"Learning from Deep Learning"
Lessons from using computer vision to identify (urban) form and function in open data satellite imagery

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Abstract: The building blocks that make up cities -the activities and agents conceptualised as urban function, and the structure that supports them conceptualised as urban form- can be spatially arranged in many ways. This paper relies on the concept of "spatial signatures", a characterisation of space designed to understand urban environments, that exhaustively divide geographical space into distinct classes based on form and function. Due to the dependency on data sources that are being updated at a variable rate, signatures cannot be easily updated with frequency. One possible solution comes from remote sensing and satellite imagery. While staying in the realm of open data, we explore this pathway using the Sentinel-2 imagery within a deep convolutional neural network (CNN) trained to predict spatial signature type across Great Britain. Our focus is not only to develop a performant CNN but also to learn about the nature of the classes we try to predict (appropriate scale, inter-class relationships) through the lens provided by the neural network. With Sentinel-2 being relatively coarse in the resolution, there are not only technical questions of the CNN architecture, but also geographical ones related to the Modifiable Areal Unit Problem and the ability of samples to capture the nature of each signature type. Furthermore, there is the question of to which degree signatures can be seen from space. We present exploratory work and empirical experiments, and discuss the opportunities and challenges in using remote sensing to reliably detect concepts like spatial signatures using openly available satellite imagery.

Key words: spatial signatures, classification, remote sensing, artificial intelligence, open data

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1. Introduction

2. Materials and Methods

2.1 Materials

2.1.1 British Spatial Signatures

2.1.2 Sentinel 2 imagery

2.2 Methods

2.2.1 Chip size

2.2.2 Data (spatial) augmentation

2.2.3 Model architecture

Appendix A. shows a brief comparison of several standard neural network architectures.

2.2.4 Performance metrics

2.2.5 Summarizing experiments

3. Results

Appendix B. shows confusion matrices.

4. Discussion

References

Appendix A. Technical appendix

A. Comparison of neural network architechture

B. Confusion matrices