USING SATELLITE IMAGERY AND CONVOLUTIONAL NEURAL NETS TO UNDERSTAND SLUM MORPHOLOGY – IN LAGOS, NIGERIA

By Cooper Nederhood

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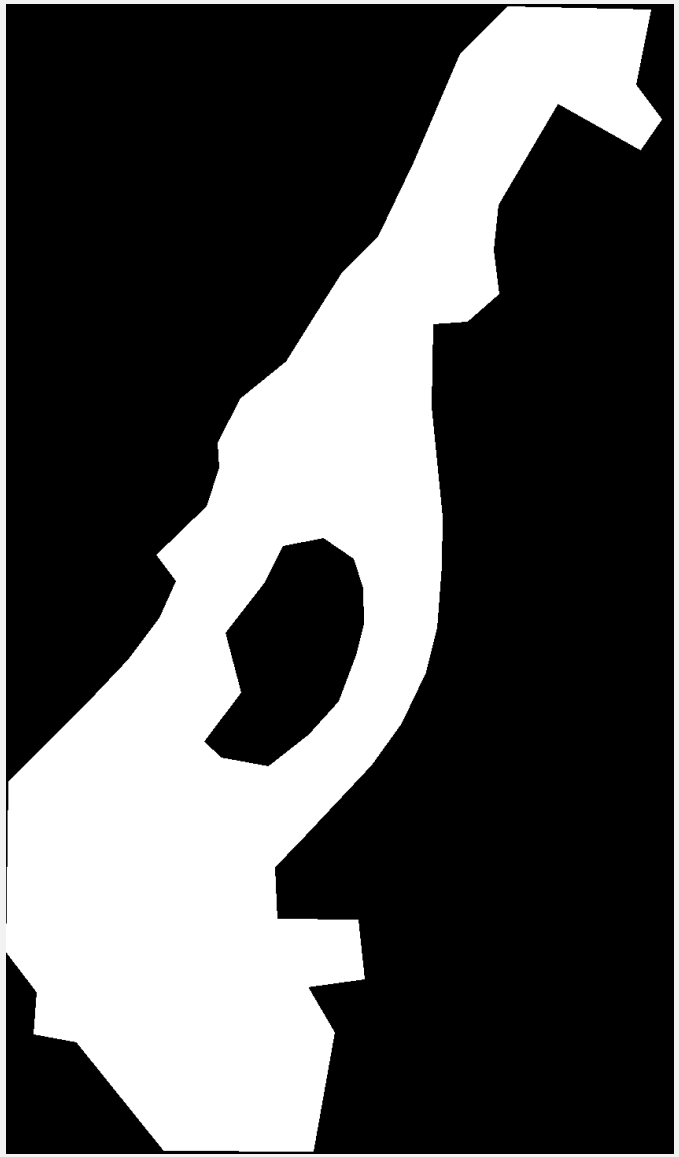
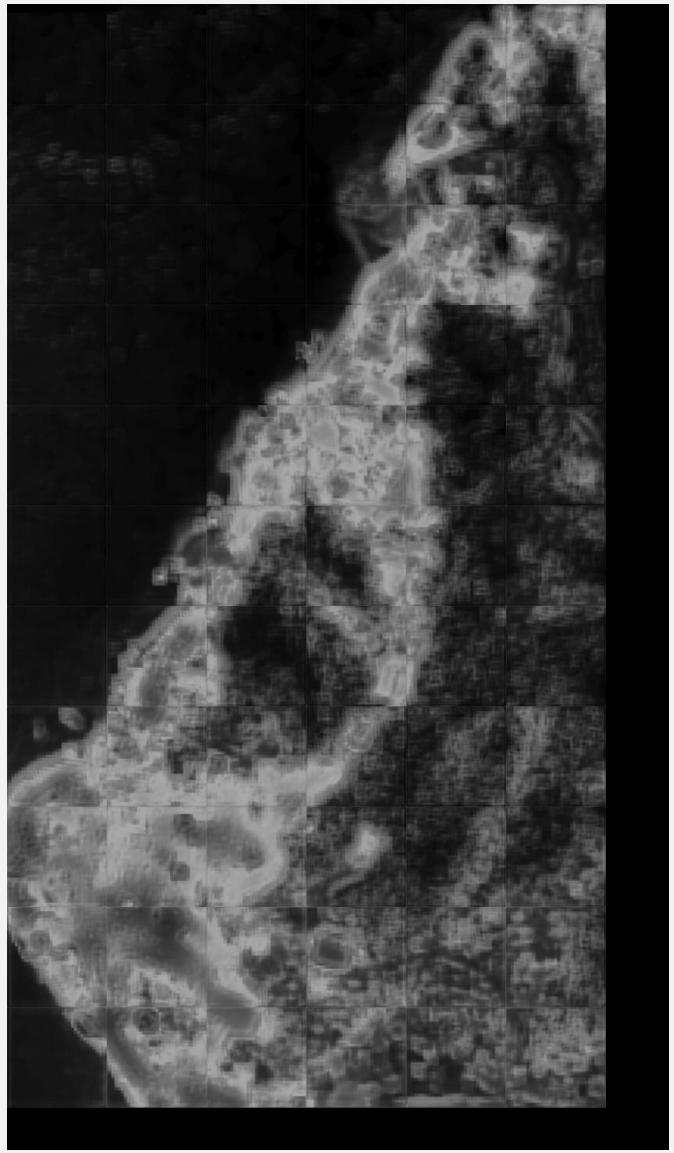
IDENTIFYING AND MAPPING SETTLEMENTS FROM SATELLITE IMAGERY

