State of the Map Europe 2023

Utilizing OSM Data in Geospatial Representation Learning

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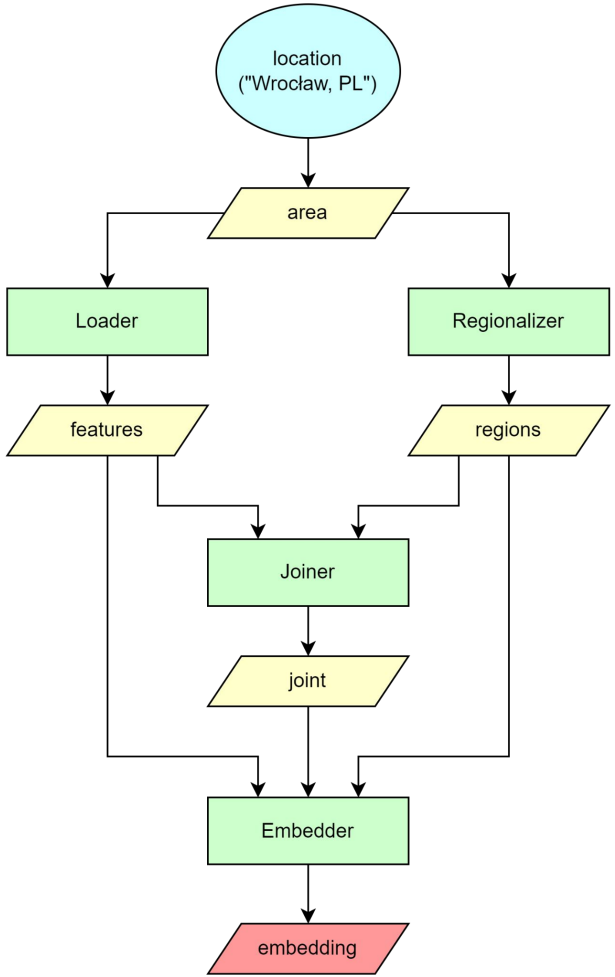
Spatial Representations for Artificial Intelligence

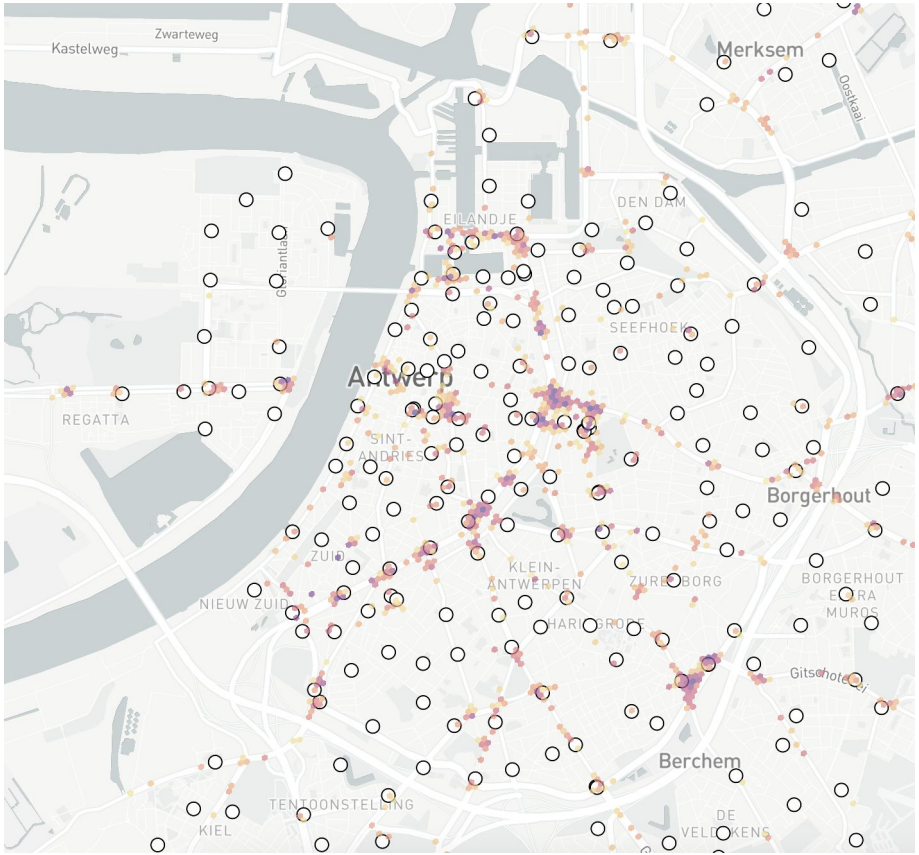
- Geospatial representation learning pipeline
  - Loading geospatial data (OSM, GTFS, ...)
  - Regionalization / tessellation (H3, S2, Voronoi, ...)
  - Embedding
- Easy access to geospatial data
- Aims to unify geospatial embedding models format
- Open-source library, Apache 2.0
- Under development and open for new models
  - Oct 26, 2023 - GeoVex model implementation

