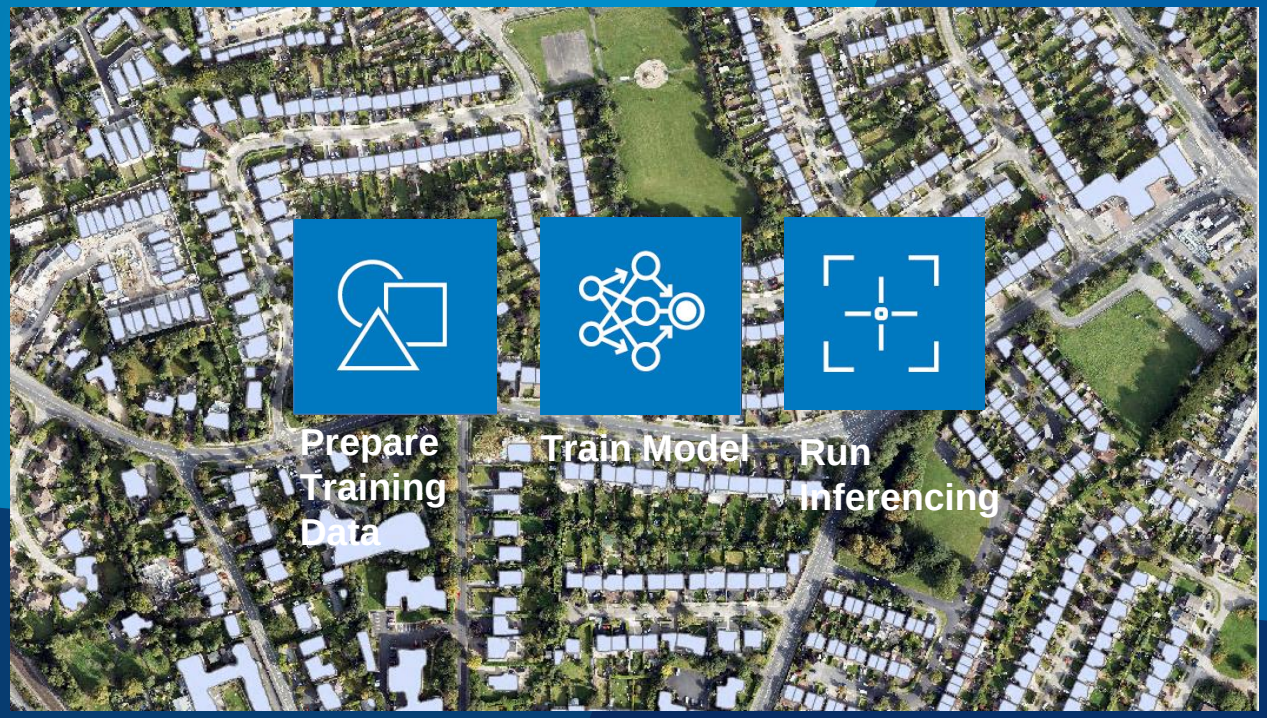
Cadastre - Taxation

- Trial in 8 Regions
- 20,000 ‘Hidden’ Pools
- 10m Euros ‘Missing’ Revenue

Undeclared pools in France uncovered by AI technology

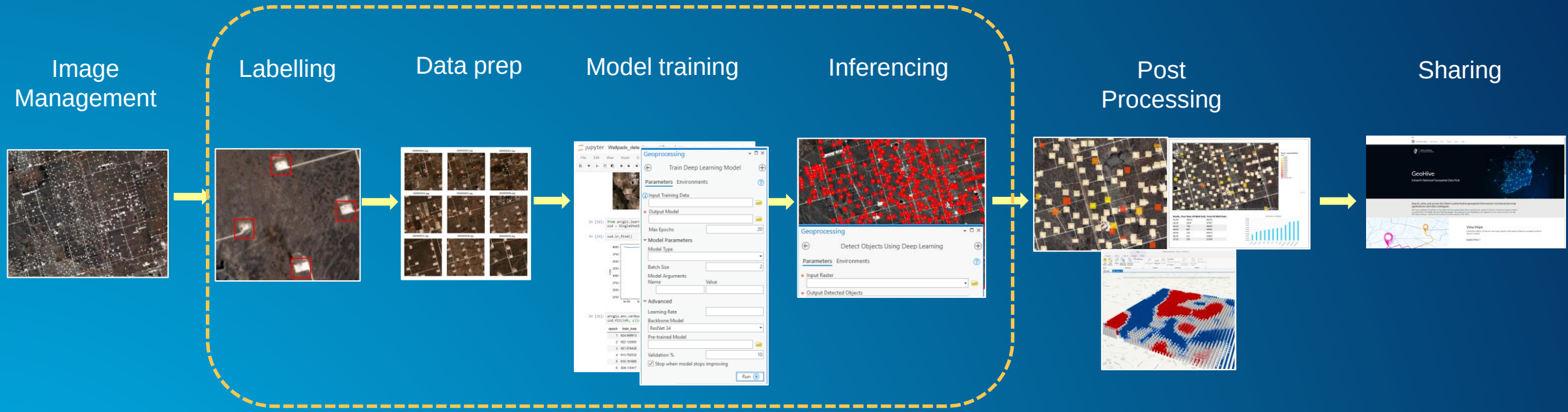
29 August

The discovery of thousands of undeclared private swimming pools in France has provided an unexpected windfall for French tax authorities.



DL Workflow

Deep Learning Workflow



For Wide Range of Data Types

- Aerial
- Satellite
- Radar
- Lidar
- Motion imagery
- Bathymetry
- Point cloud
- Drone

