SDSS 2022 Tutorial submission

Understanding the structure of cities through the lens of data

Tutorial

Every city is unique - from social composition through economic performance and culture to the topic of this talk - physical structure. The ways cities around the world are built vary, and spatial data science is trying to capture these differences and understand morphological patterns that characterise cities and their parts using many approaches.

This tutorial introduces a purely data-driven method under the umbrella of *urban morphometrics*. It presents the current state of urban morphology in the Python world, focusing predominantly on vector data capturing building footprints and street networks. The main part of the tutorial introduces momepy, a toolkit from the PySAL family allowing a complex multi-scale analysis of urban form from the perspective of measuring the spatial configuration of simple vector features.

We will cover the ways of generating additional analytical elements representing basic spatial units, leading to measuring different aspects of geometry itself. By determining the spatial relationship between buildings, street networks and other features using GeoPandas, PySAL and networkX, we can quantify the size, shape, spatial distribution, and configuration of different parts of cities all in the detail of a single element. Together with measurable density and diversity, we can derive an extensive set of morphological indicators capturing the complexity of urban form patterns.

The tutorial's final part uses many indicators within the classification model to detect distinct spatial patterns without the need for explicit spatial constraints. The second level of clustering results in a hierarchical dendrogram that reflects the relationship and similarity between identified patterns. Those represent a proxy for a taxonomy of urban form types.

The procedures could be robust enough to accommodate different levels of detail of open data mapping, from agglomerated Microsoft US Building Footprints to detailed open data released by local municipalities, as illustrated using various case studies.

Attendees of the workshop will be able to code along on their machines or in-browser using MyBinder and Google Colab.

The tutorial expects basic knowledge of Python to be able to code along, but the principles should be transferable to other languages (though the tools in R or Julia are not as mature as in Python).

Session leads

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Expected participation

People with a general interest in cities who are interested in learning how to capture their morphological dimension quantitatively. Based on the experience from past conferences that included a tutorial or session on the same topic, the contents are usually of high interest.