SRAI: Towards Standardization of Geospatial AI

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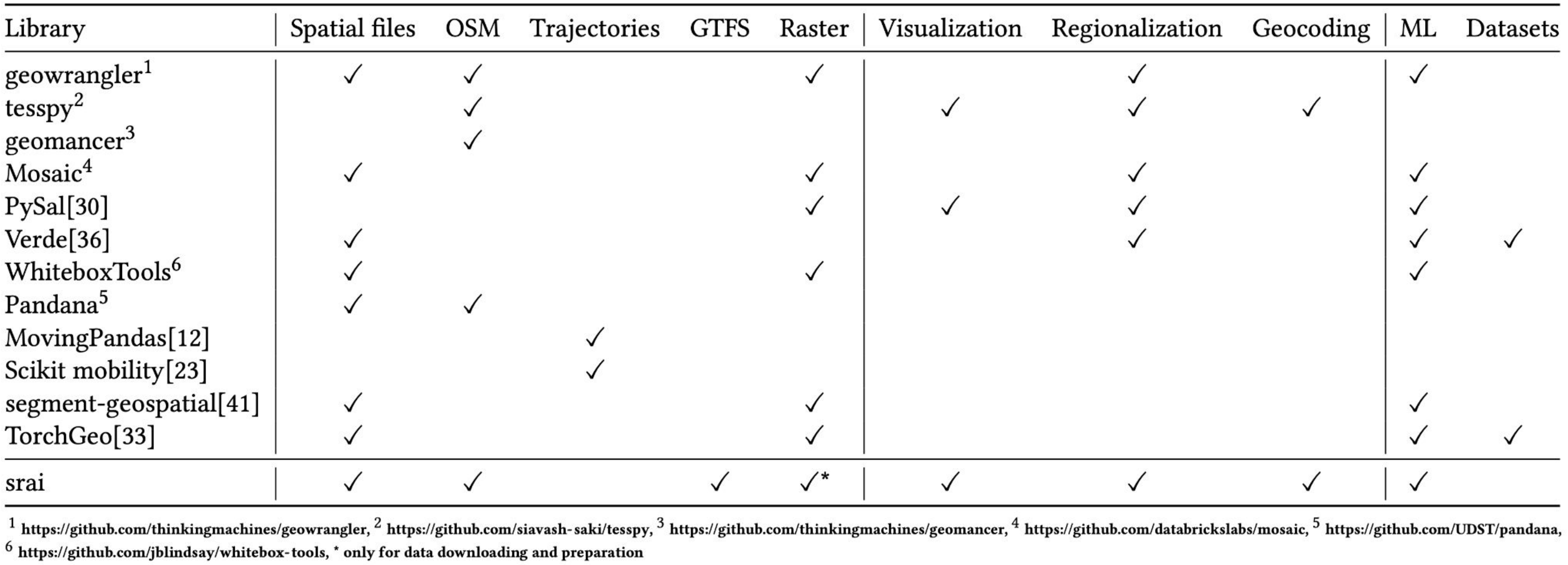
Kraina AI

srai

The need for Standardization in Geospatial AI

- a *Hugging Face*-like hub
- reproducibility in GeoAI
- encouraging sharing of data and code
- uniform interface/pipeline for GeoAI
- lack of established benchmarks
- easier access to openly available geospatial data

