openrouteservice - route the world dynamically

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Fact Sheet

- **openrouteservice** is a project of the KTS backed HeiGIT institute at the University of Heidelberg
- started in 2008, **openrouteservice** was one of the first routing API's
- entirely **open-source**, backend written in **Java**
- based on **OpenStreetMap** data
- 2500 requests per day **for free**

Available API's

Directions

Isochrones

Geocoding

Matrix

Places

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Local installation

License: Apache 2.0

```
git clone https://github.com/GIScience/openrouteservice
cd docker && sudo docker-compose up
```

Approx. **64-128 GB RAM** per profile for `planet.pbf`.

Geocoding and **Places** need special setup:

https://github.com/pelias/pelias

https://github.com/GIScience/openpoiservice

Architecture

openrouteservice

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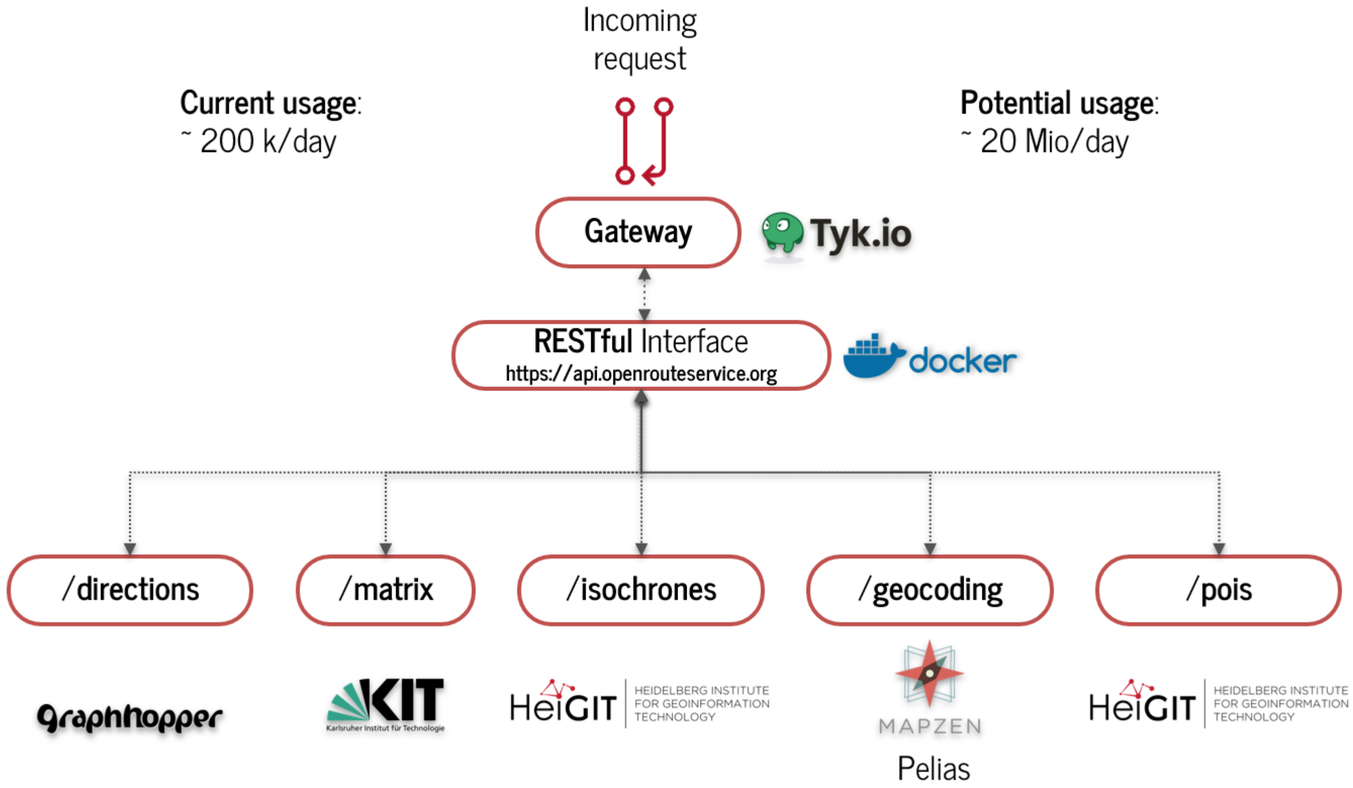

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Infrastructure

Clients

Python client

Github PyPI RTD

R client

Github Docu

QGIS plugin

Github Plugin repo

Web app

Github

Microservices

openpoiservice

Flask application to serve OSM Places of Interest (POI's) via a Rest API.

