TREESEG

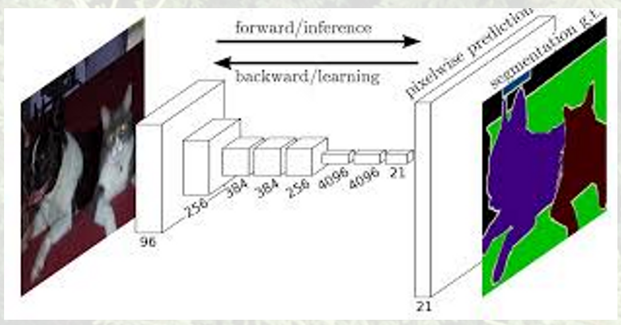
Segmentation improvements with CNNs & engineered features

Convolution Neural Networks (CNN) are an industry-standard AI architecture for image processing. This investigation analysed the effects of single pixel, local pixel and global pixel feature engineering as input to 3 different CNN architectures. The aim of which was to increase segmentation accuracy in the context of drone-captured images of trees provided by Aerobotics.

Convolutional Neural Network Architectures

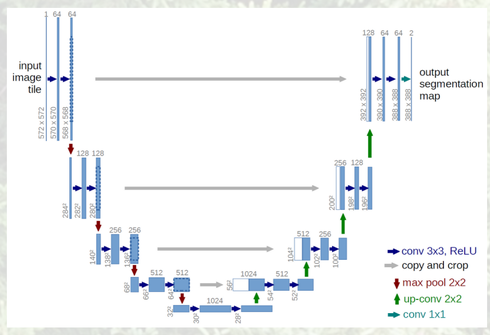
Fully CNN

- Allows for arbitrary-sized input images
- The last fully connected layer has a large receptive field



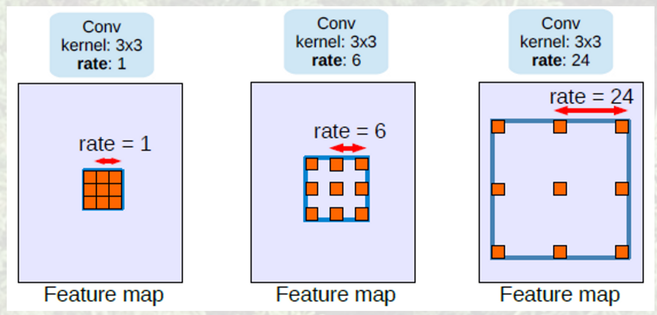
U-Net

- Developed for medical segmentation
- Low data requirement for accuracy
- Convolutions create a "U"



Atrous CNN

- Use atrous convolutions
- These capture space between features
- Uses less computation than standard convolutions



Engineered Features

Single Pixel

Manipulating single pixel data:

- Color Spaces (HSI, Lab, RGB)
- Principle Component Analysis

Local Pixel

Manipulating a region of pixels:

- Mean Shift
- Canny Edge Detector
- Morphological Closing

Global Pixel

Manipulating all pixels:

- Thresholding
- Greyscale Histogram Equalization
- Independent Component Analysis

Findings & Conclusion

Improvements in segmentation metrics

(% increase from base RGB accuracy)

	Morph. Closing	Histogram Equalization
U-Net	0.73%	1.14%

	LAB	Histogram Equalization
FCNN	2%	1%

	LAB	Morph. Closing, ICA, Histogram Equalization
Atrous	0.12%	1.97%

Large scale feature extractors removed image noise and performed better

- Accurately highlighted tree boundaries
- Removed tree shadows
- Excluded other ground vegetation

This allowed the CNNs to segment input images more accurately

Improved segmentation in challenging cases

(Determined by visual analysis)

Baseline RGB Result

Result with Feature Extraction

Computer Science Department
University of Cape Town
Private Bag X3
Rondebosch
7701

Supervisor
A/Prof. Patrick Marais
A/Prof. Deshen Moodley

Team Members
Charl Ritter
Fergus Strangways-Dixon
Michael Scott