Mask R-CNN for Individual Tree Crown Delineation

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UBC Forestry
University of British Columbia

Integrated Remote Sensing Studio

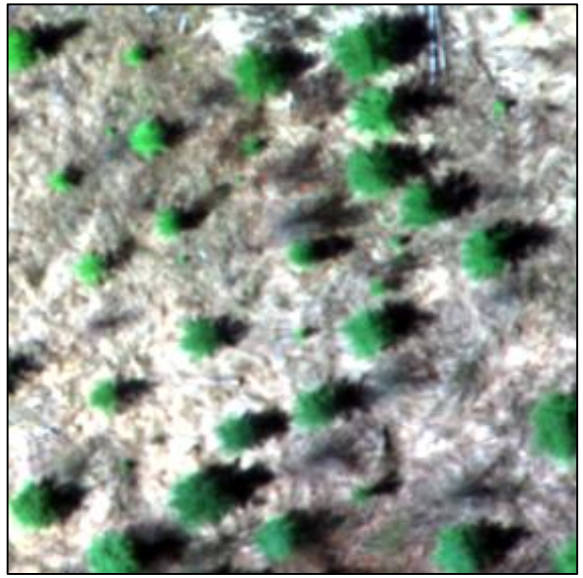
Me

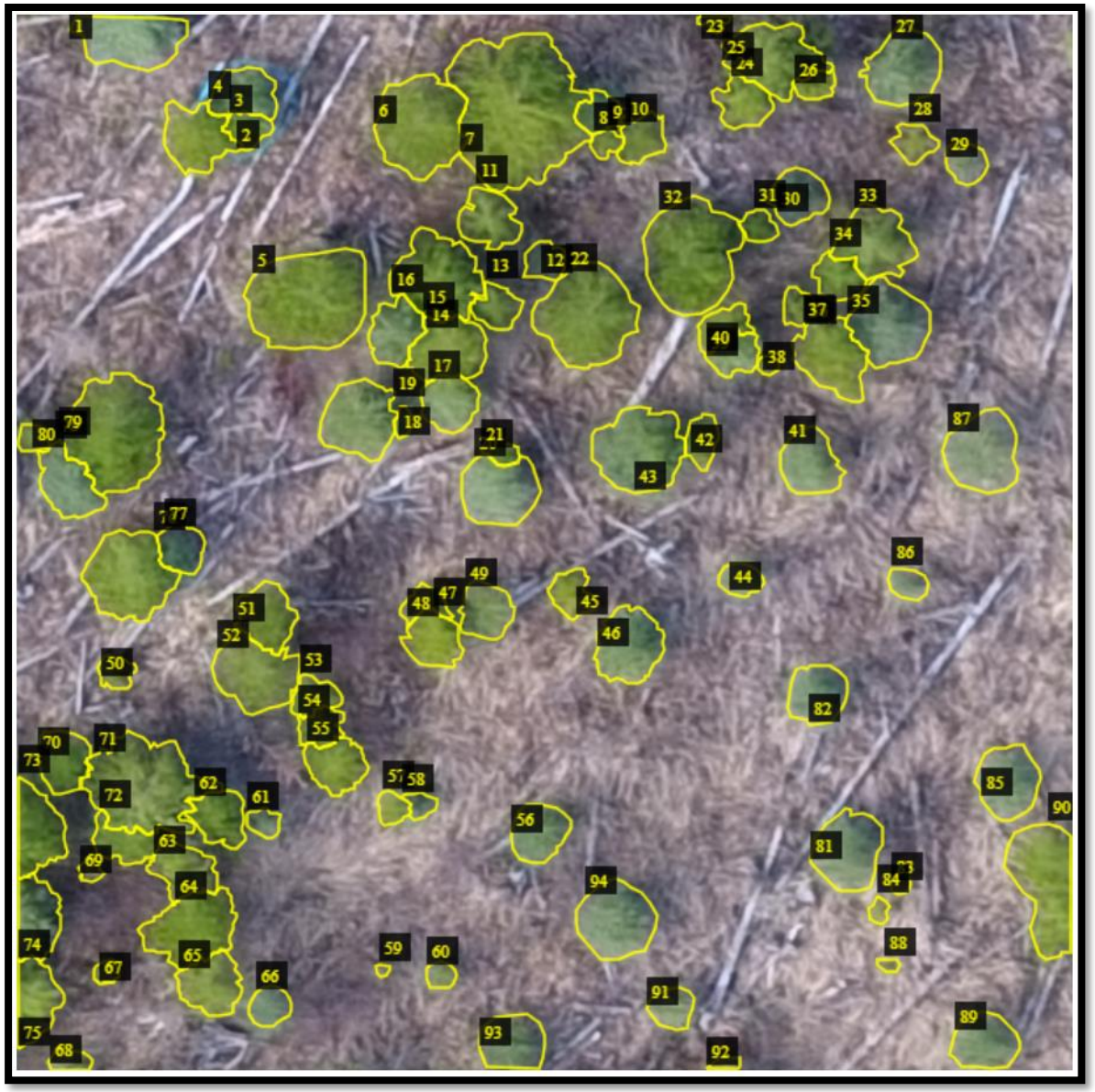
Education

- York University – BES in Environmental Management (2018)
- York University – Certificate in GIS and Remote Sensing (2018)
- UBC – Master of Geomatics for Environmental Management (2019)
- PhD – UBC Forestry (2020-Present)

Mask R-CNN

- Builds upon R-CNN
- Added network branch
- Per-pixel mask prediction





My Work

Open Access Article

Automatic Delineation and Height Measurement of Regenerating Conifer Crowns under Leaf-Off Conditions Using UAV Imagery

by Andrew J. Chadwick [1,*], Tristan R. H. Goodbody [1], Nicholas C. Coops [1], Anne Hervieux [1], Christopher W. Bater [2], Lee A. Martens [2], Barry White [3] and Dominik Röeser [1]