Features

- fully self-contained microservice to create, drop and populate PostGIS tables
- `POST` endpoint, which accepts GeoJSON as geometry and OSM tags as filters
- Customizable setup with Docker container

Github

Coming Soon!!

openfuelservice

Flask application to estimate fuel consumption on > 600 car models. Takes GeoJSON and car model as input.

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Directions API

Classical routing API, based on the excellent GraphHopper stack.

Features

- 10 routing profiles:
  - 2 car: `driving-car`, `driving-hgv`
  - 5 cycling, incl. `*-mountain`, `*-safe`
  - 2 walking: `foot-walking`, `foot-hiking`
  - **`wheelchair`**
- Output formats: `geojson`, `gpx`
- 13 languages for instructions
- Returns extra way information for route segments, e.g. steepness, surface, tollways

Functionalities

- `bearing`, `radiuses`: Control input point snapping behavior
- `continue_straight`: Avoid u-turns, even if faster
- `avoid_*`: Avoid features, e.g. ferry, **countries**, **polygons**
- vehicle dimensions: use OSM dimension tags to route compliantly
- **green/quiet**: prefer green and/or quiet routes (**only** available in Germany right now)
- **landmark** backed pedestrian navigation (**only** available in Germany)

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Directions - Avoid features for `cycling-regular`

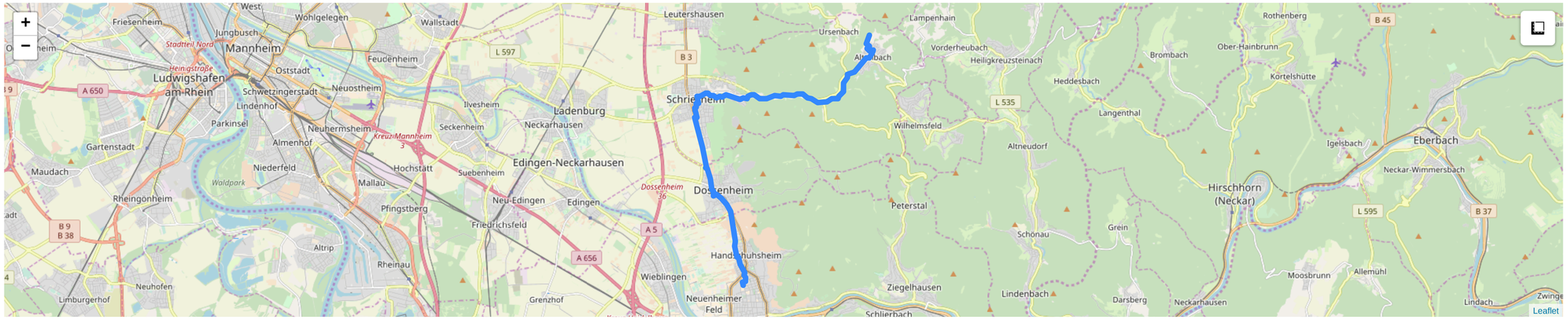
In [4]:

```
import openrouteservice as ors

ors_key = api_key["ORS"] # keys are stored in local file
clnt = ors.Client(key=ors_key) # set up client
# This function is called by the widget's event callback
def avoidHills(mode):
    params = {'coordinates': [[8.681602, 49.422141],[8.737221, 49.49333]],
              'profile': 'cycling-regular',
              'format_out': 'geojson'}
    if mode != 'none':
        params['options'] = {'avoid_features': mode}
    route = clnt.directions(**params)
    return route

widget_hills
```

Avoid: hills | unpavedroads | none



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Directions - Avoid countries for `driving-hgv`

In [20]:

```python
import openrouteservice as ors

ors_key = api_key["ORS"] # comes from local file
clnt = ors.Client(key=ors_key) # set up client
# This function is called by the widget's event callback
def avoidCountry(country):
    country = '|'.join([str(c) for c in country])
    params = {'coordinates': [[7.987061, 47.682032],[9.733887, 47.090696]],
              'profile': 'driving-hgv',
              'format_out': 'geojson',}
    if country != 'None':
        params['options'] = {'avoid_countries': country}
    route = clnt.directions(**params)
    return route

widget_country
```

Countries
DE
CH
AT
None

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Directions - Route green or quiet for `foot-walking`

