URBAN EAGLE

computer vision

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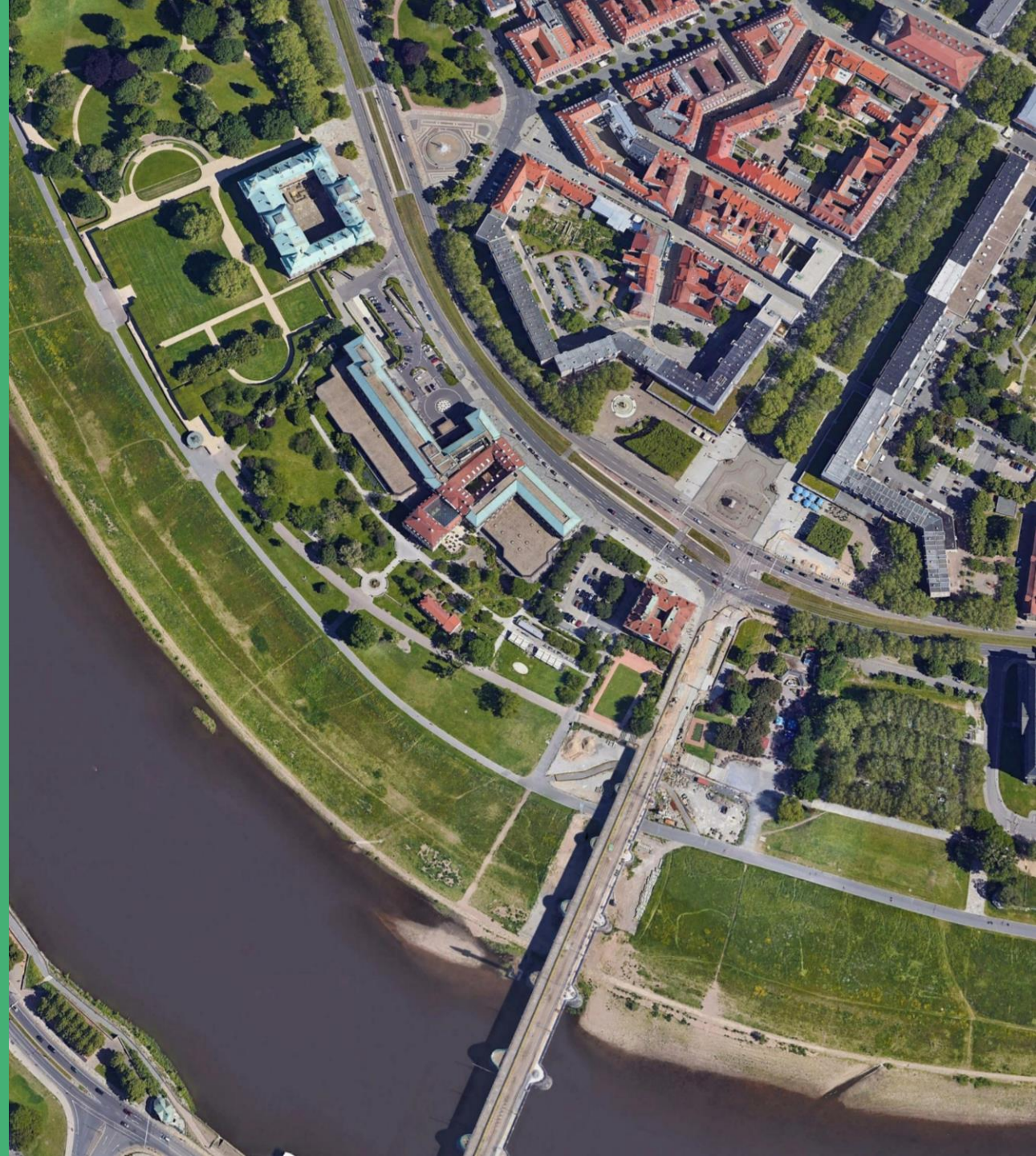
How can ai empower

the advocates of

urban sustainability?