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My Work

Location

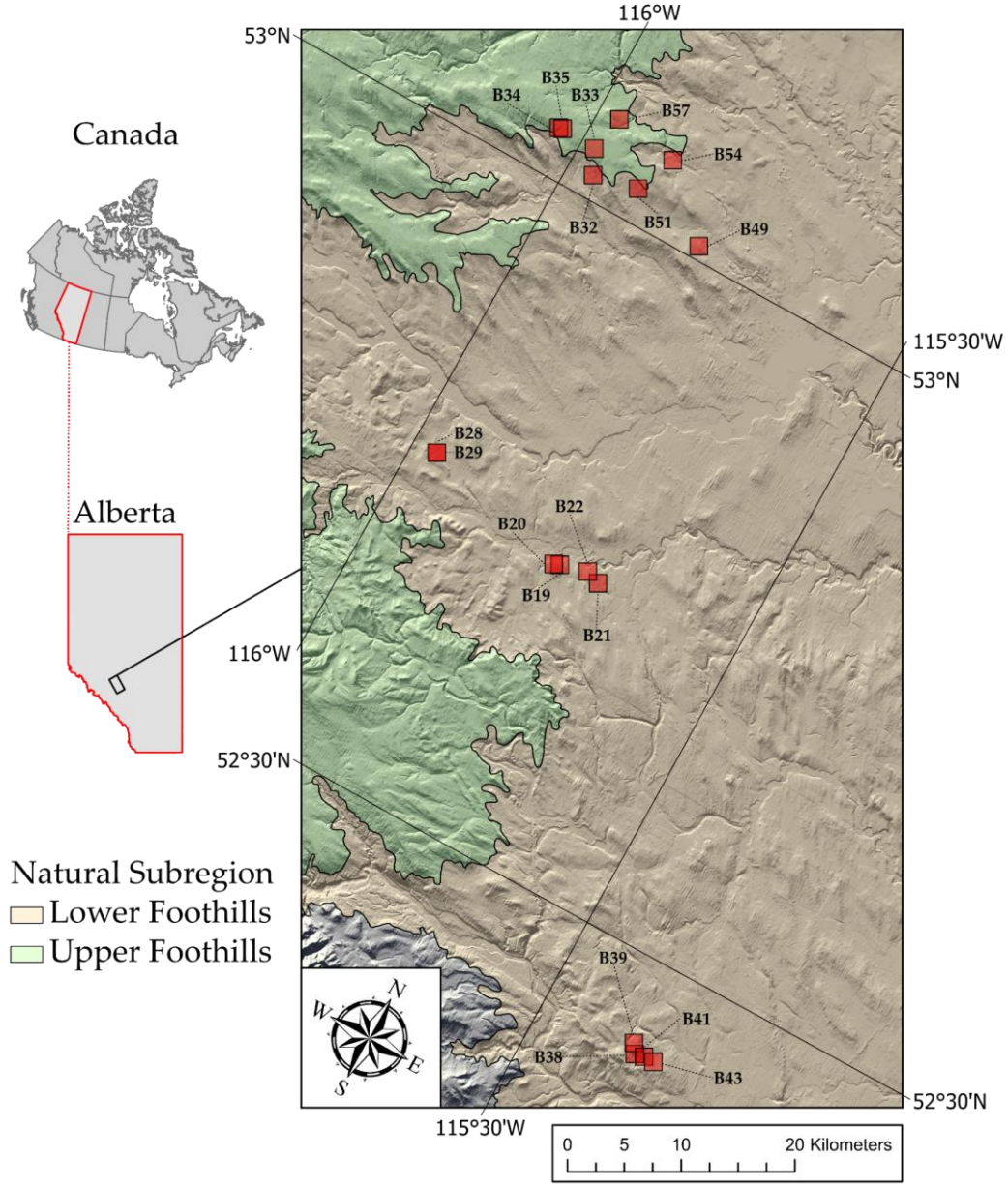
- Boreal Alberta
- Managed Regeneration

Trees

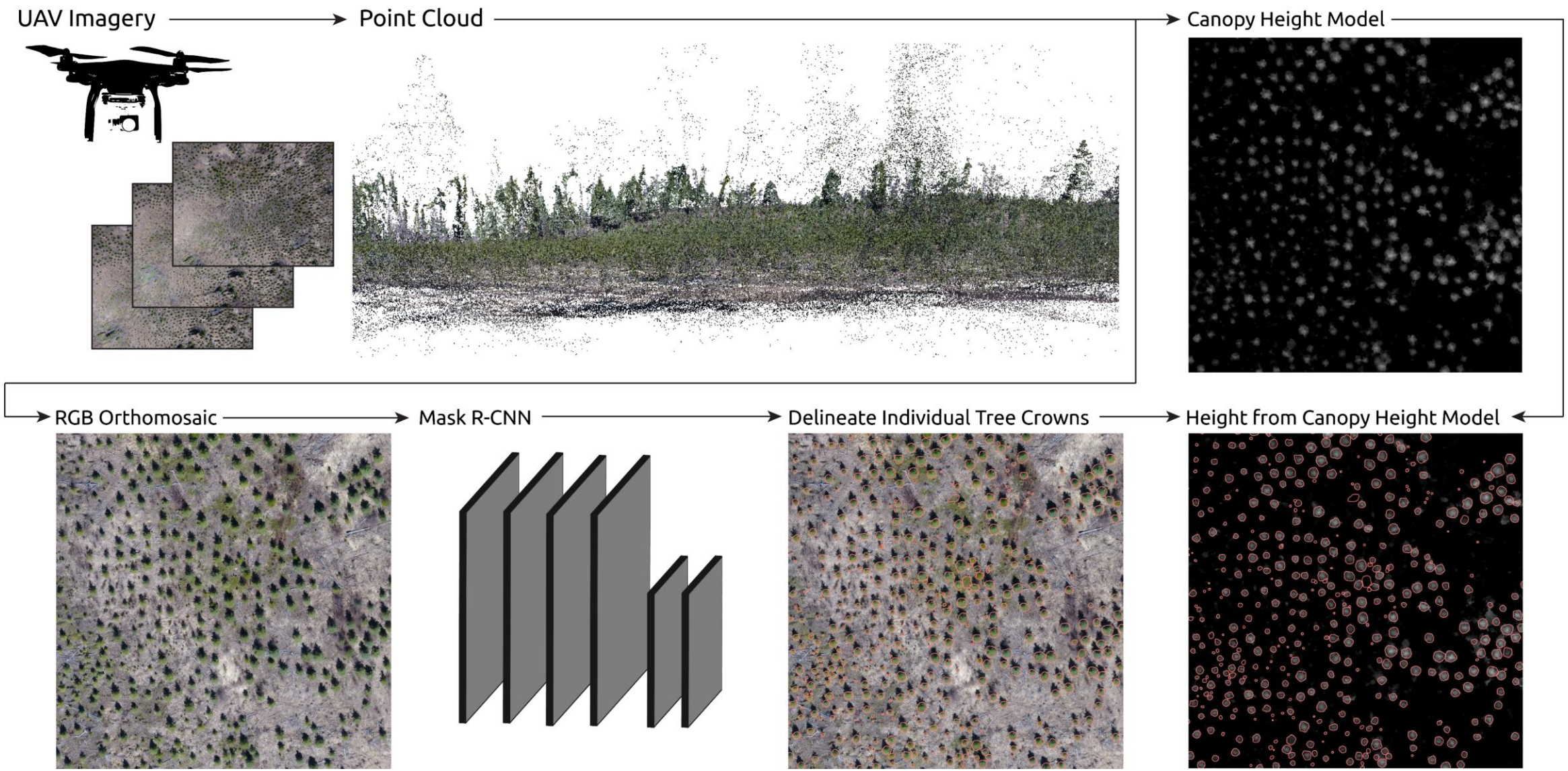
- Focus on conifers
- 13 years old
- 30cm-5m in height

Imagery

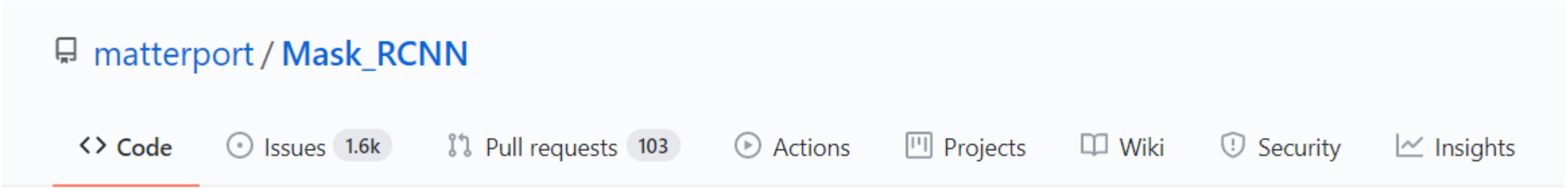
- RPAS orthomosaics (RGB)
- 3 cm spatial resolution



My Work


UAV Imagery
Point Cloud
Canopy Height Model
RGB Orthomosaic
Mask R-CNN