Implementing Many Tasks

- Object classification
- Object detection
- Pixel classification
- Image translation
- Object tracking
- Scanned maps

Integration with DL Libraries

Deep Learning Workflow

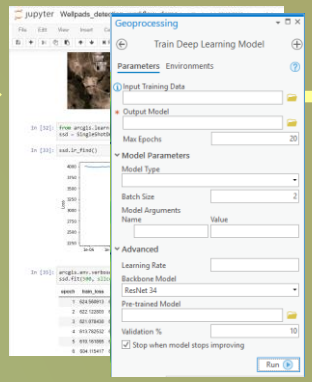
Pre-trained Models

Image Management

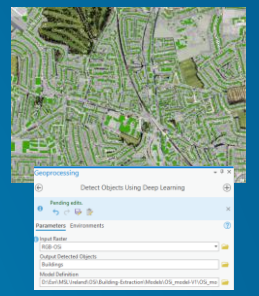
Labelling

Data Prep

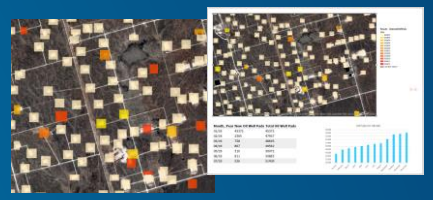
Model Training



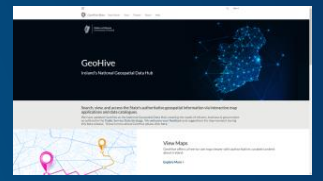
Inferencing



Post Processing



Sharing

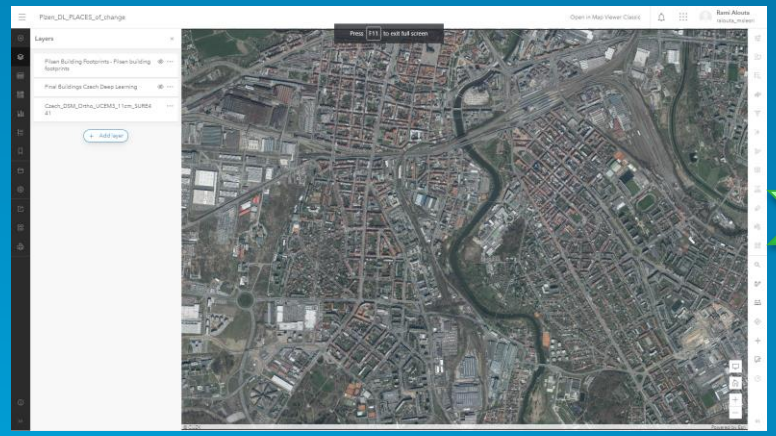


Eliminates:

