Constructing a Visual Dataset to Study the Effects of Spatial Apartheid in South Africa

**Intro & Motivation**

Removing many of the legacies of apartheid is an important problem in South Africa. Figures 1 and 2 show some aerial images taken by photographer Johnny Miller, depicting completely segregated neighbourhoods of townships next to gated wealthy neighbourhoods that have largely remained unaffected by the ending of apartheid [1].

Studying changes in the demographic makeup of different neighbourhoods could help implement policies to desegregate them.

This paper introduces the first publicly available dataset to study the evolution of spatial apartheid.

We describe our iterative process to create this dataset over two years, which includes pixel-wise labels for 4 classes of neighborhoods: wealthy areas, non wealthy areas, nonresidential neighborhoods and background (undeveloped land).

**Models**

*Sampled 1,869,840 images from the 10,284,120 images covering the country.
*Trained a UNet [2] (right) and a Deeplab [3] (below) model on the datasets.

**Results**

*Our best model (UNet) on 4 classes of neighborhood types: MIoU = 54.96% [4].
*Comparison: SOTA on 10 classes of neighborhood types had MIoU = 45.85%.
*Our best model (UNet) on 4 classes of neighborhood types: MIoU = 66.22%.
*The UNet performed the best on both 12 and 4 classes on all experiments.

**Conclusion & Figure work**

We have introduced the first visual dataset of South Africa which can be used to analyze the effects of spatial apartheid, and described our iterative data annotation process that allowed us to assemble this dataset.

*Future work we expect to use this dataset for includes exploring how neighborhoods have changed in different parts of the country.
*The images on the right show how we use the model trained on 2011 images (a) & (b) to estimate the changes in 2017 ((c) & (d)).

With our dataset, we hope to enable those interested in studying and reversing the effects of spatial apartheid, to use this dataset.

**Acknowledgements**

Thank you to Alex Hanna, Ben Pasker, Deb Rajo, David Everatt, Danielle Wood, Memory Mbembe, Samy Kalumba, Emily Denton, Neil Lawrence, Xiao Wei for insightful discussions and suggestions. Funding for this project was provided through five sources: The South African Department of Science and Technology and the Council of Scientific & Industrial Research (as a masters scholarship award to Raesetje Sefala), Google (as a research award and compute credits to Raesetje Sefala), the Deep Learning Indaba and Nvidia (Nvidia Titan V prize for best poster presentation at the 2018 Deep Learning Indaba summer school), and the Distributed AI Research Institute (DAIR).

**References**