Delineate Individual Tree Crowns
Height from Canopy Height Model

Mask R-CNN



- Source code for Python implementation
- Setup.py
- Demos
- Active “Issues” forum

Mask R-CNN

matterport / Mask_RCNN

<> Code | Issues 1.6k | Pull requests 103 | Actions | Projects | Wiki | Security | Insights

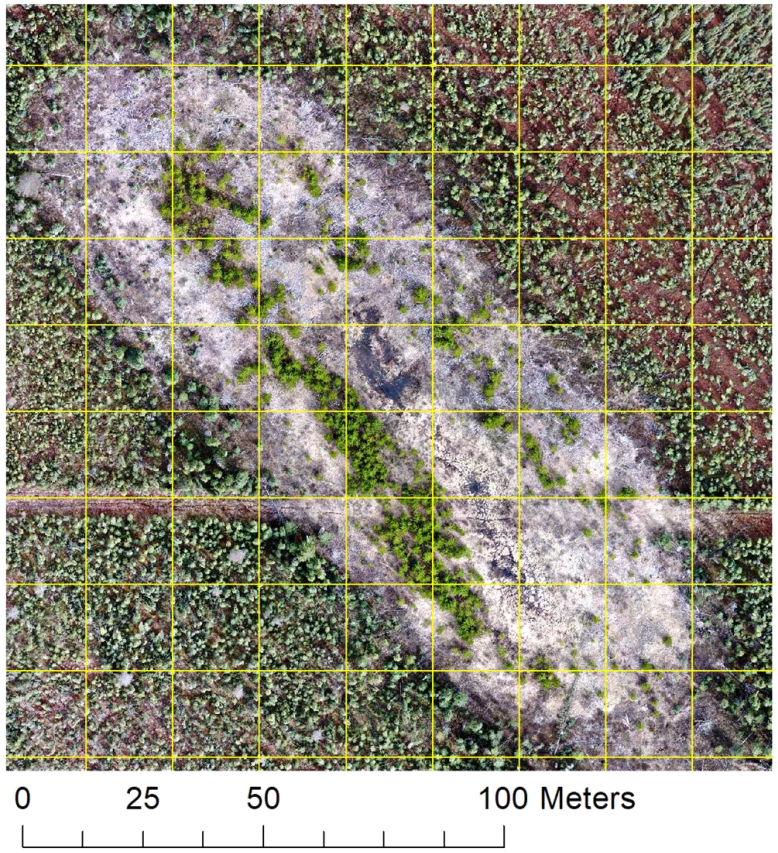
```
numpy
scipy
Pillow
cython
matplotlib
scikit-image
tensorflow>=1.3.0
keras>=2.0.8
opencv-python
h5py
imgaug
IPython[all]
```