https://github.com/kraina-ai/srai



Bikes transfer learning

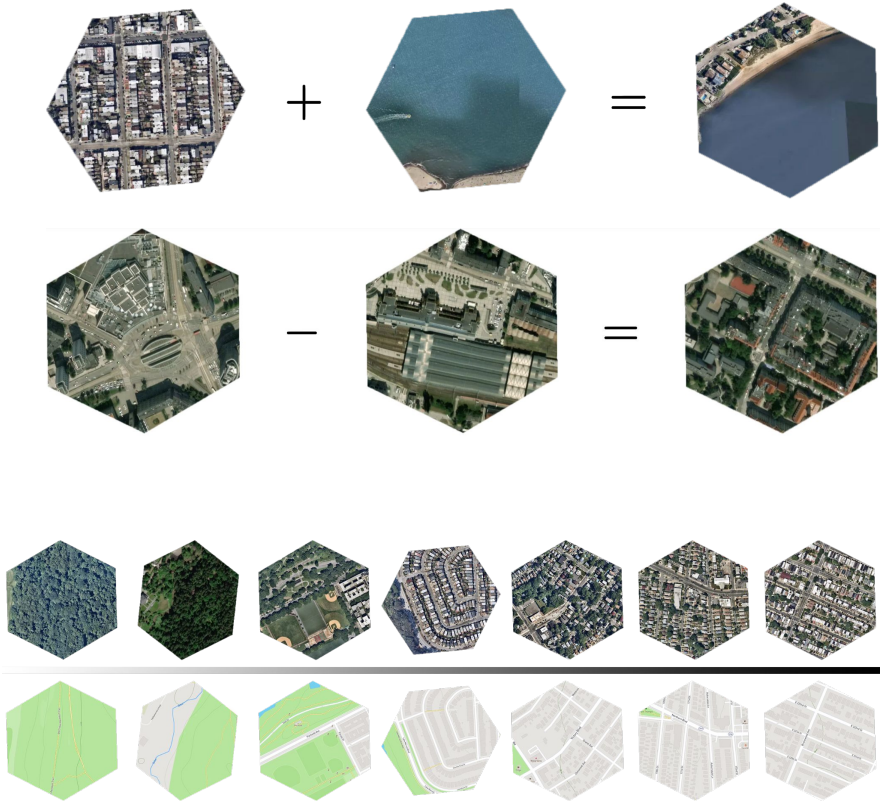
- key/tag metadata from OpenStreetMap
- Uber's H3 cells as micro-regions
- Contextualized feature counts
- 34 European cities
- Prediction for any city with OSM data



Raczycki, K. & Szymański, P. (2021). Transfer learning approach to bicycle-sharing systems' station location planning using OpenStreetMap data. *Proceedings of the 4th ACM SIGSPATIAL International Workshop on Advances in Resilient and Intelligent Cities (ARIC '21)*, 1-12, https://doi.org/10.1145/3486626.3493434

Hex2Vec

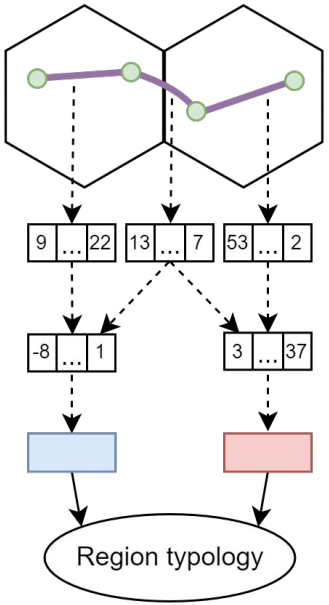
- key/tag metadata from OSM
- Skip-gram model with negative sampling
  - similar to fastText
  - Tobler's First Law of Geography
- Pre-training on 36 cities
- Vector addition and subtraction
- Interpolation in vector space retains semantics