ALL YOU NEED

… is objective, accessible, scalable and relevant information

Relevant & coherent metrics

- Object **counting, identification, tracking**
- **Surface** specification
- Analyse object **state**

Accessible & scalable

- **Free** online access
- Easy to **find**
- **Data** source for many regions & times

Comparable & objective

- **Independent** ownership
- **Transparent** functionality
- **Recreatable** evaluations

Reports & UX

- Individual **reports**
- Informative **exports**
- **Easy-to-use** application

HAVE IMPACT

DATA

- **Aerial** images from GoogleEarth
- 2.400 x 4.800 pixel
- **~ 30 cm per pixel**
- Coverage of ~ 750 x 1.250 m
- **Historic** images

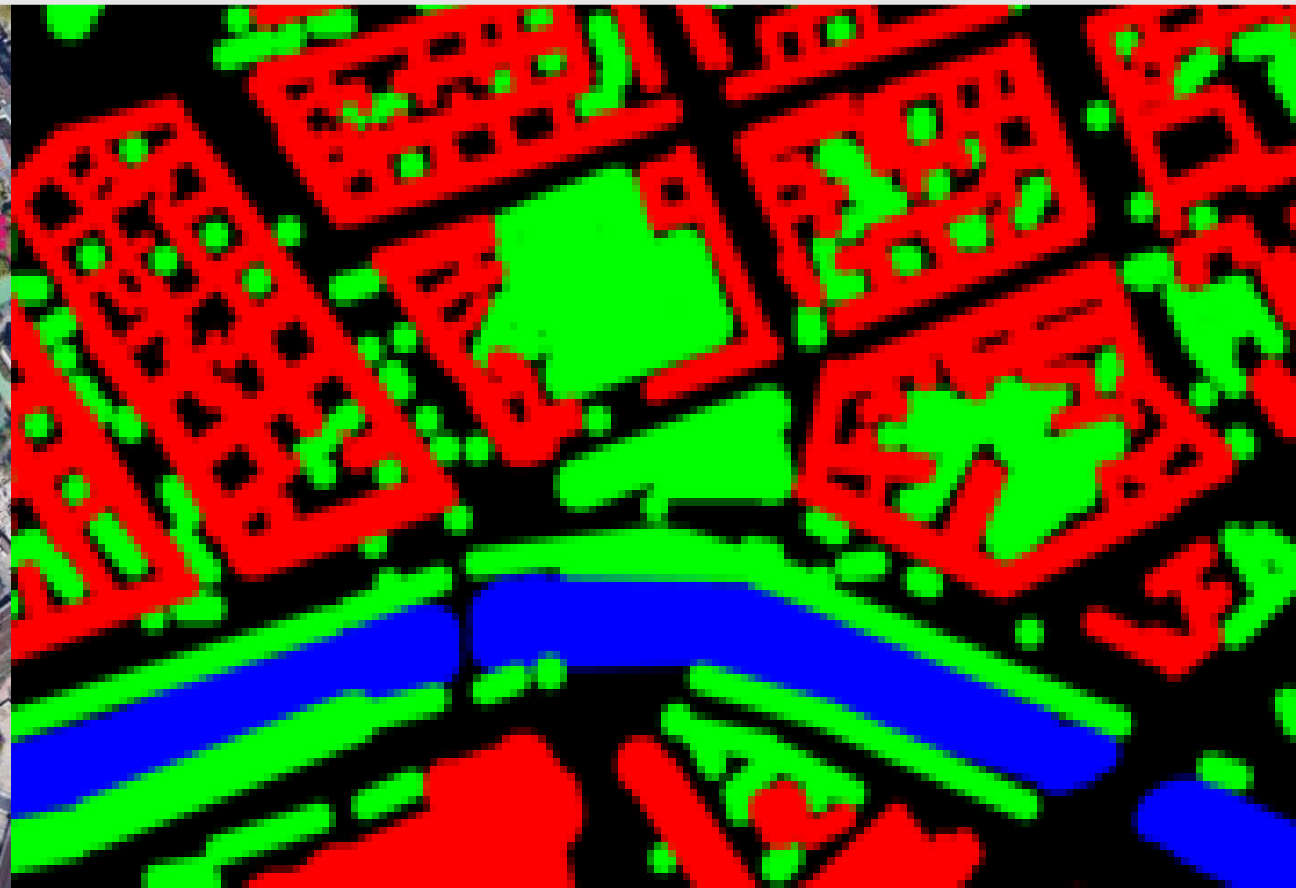
LIMITATIONS

- Only **small area** covered per image
- **Resolution** of satellite images low or prices too high
- Sometimes **skewed**
- No connection to **geo-coordinates**
- Reliant on **weather** and coverage