My Build

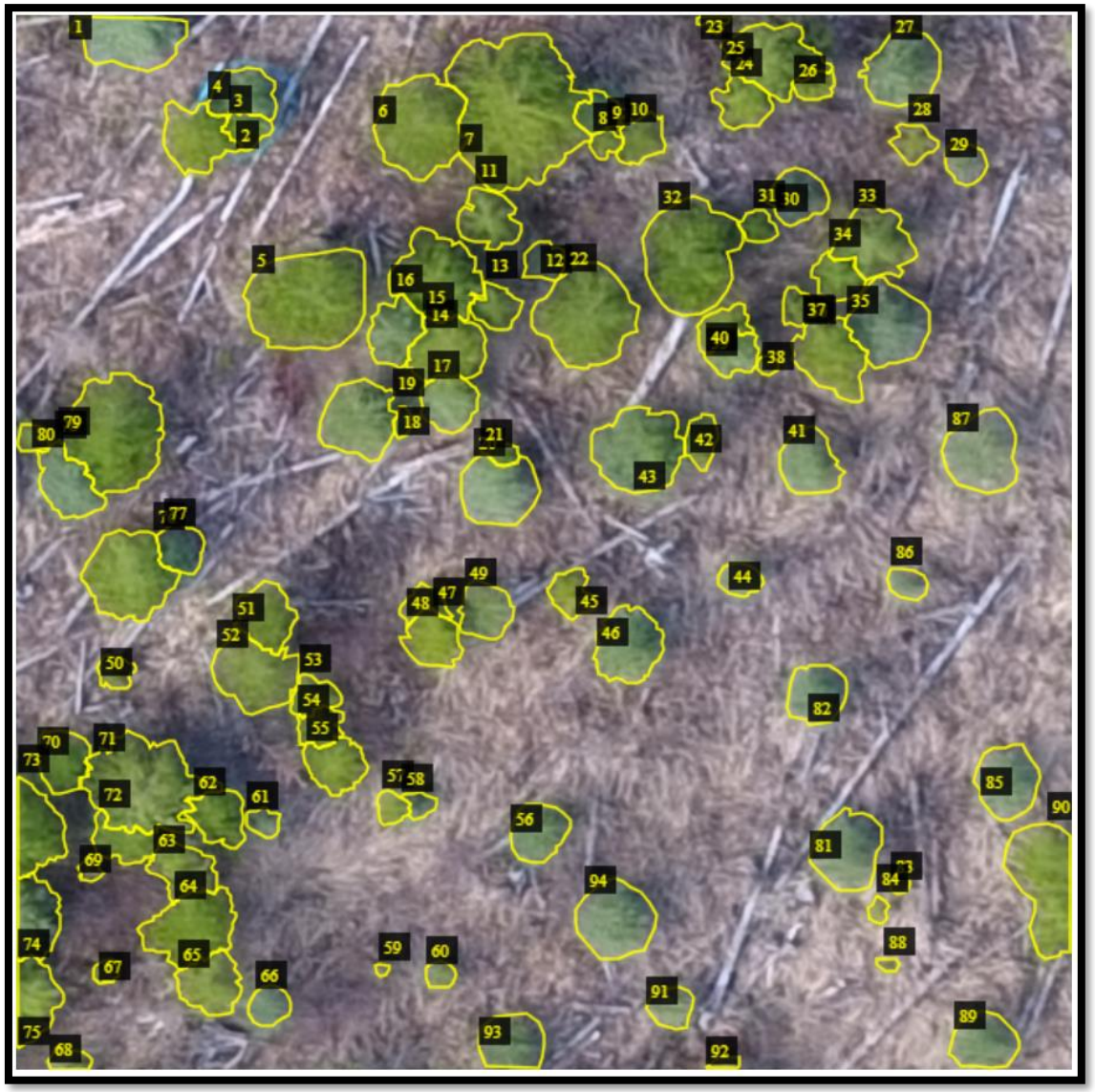
- Python 3.6
- Tensorflow-gpu-1.12.2
- Keras 2.2.4
- Cuda 9.0
- MSVC 2015 update 3
- NVIDIA Quadro M4000 GPU – 8 GB memory

Building a Dataset

- Trained on labeled data
- Image + Polygons + Labels
- Built for “Natural” imagery