In [22]:

```python
import openrouteservice as ors

ors_key = api_key["ORS"] # comes from local file
clnt = ors.Client(key=ors_key) # set up client
# This function is called by the widget's event callback
def routeGreen(pref):
    params = {'coordinates': [[8.690872, 49.406673],[8.692117, 49.430124]],
              'profile': 'foot-walking',
              'optimized': 'false',
              'format_out': 'geojson'}
    if pref != 'none':
        params['options'] = {'profile_params': {'weightings': {pref: {'factor': 1.0}}}}
    route = clnt.directions(**params)
    return route

widget_green
```

Preference: green | quiet | none

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Isochrones API

Features

- 9 routing profiles:
  - 2 car: `driving-car`, `driving-hgv`
  - 5 cycling, incl. `*-mountain`, `*-safe`
  - 2 walking: `foot-walking`, `foot-hiking`
- Query up to 5 locations and 10 intervals in one request

Functionalities

- **`attributes`**: Returns e.g. total population within isochrone[1]
- plus similar functionalities as **Directions** API

[1] Global data coverage by EU GSH

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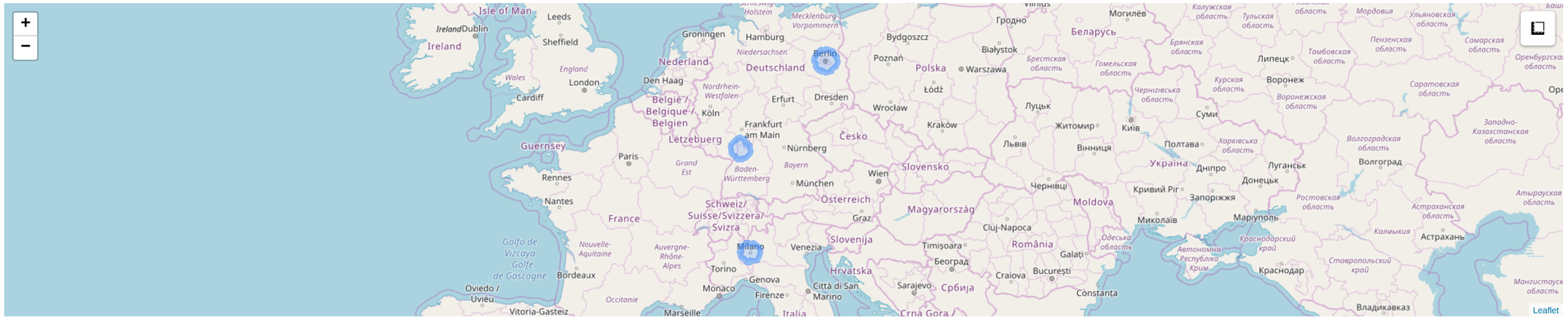
Isochrones - Retrieve population

In [24]:
```python
import openrouteservice as ors

ors_key = api_key["ORS"] # comes from local file
clnt = ors.Client(key=ors_key) # set up client
# This function is called by the widget's event callback
def calculateIso(dim):
    number = 1800 if dim == 'time' else 50000
    # Milan, Heidelberg, Berlin
    params = {'locations': [[9.170837, 45.47554],[8.684692, 49.409186], [13.41332, 52.521626]],
              'profile': 'driving-car',
              'range_type': dim,
              'intervals': [number],
              'segments': number,
              'attributes': ['total_pop']}
    iso = clnt.isochrones(**params)
    return iso

widget_iso
```

Type: time distance



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Geocoding API

Fork of [Pelias](#) geocoding engine.

Features

- 3 endpoints:
  - `geocoding/search?`
  - `geocoding/reverse?`
  - `geocoding/autocomplete?`
- 4 data sources:
  - **WhosOnFirst**: Global administrative boundaries
  - **OSM**
  - **openaddresses**: ~ 500 Mio addresses
  - **geonames**: Additional place names and locations

Functionalities

- **libpostal**: address parser and normalizer
- **placeholder**: address parser for unstructured text
- **interpolation**: attempts interpolation for unknown house numbers

These extra services are stand-alone API's and can be used in any application.

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Geocoding - Running out of names?!