OBJECT DETECTION

I. Identification of tiles with **tree**
II. Fine positioning

SEMANTIC SEGMENTATION



OBJECT DETECTION

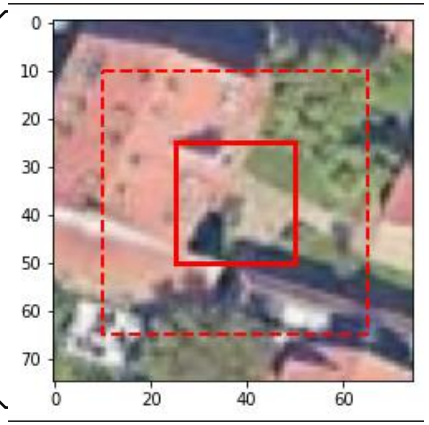
I. Identification of tiles with **tree**

II. Fine positioning

Adoption of YOLO logic

1 Splitting of original image into tree-sized tiles

2 Expansion for more context



Tile expansion in pixel

OBJECT DETECTION

I. Identification of tiles with tree

II. Fine positioning within tile using regression

Results

- Reliant on **threshold**
- Some objects often **misclassify**
- Restrictive **grid** definition
  - 1 tile allows only 1 tree
  - 1 tree can occupy 2 tiles

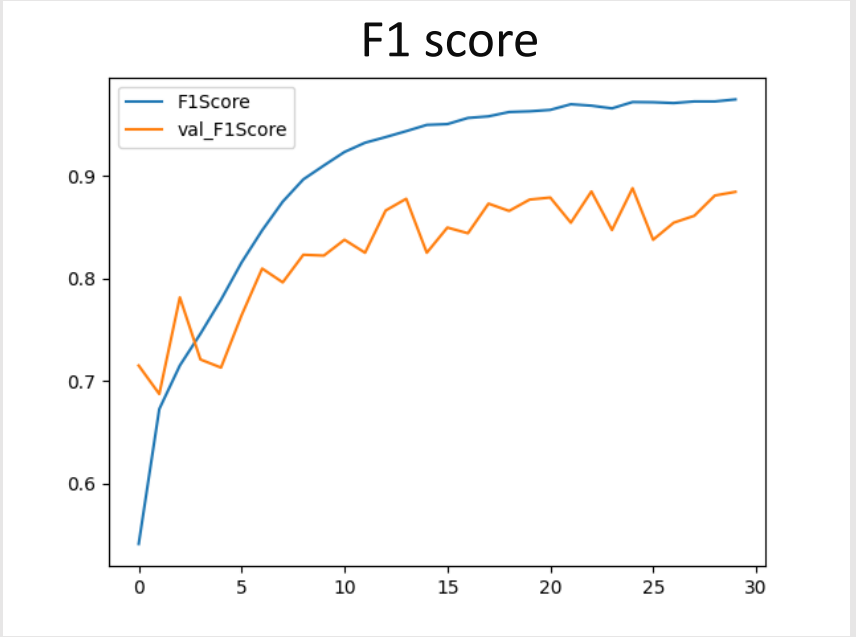
Potential alternative approach could be pixel segmentation.

Annotation

- 7.7 tsd trees annotated leading to 6.3 „true tiles“
- augmented & balanced

Model: CNN

- Self-trained, 11 layers
- Callback: f1 score
- Loss: binary cross-entropy
- Activation: sigmoid



Result of tile identification

OBJECT DETECTION

I. Identification of tiles with **tree**
II. Fine positioning within tile using regression

Results

- Low performance due to **small dataset**
- as-is no impact on main feature: identification