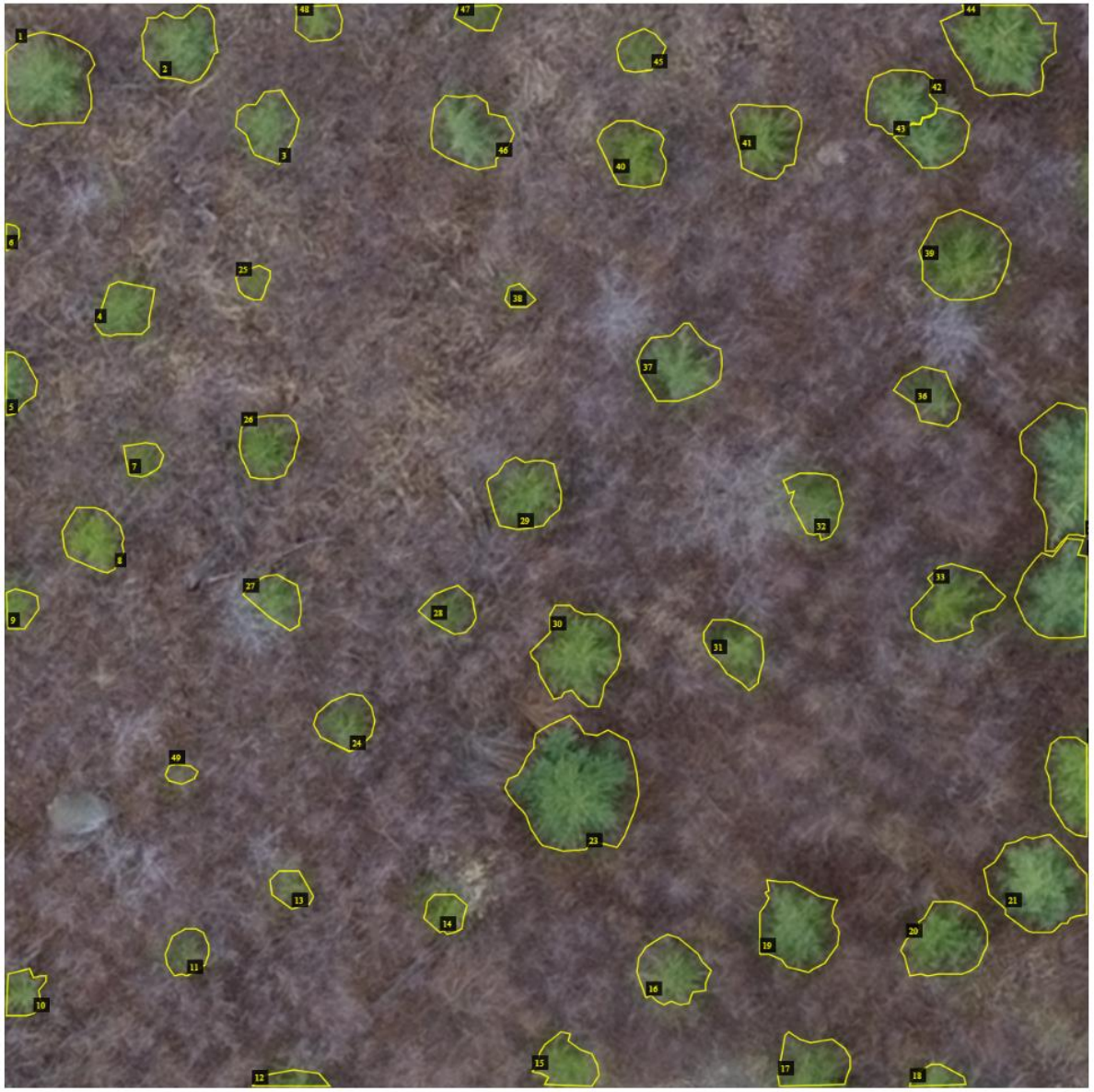


Annotation



- Used free web-based annotation software – VGG Image Annotator
- But, recommend a GIS for Remote Sensing applications