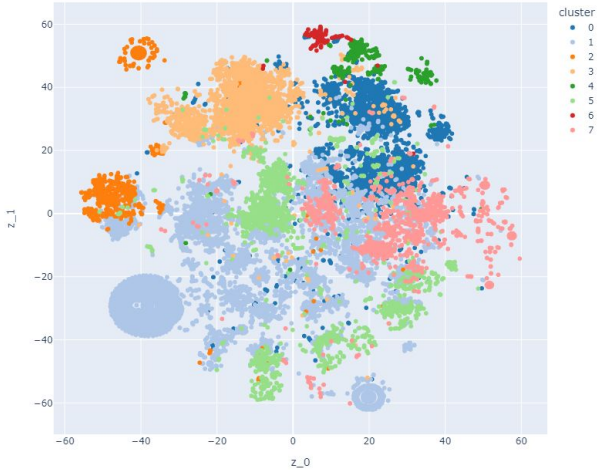


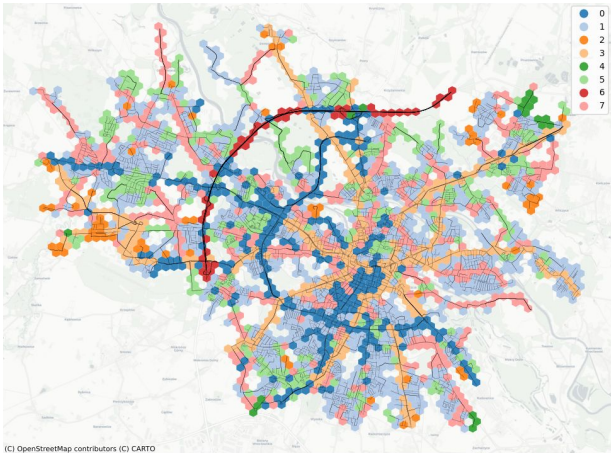
Woźniak, S. & Szymański, P. (2021). Hex2vec: Context-Aware Embedding H3 Hexagons with OpenStreetMap Tags. Proceedings of the 4th ACM SIGSPATIAL International Workshop on AI for Geographic Knowledge Discovery (GEOAI '21), 61-71, https://doi.org/10.1145/3486635.3491076.

Highway2Vec

- Aggregating road segment embeddings into microregions
- Typology of regions capturing characteristics of road network
- Automatic way of discovering the city's road structure
- 13 Polish cities



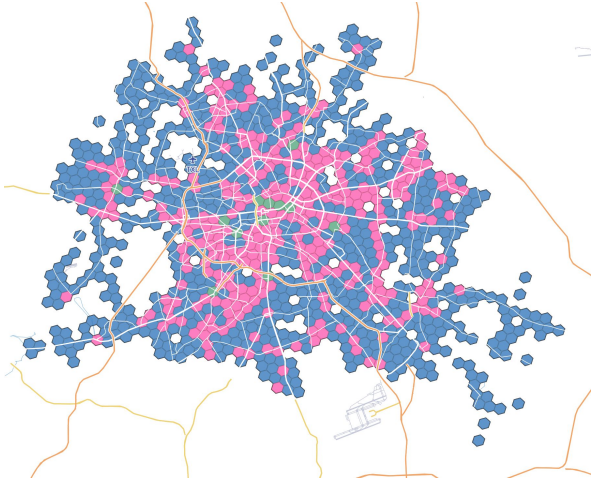


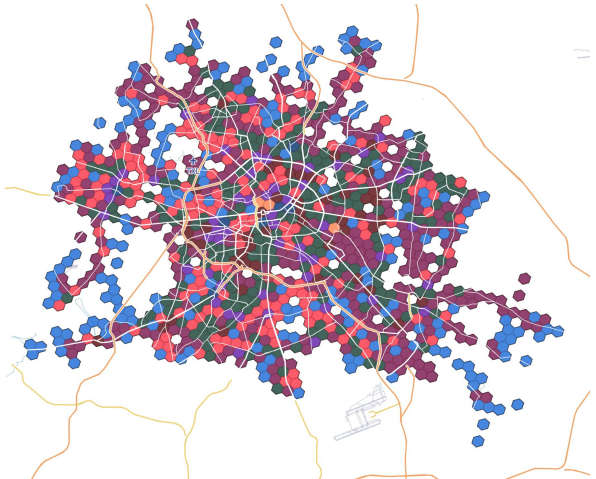


Leśniara, K. & Szymański, P. (2021). Highway2vec: representing OpenStreetMap microregions with respect to their road network characteristics. Proceedings of the 5th ACM SIGSPATIAL International Workshop on AI for Geographic Knowledge Discovery (GEOAI '22), 18-29, https://doi.org/10.1145/3557918.3565865.

GTFS2vec

- Public transport availability:
  - Number of trips / hour
  - Number of directions / hour
- AutoEncoder neural network
- 49 European cities
- Dual level topology obtained:
  - hubs / mid-city / sub-urban
  - more detailed with 9 levels





Gramacki, P., Woźniak, S. & Szymański, P. (2021). Gtfs2vec: Learning GTFS Embeddings for comparing Public Transport Offer in Microregions. Proceedings of the 1st ACM SIGSPATIAL International Workshop on Searching and Mining Large Collections of Geospatial Data (GeoSearch'21), 5-12, https://doi.org/10.1145/3486640.3491392.

Thank you!

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