Positioning of SRAI

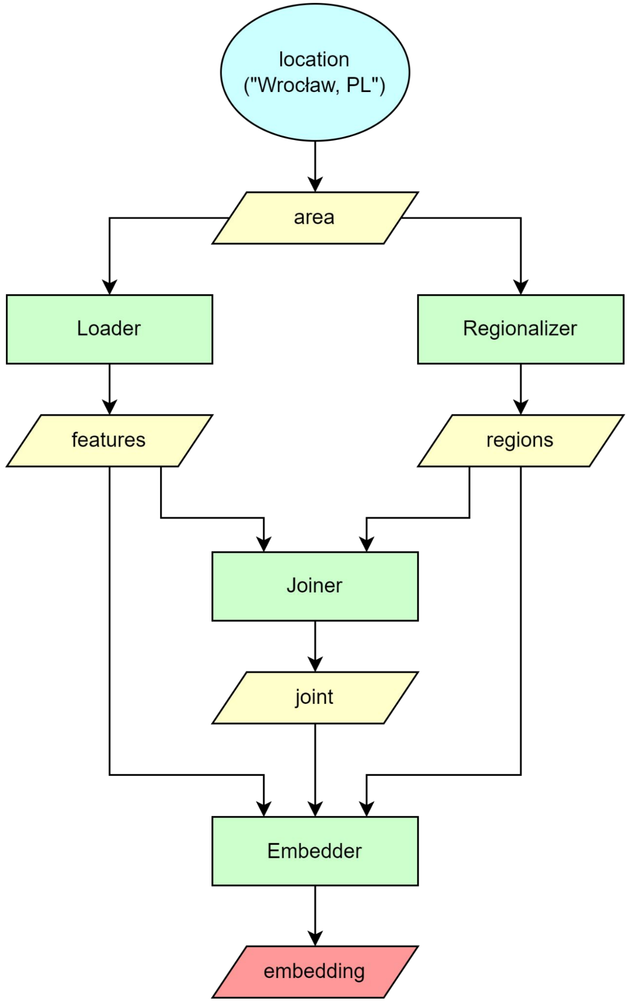


Library	Spatial files	OSM	Trajectories	GTFS	Raster	Visualization	Regionalization	Geocoding	ML	Datasets
geowrangler[1]	✓	✓			✓		✓		✓	
tesspy[2]		✓				✓	✓	✓		
geomancer[3]		✓								
Mosaic[4]	✓				✓		✓		✓	
PySal[30]					✓	✓	✓		✓	
Verde[36]	✓						✓		✓	✓
WhiteboxTools[6]	✓				✓				✓	
Pandana[5]	✓	✓								
MovingPandas[12]			✓							
Scikit mobility[23]			✓							
segment-geospatial[41]	✓				✓				✓	
TorchGeo[33]	✓				✓				✓	✓
srai	✓	✓		✓	✓*	✓	✓	✓	✓	

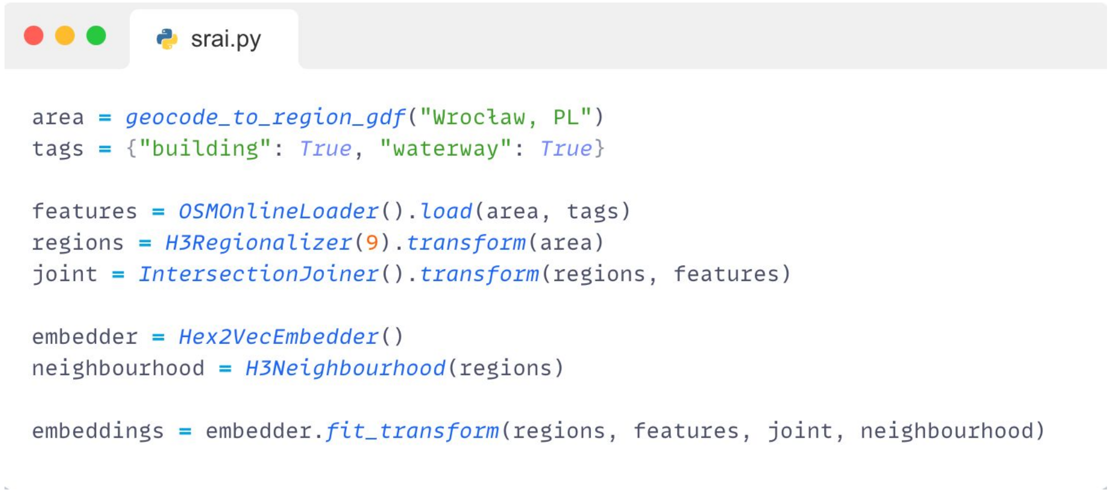
[1] https://github.com/thinkingmachines/geowrangler, [2] https://github.com/siavash-saki/tesspy, [3] https://github.com/thinkingmachines/geomancer, [4] https://github.com/databrickslabs/mosaic, [5] https://github.com/UDST/pandana, [6] https://github.com/jblindsay/whitebox-tools, * only for data downloading and preparation