Image Tiles



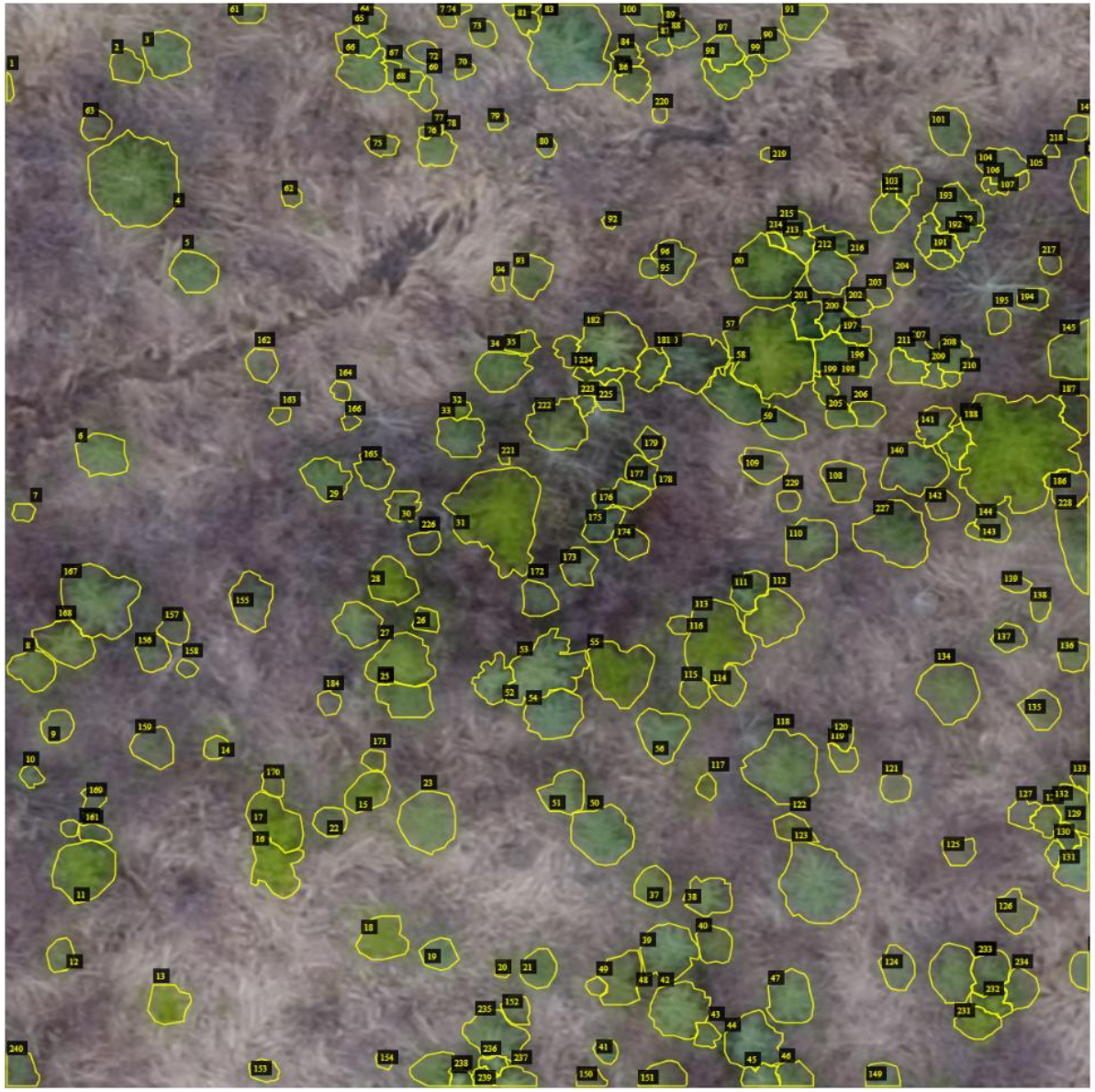