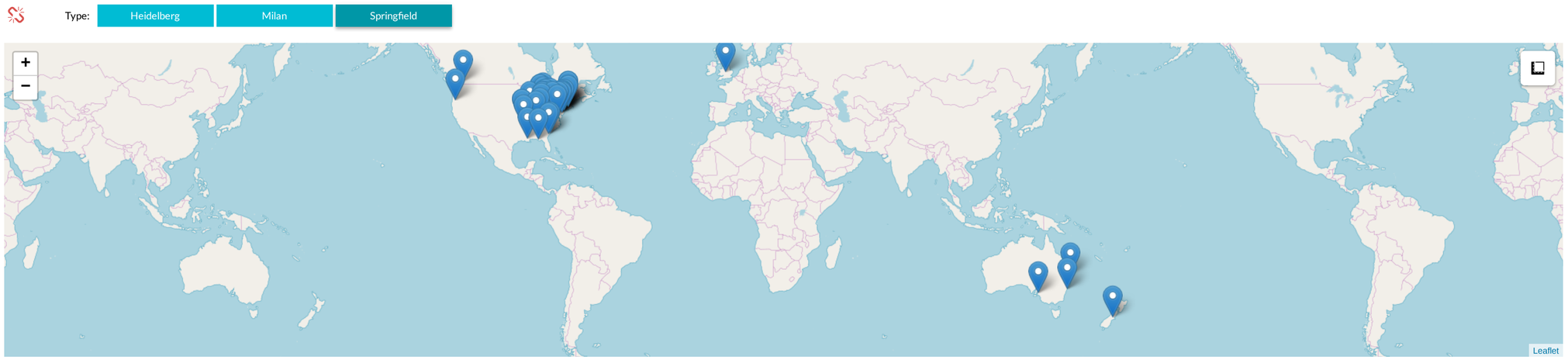
In [14]:

```
import openrouteservice as ors

ors_key = api_key["ORS"] # comes from local file
clnt = ors.Client(key=ors_key) # set up client
# This function is called by the widget's event callback
def geocode(name):
    route = clnt.pelias_search(name, size=50)
    return route

widget_geocode
```

```
Amount of cities worldwide:     40
Amount of cities in US:         34
```



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Matrix API

Features

- Calculates OD matrices for up to **50x50 locations**
- For all 9 profiles
- Both `distance` and `duration` are returned

POI API

Features

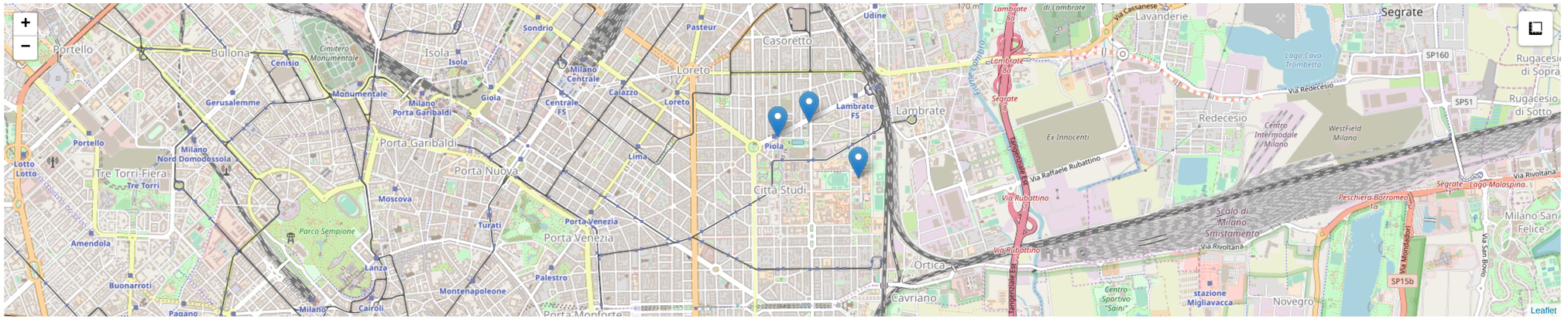
- Query OSM POI's for up to 5 categories in one request
- Use GeoJSON geometries or bbox to filter geographically
- Use OSM tags to filter POI's, e.g. `smoking: no`, `wheelchair: yes`
- Returns up to 2000 POI's per request

POIs - What's around us

In [28]:
```
import openrouteservice as ors
from geojson import Point

ors_key = api_key["ORS"] # comes from local file
clnt = ors.Client(key=ors_key) # set up client
# This function is called by the widget's event callback
def getPois(location):
    params = {'request': 'pois',
              'geojson': Point(location),
              'buffer': 1000, # 1km radius around SOTM location
#               'filter_category_ids': [570],
              'sortby': 'distance'}
    route = clnt.places(**params)
    return route
pois = getPois(milan)
options = populate_list(pois)
widget_pois = widgets.Dropdown(options=options)
widget_pois.observe(on_change_pois, names='value')
widget_pois
```

atm



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You know what's on for dinner?