Spatial Representations for Artificial Intelligence

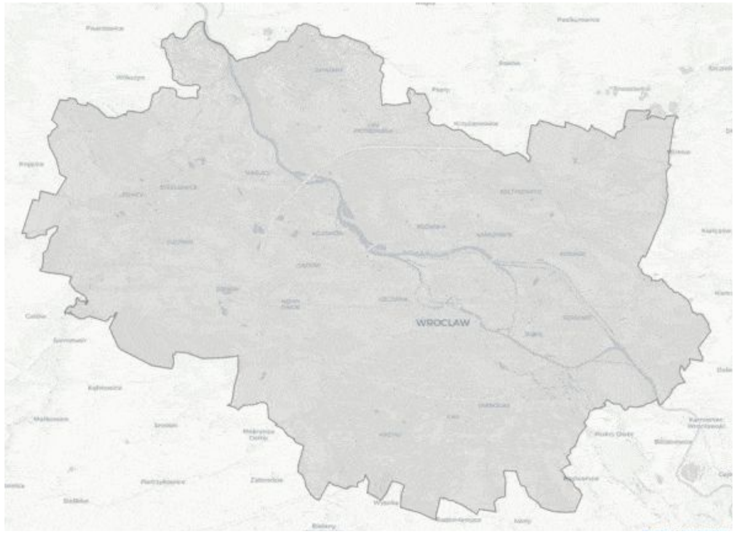
1. Geospatial data loading
   - OSM
   - other sources
2. Regionalization / tessellation
   - Spatial indices
   - Voronoi
   - Administrative
3. Embedding
   - Feature counts
   - Generic OSM based
   - Road segments
   - Public transport



Usage example

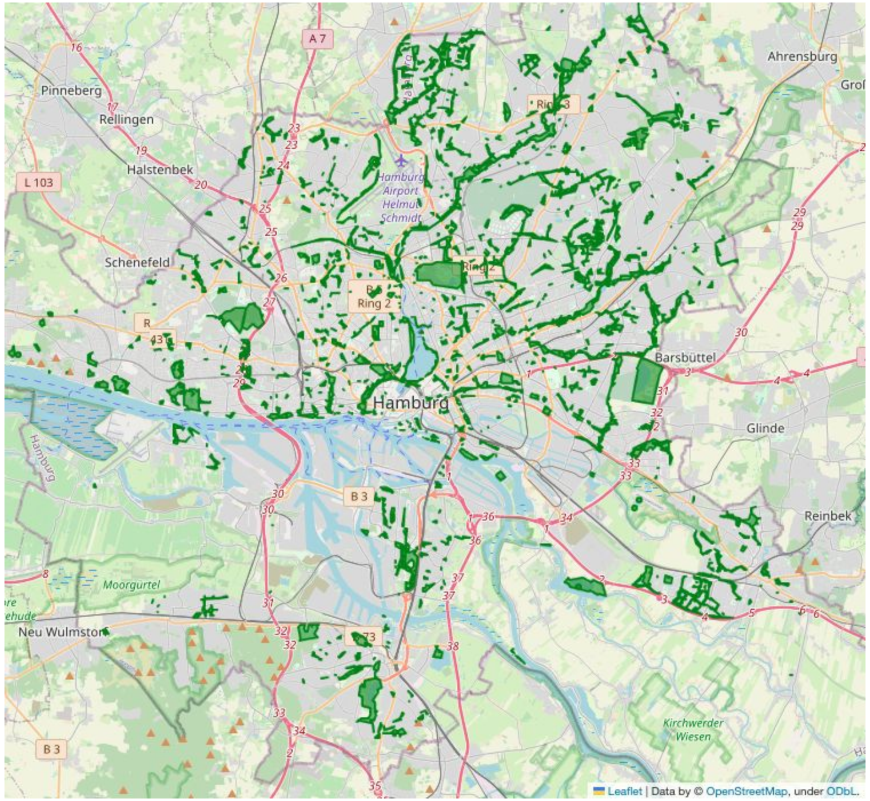

srai.py

```python
area = geocode_to_region_gdf("Wrocław, PL")
tags = {"building": True, "waterway": True}

features = OSMOnlineLoader().load(area, tags)
regions = H3Regionalizer(9).transform(area)
joint = IntersectionJoiner().transform(regions, features)

embedder = Hex2VecEmbedder()
neighbourhood = H3Neighbourhood(regions)

embeddings = embedder.fit_transform(regions, features, joint, neighbourhood)
```