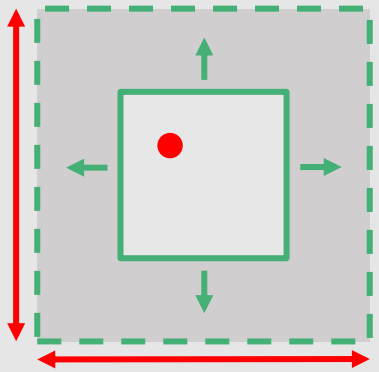
Annotation

- ~ 1 tsd annotated tiles
- Pixel position within a tile
- 2 continuous labels

Model: CNN

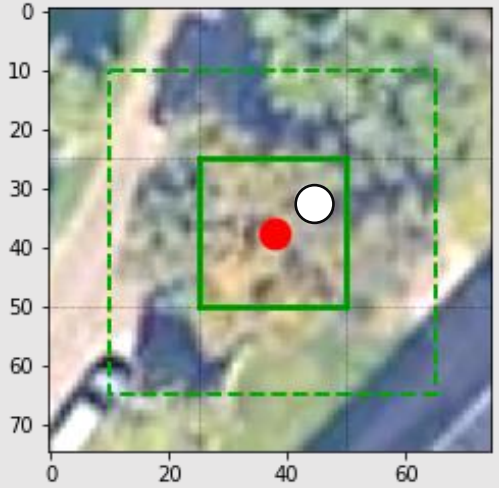
- AutoKeras Image Regression
- ResNet50 (ImageNet)
- Loss: mse
- 30 trials x 10 epochs

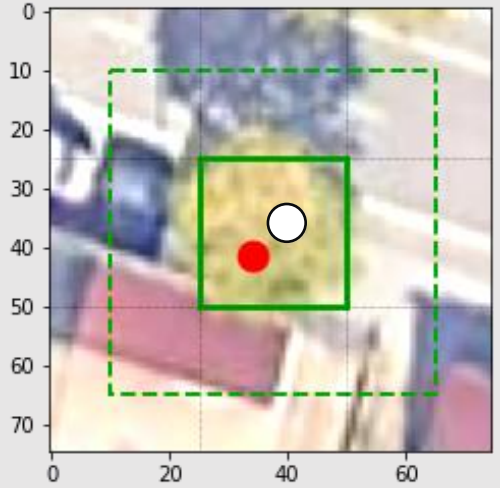
Find horizontal & vertical position of the tree in the tile