Input Image

Ground Truth Boundaries



Estimated Boundaries



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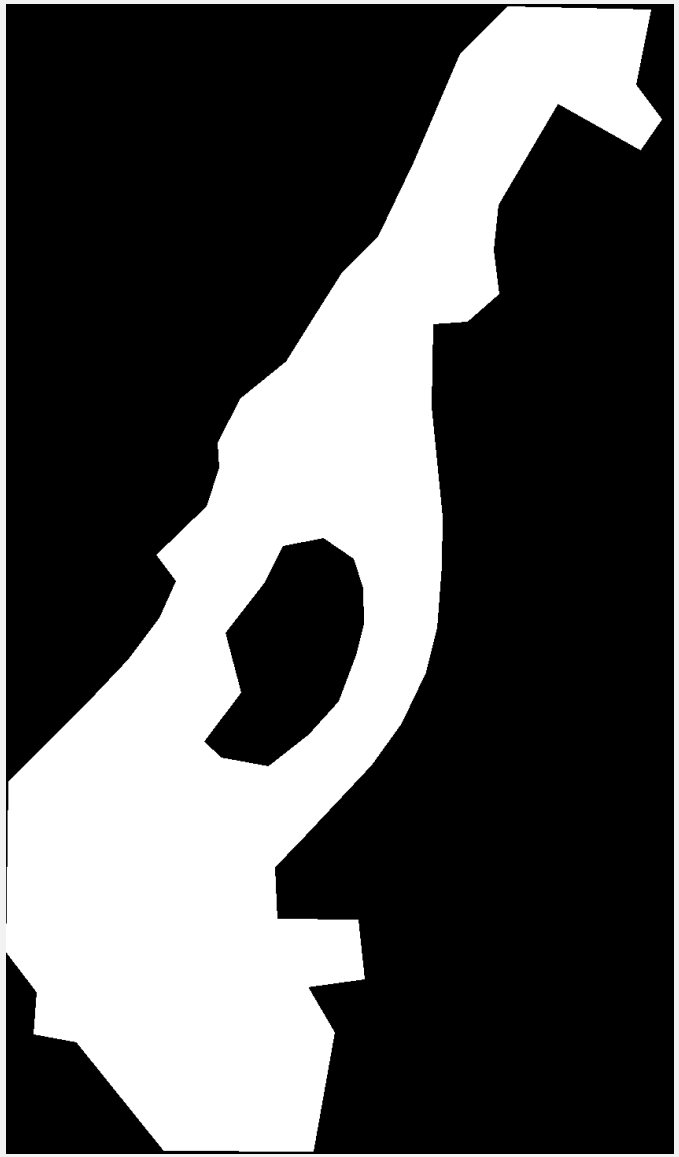