- Imagery requirements for model training
- Labelling requirements
- Training AI models
- Massive compute requirements

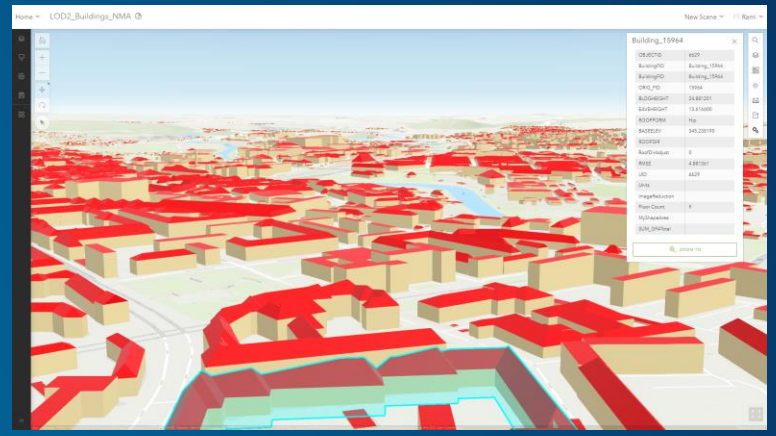
Workflow Automation

Czech NMA



DSM
True Orthos
3D Mesh

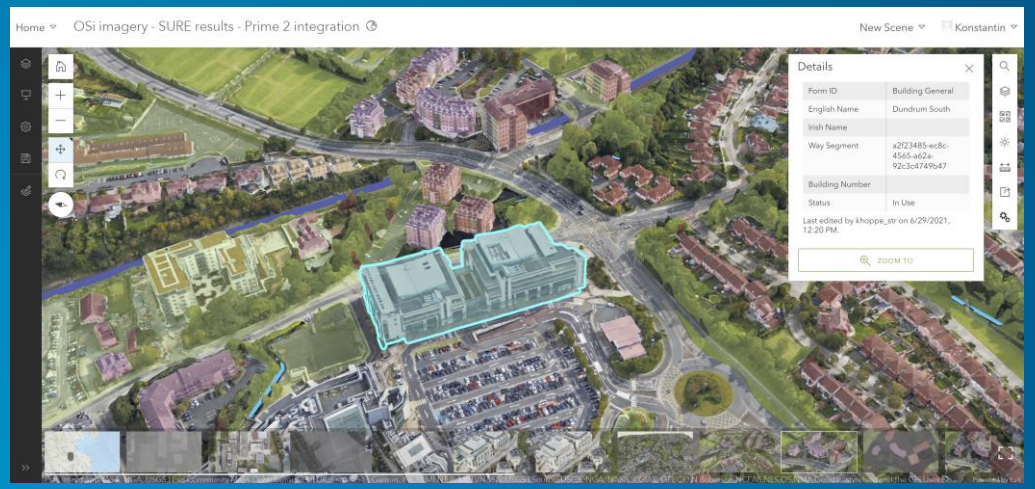
Extracted Buildings using DL



LOD2 Buildings

The National Map of the Future?