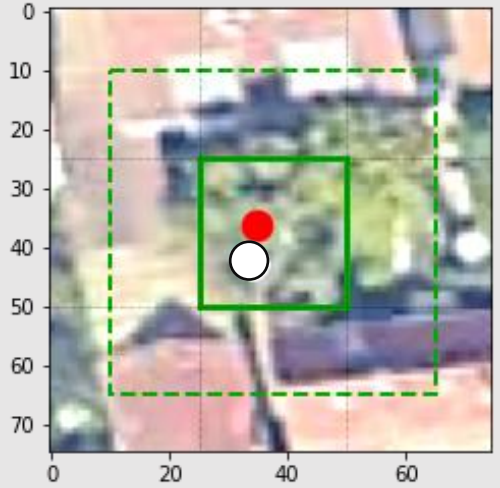


Tile size: 25 x 25 px
Expansion: + 15 px

○ annotation
● Predicted position





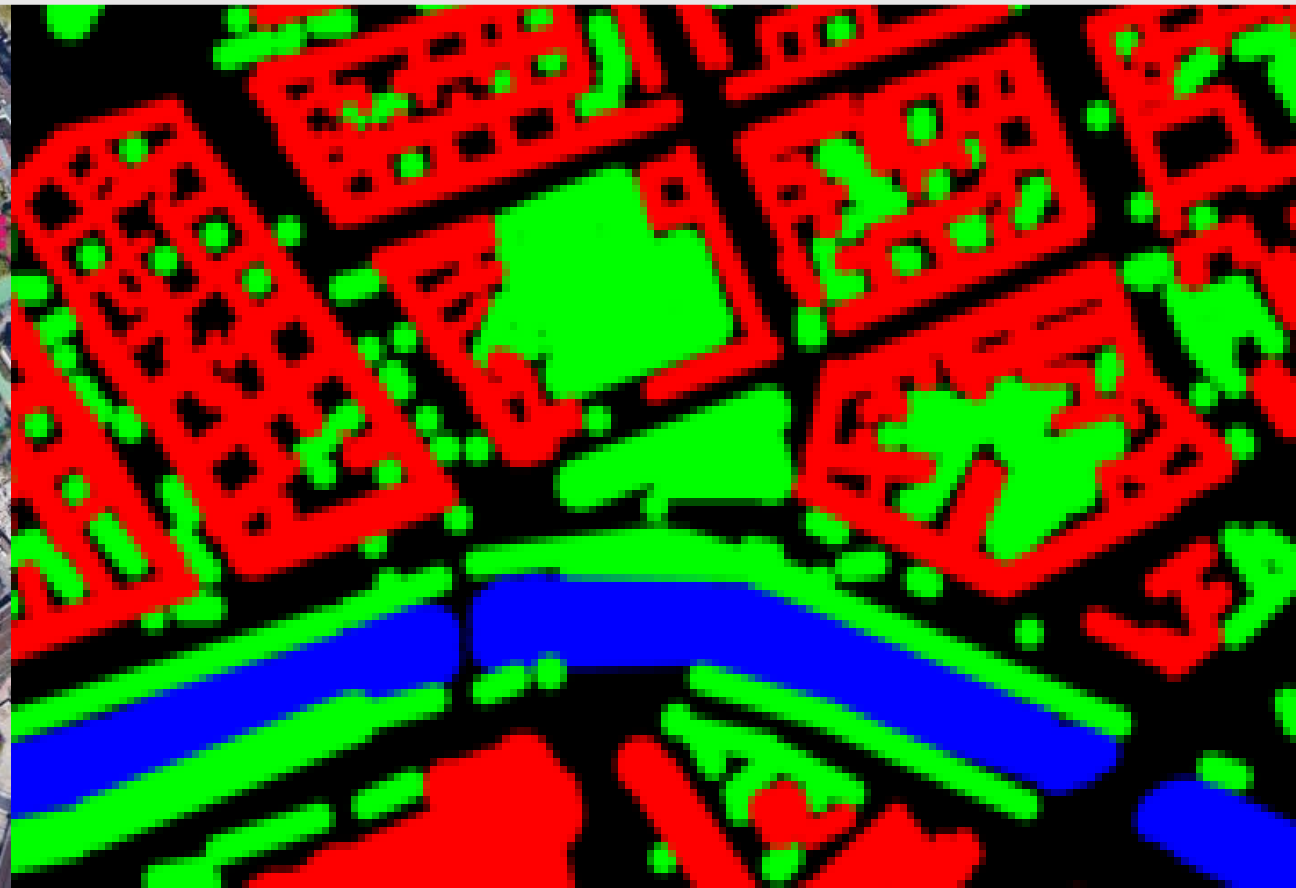


OBJECT DETECTION

SEMANTIC SEGMENTATION

Segmentation of 4 surface type classes:

buildings **vegetation** **water** **else (sealed)**



SEMANTIC SEGMENTATION

Input → **↓ Convolution ↑** → **Output**

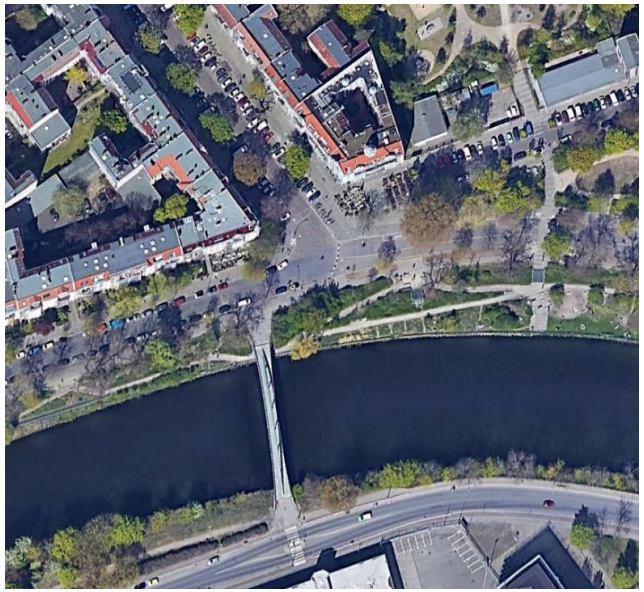
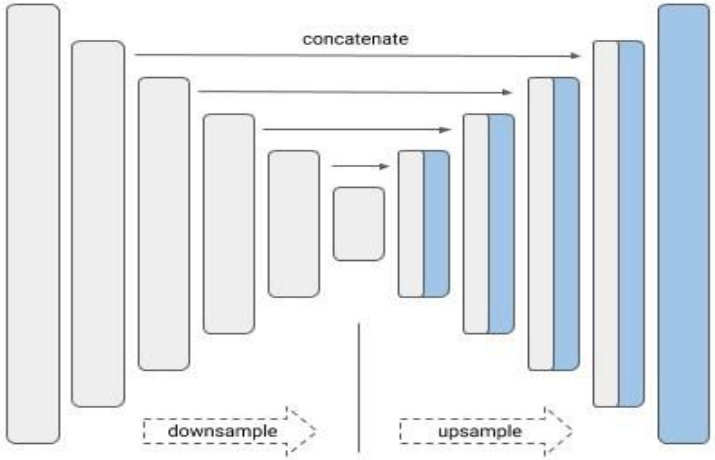
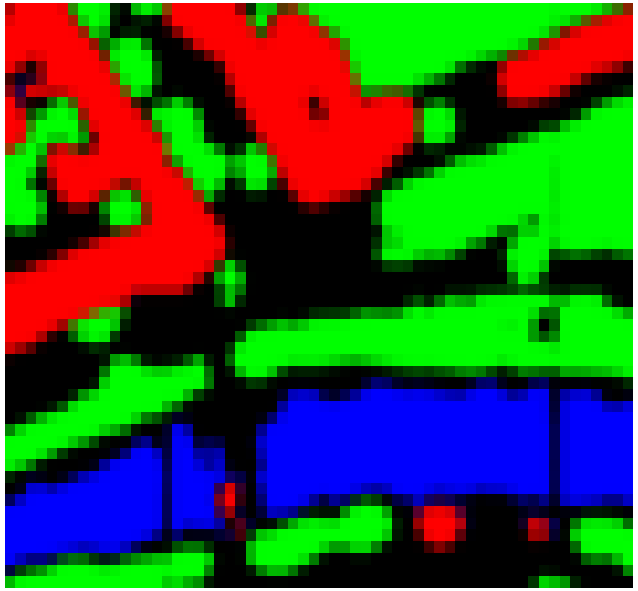


Image tile of 512 x 512 pixels



Goodaudio blog

Unet



Annotated tile of 512 x 512 pixels

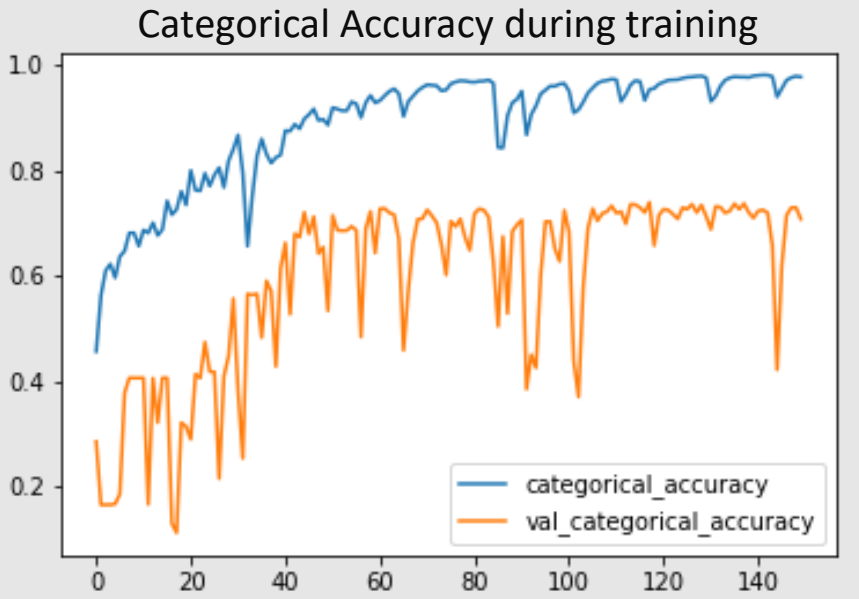
- ResNet50 unet (ImageNet)
- Callback: MeanIoU
- Loss: categorical cross-entropy
- Activation: softmax