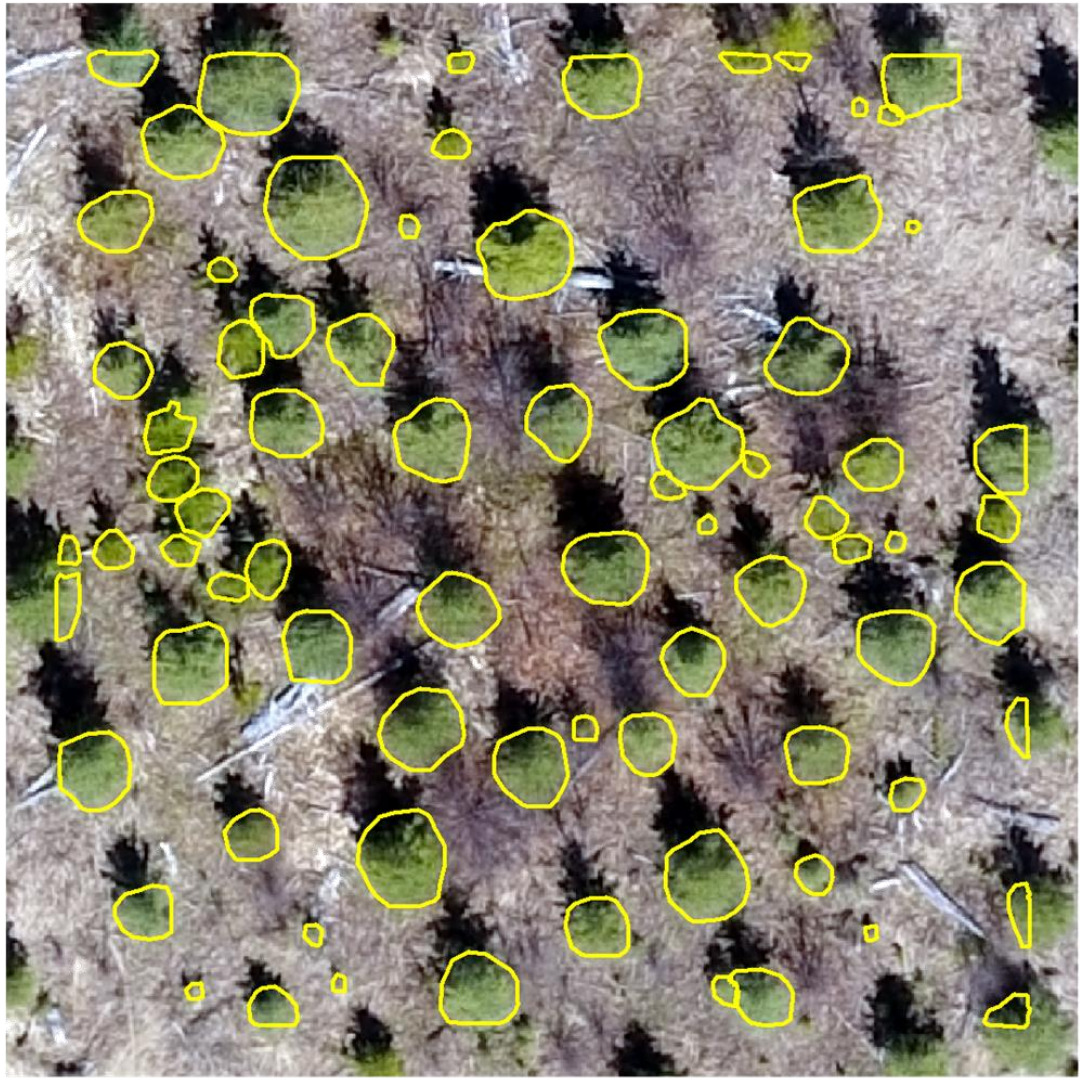
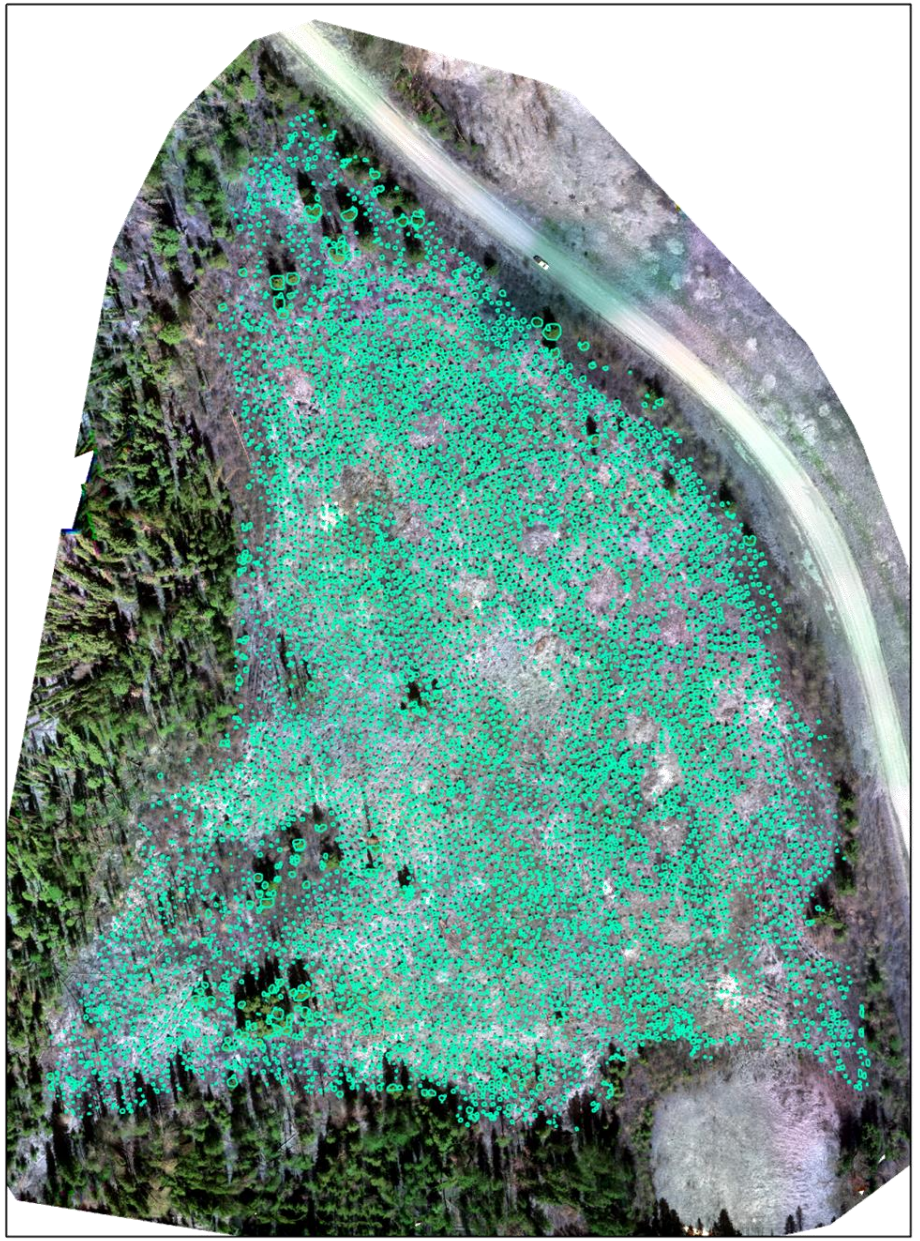