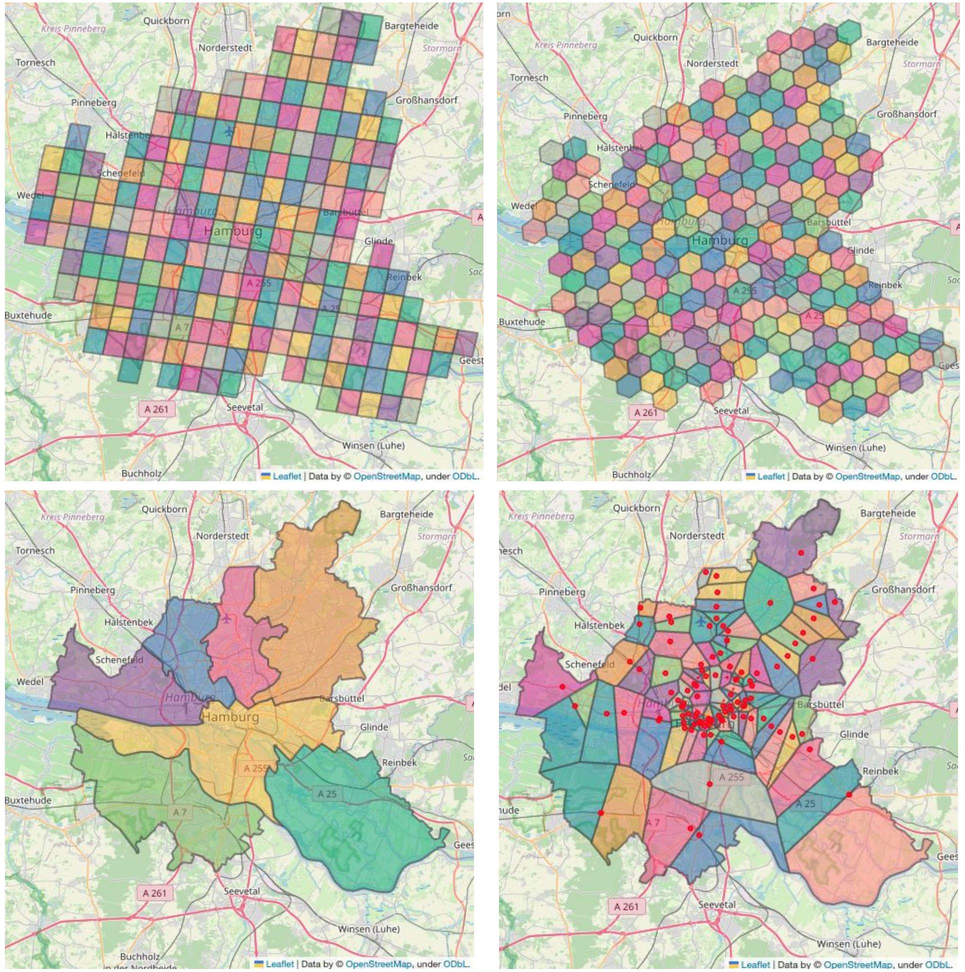
Loaders

1. OpenStreetMap
   - Tags & geometries
     - Overpass
     - Protomaps
     - Geofabrik & OSM.fr
   - Road networks
   - Map tiles
2. GTFS
   - public transport availability



Regionalizers

1. Spatial indices
   - Uber’s H3
   - Google’s S2
2. Data driven regions
   - Voronoi cells
3. Existing regions
   - OSM based
   - Admin levels



Embedders

1. Baseline embedders
   - Feature counts
   - Contextualized feature counts - ARIC’21
2. Trainable models
   - Hex2Vec - GeoAI’21
   - GTFS2Vec - GeoSearch’21
   - Highway2Vex - GeoAI’22
   - GeoVex - GeoAI’23 (by Daniele Donghi & Anne Morvan, impl. Max Schrader)

Future works

1. Pre-trained models and pre-calculated embeddings hosting
2. Datasets and Benchmarks
3. Fine-tuning interface
4. Multimodal approach - Computer Vision and Graph Embeddings
5. Next-gen Geospatial Representation Learning Models
6. Support for out-of-core scenarios (DuckDB or Dask-GeoPandas)
7. ...

Q&A

Library: github.com/kraina-ai/srai

Website: kraina.ai