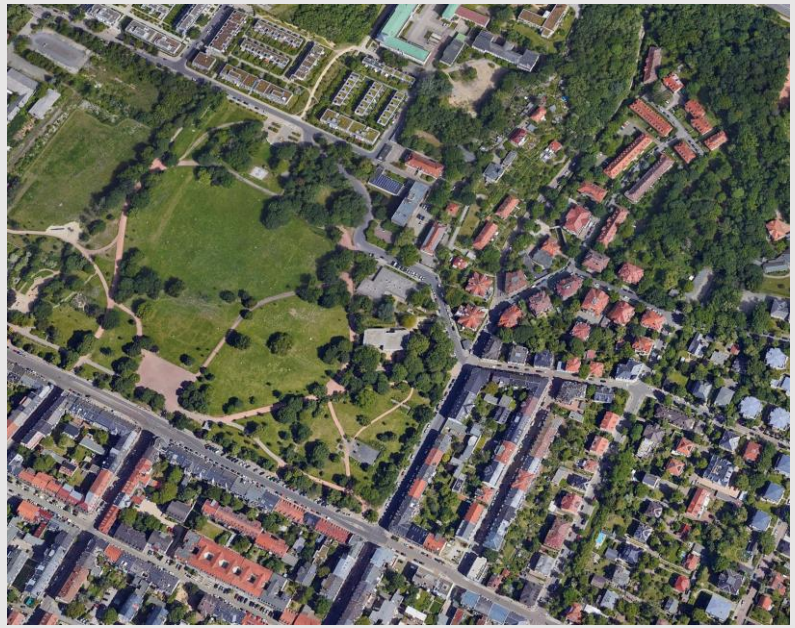
- 2 images, 36 tiles each
- 4 classes, fairly balanced
- One-hot encoded
- Classes encoded to RGB channels

SEMANTIC SEGMENTATION

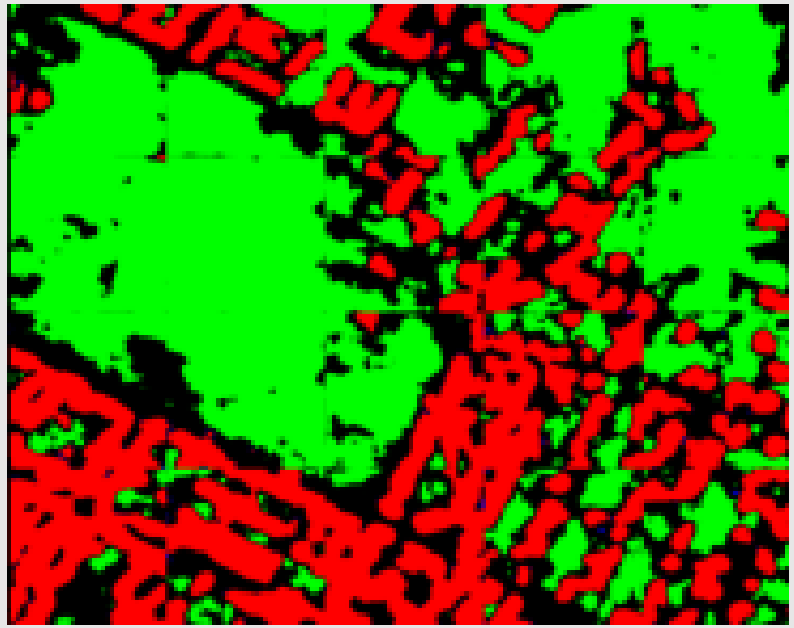
Results

- Good performance & generalization
- More training data in broader range of images required