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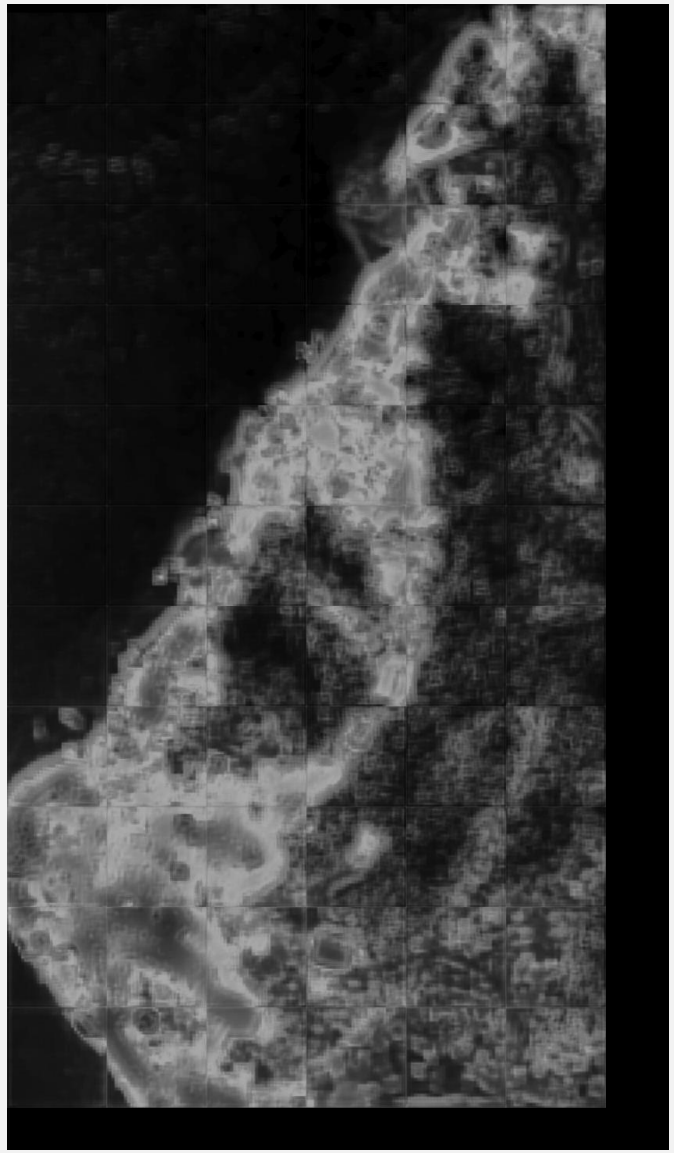

MOTIVATION

- Most of the world lives in urban areas now
- Rapid urbanization in emerging economies like Lagos, Nigeria
- Mapping can help gain secure land tenure!!!

METHOD: SEMANTIC SEGMENTATION

- Semantic segmentation – predicting a discrete classification for each pixel in the input image
- Use Convolutional Neural Networks
- Original computer vision imagery is very different than satellite imagery
  - To the side vs overhead
  - Large object vs many small objects