More current (up-to-date) 2D Base Map



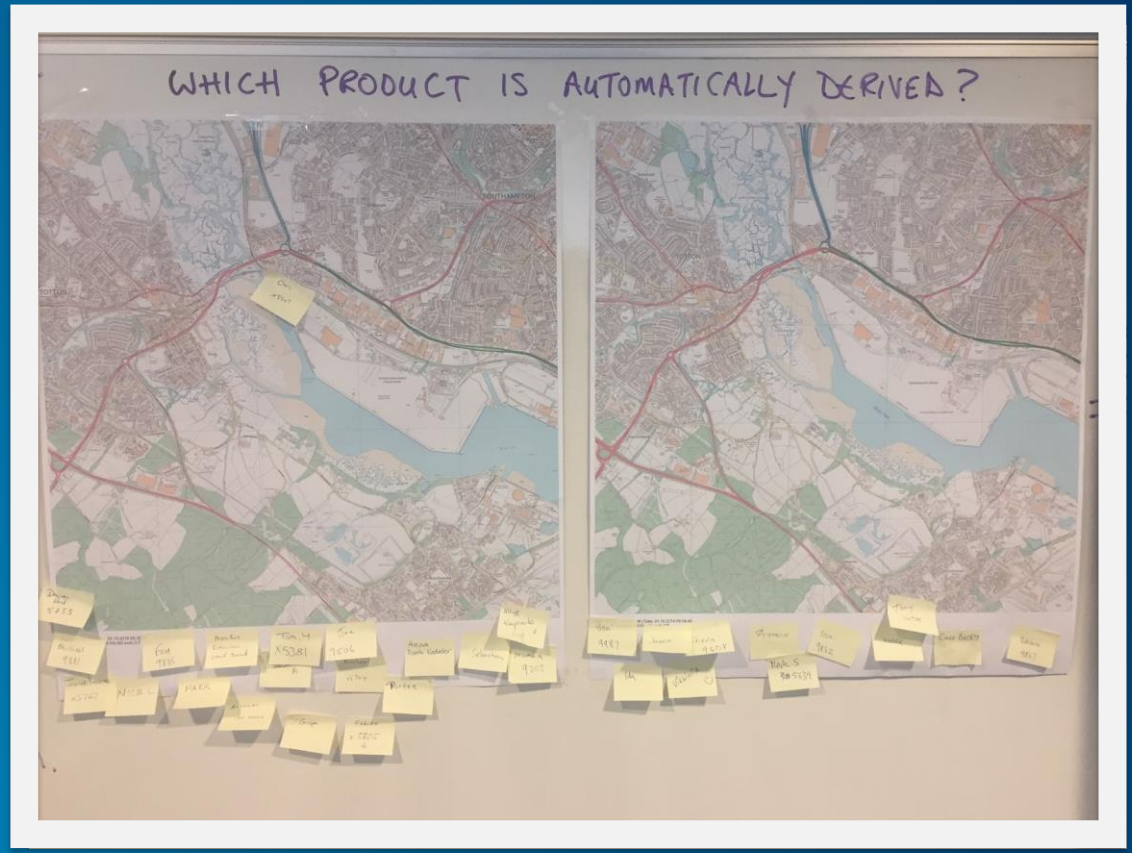
Integrated 2D Vector / 3D Mesh

Integrated Ortho & LOD2 Buildings

Lessons we can learn?

Automatic Generalisation

- Customer need?
  - Currency of product
  - Geometric accuracy
- Flexibility with product specification?
- Cost, Time, Quality?
- What's "Good enough"?



In Summary

It's not 'perfect' but ….

- DL is delivering benefits now
  - Change detection & feature extraction
- Iterative, incremental, approach for each Use Case
  - What's "good enough"?
- Training data is key
- DL is one tool in the GIS tool box

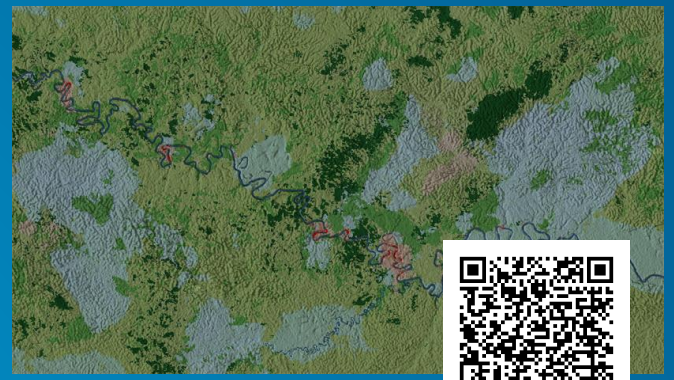
Collect → Manage → Produce → Share

Deep Learning Resources

Deep Learning with ArcGIS Pro Tips & Tricks: Part 1

Scan Me

Deep Learning with ArcGIS Pro Tips & Tricks: Part 2



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Deep Learning with ArcGIS Pro Part 3: QA/QC Extracted Features

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Fine Tuning a Pretrained Deep Learning Model

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Introducing pre-trained geospatial deep learning models

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Pre-trained deep learning models update (February 2021)

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