Test image of Dresden



Prediction result

URBAN EAGLE

demo

Deployed with Streamlit & Github

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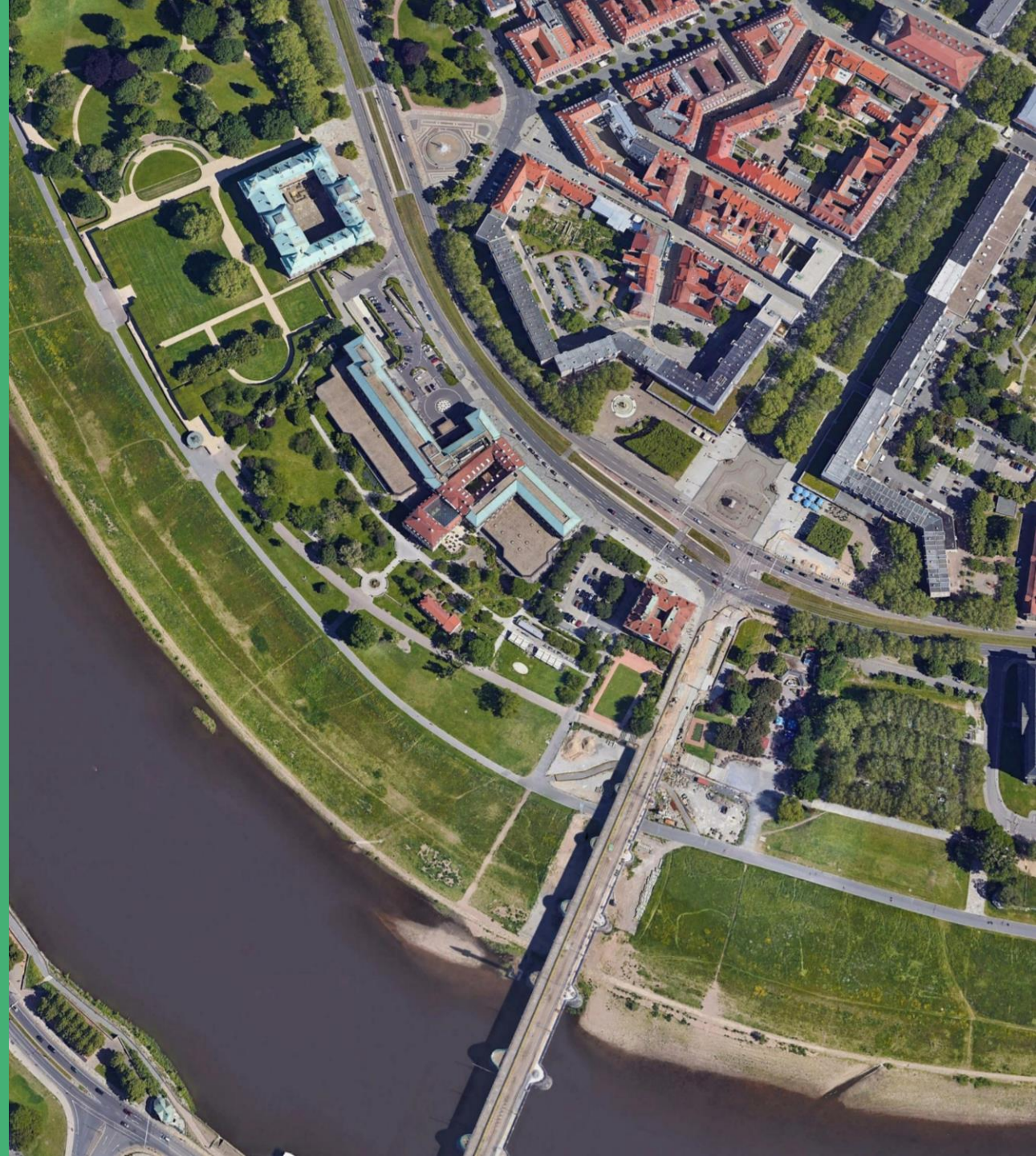

ARE WE THERE YET?

Relevant & coherent metrics

>> Add metrics

>> improved predictions

Accessible & scalable

>> Image uploads

>> GoogleEarth API

>> Server

>> Larger images

Comparable & objective

>> Documentation

>> Structure

Reports & UX

>> Add reports

>> Allow exports

>> Include comparisons (regions & time)

Technological proof of concept

Next

>>

Ask users!

URBAN EAGLE

thanks you!

URBAN EAGLE web app

URBAN EAGLE GitHub repo

Luise Strathe LinkedIn