Image Tiles



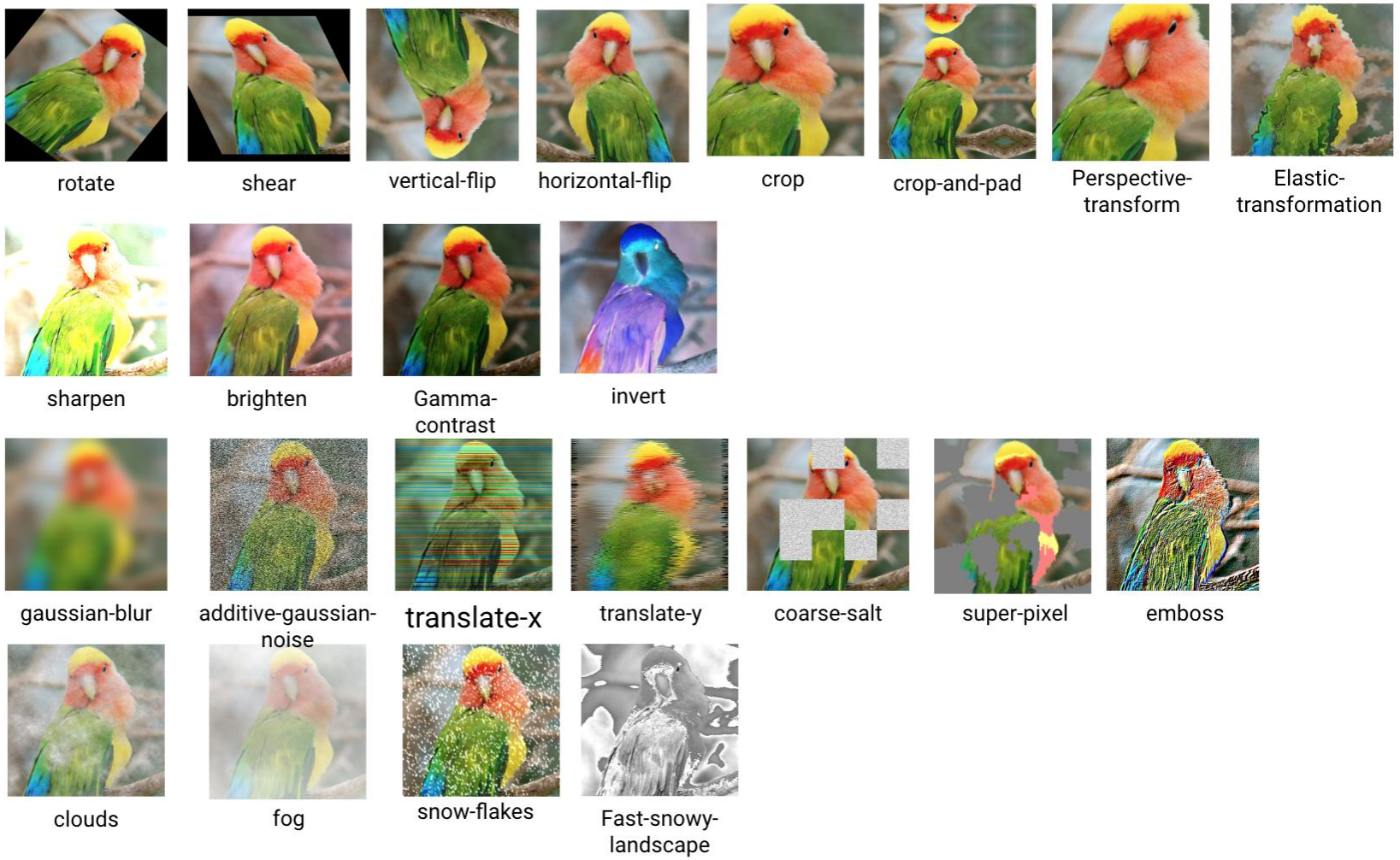


Validation Data

- Split into train/val/test
- No optimal convention on split ratios
- Used 80/10/10
- Consider not just image count, but number of instances per image
- Ensure representation
- Consider “ground truth”

Augmentation

Base Augmentations



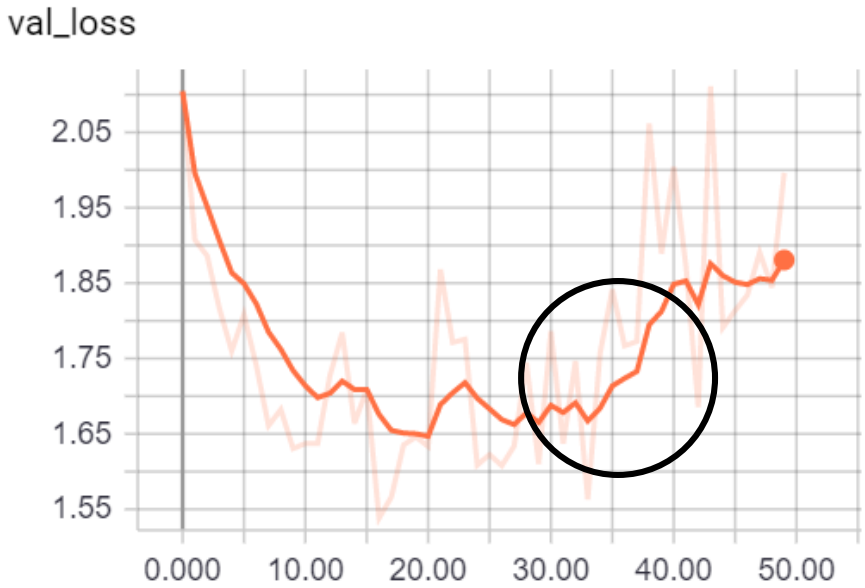
Özmen, Bariş. “AutoML for Data Augmentation.” *Medium*, Insight, 3 May 2019, blog.insightdatascience.com/automl-for-data-augmentation-e87cf692c366.

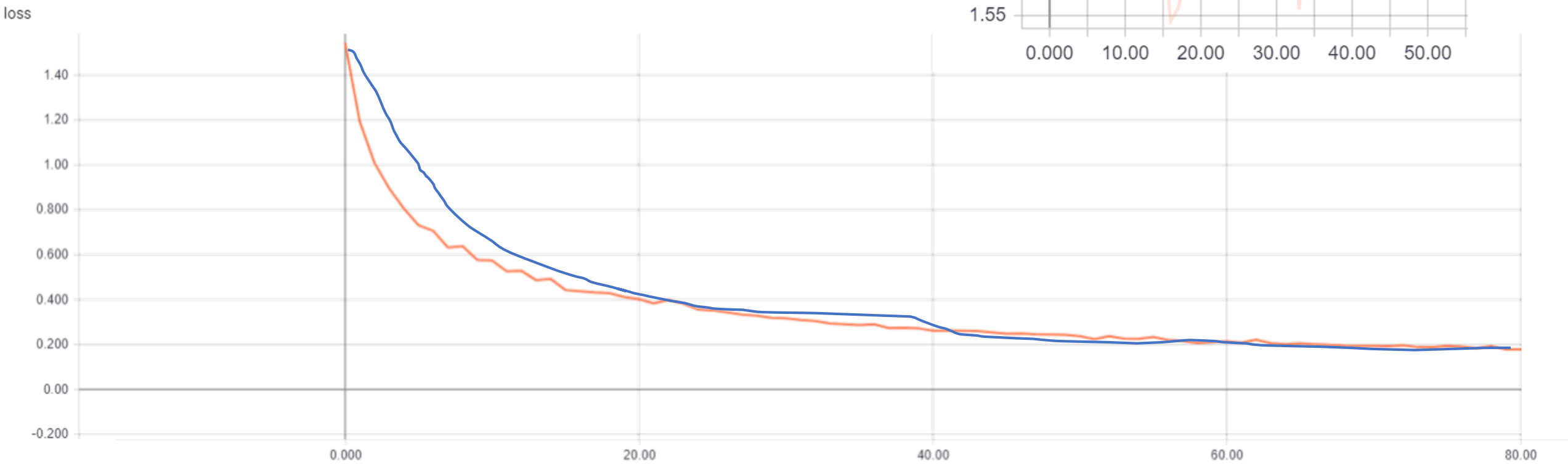
Pre-Trained Weights

Abdulla, Waleed. “Splash of Color: Instance Segmentation with Mask R-CNN and TensorFlow.” *Medium*, Matterport Engineering Techblog, 10 Dec. 2018, engineering.matterport.com/splash-of-color-instance-segmentation-with-mask-r-cnn-and-tensorflow-7c761e238b46.

Evaluation

- Loss good indicator of successful training
- Recommend Tensorboard to monitor
- Monitor Val loss for indication of overfitting
- But, loss != performance





Hyperparameters