predict

Person
Bicycle
Background

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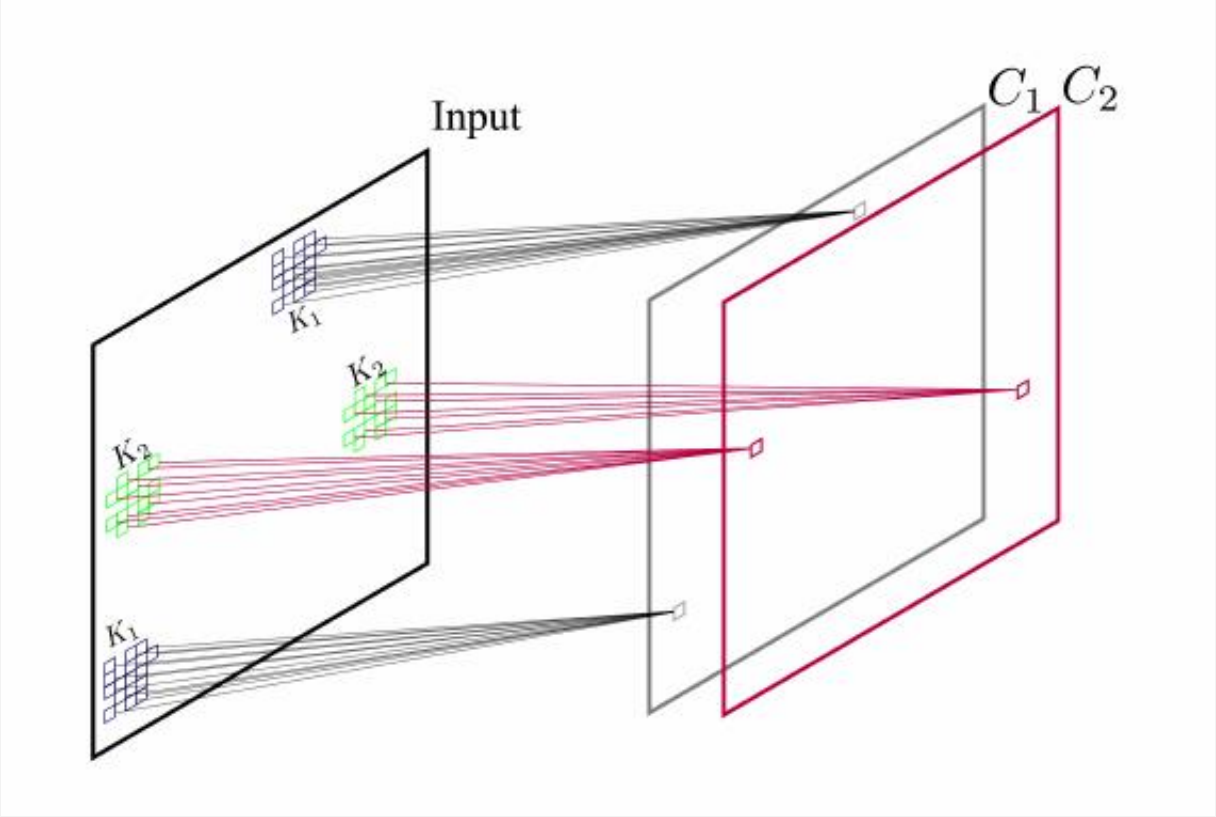
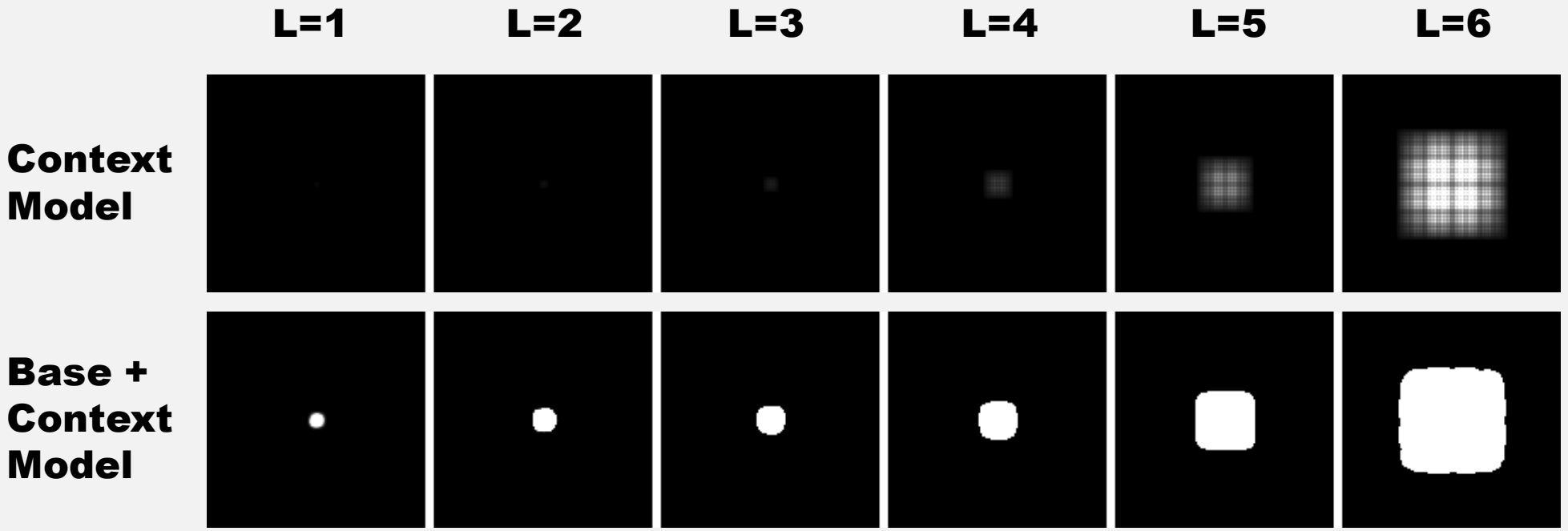
TEST #1 - EXPANDING THE 'RECEPTIVE FIELD' OF THE SEGMENTATION MODEL

- 'Receptive field' is the set of Input pixels affecting a given Output classification
- Effective Receptive Field << Theoretical Receptive Field
- Large receptive field important in all segmentation
  - Especially important for slum urban vs non-slum urban



TEST #1 - EXPANDING THE 'RECEPTIVE FIELD' OF THE SEGMENTATION MODEL

- Append 'Context Model' to 'Base Model' to iteratively increase the Effective Receptive Field



TEST #2 - BANDS BEYOND THE RGB VISIBLE SPECTRUM

- Near infrared bands beyond the human visible spectrum

CONCLUSION

- Combining deep learning with satellite imagery allows for unprecedented analysis of the built environment
- But adapting deep learning models requires specific understanding of the unique context with satellite imagery