Let's see how OSM and Yelp make the restaurant choice a little easier:

- Find restaurants within 10 min walking distance from SOTM location
- Filter restaurants with Yelp rating >= 4
- Create widget to filter by restaurant category

Set up *openrouteservice* client

1. Sign up on our homepage
2. Create API key on our developer portal
3. Review our ToS
4. `pip install openrouteservice`
5. Fire away!

Here we:

- ***Geocode*** the SOTM official address
- Create an ***isochrone*** with 10 mins walking radius

In [17]:
```
import openrouteservice as ors

clnt = ors.Client(key='5b3ce3597851110001cf624870cf2f2a58d44c718542b3088221b684')

params_geocode = {'text': 'Politecnico di Milano - Piazza Leonardo da Vinci, Milan, Lombardy, Italy'}

sotm_location = clnt.pelias_search(**params_geocode)['features'] # Geocode from official address
sotm_isochrone = clnt.isochrones(locations=sotm_location[0]['geometry']['coordinates'], # Calculate isochrones
                                 intervals=[600],
                                 segments=600,
                                 profile='foot-walking')
```

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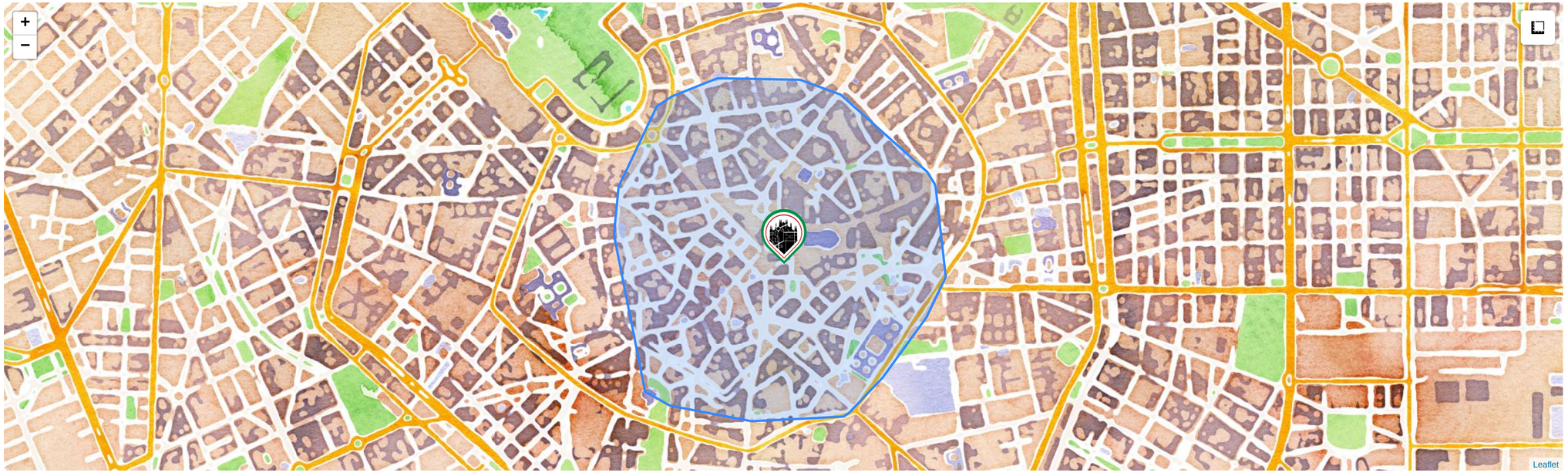
Set up a basic `folium` map

- The `createWidgetBaseMap` factory sets up the initial map, so we start fresh every time

In [19]:
```
fig, m = createWidgetBaseMap('100%', 600) # Call map factory with figure dimensions
fig.add_child(m)
fig
```

Out[19]:



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Request restaurant POI's

- `/pois?` endpoint takes GeoJSON
- we can pipe the GeoJSON output of `/isochrones?` directly to `/pois?` to limit the query to the isochrones geometry

In [20]:
```
param_pois = {'request': 'pois',
              'geojson': sotm_isochrone['features'][0]['geometry'],
              'filter_category_ids': [570], # ID list: https://github.com/GIScience/openrouteservice-docs#sustenance--560
              'sortby': 'distance'}

sotm_restaurants = clnt.places(**param_pois)['features']
display(HTML('<br><br>Amount of restaurants within 10 mins walking radius: <strong>{}</strong>'.format(len(sotm_restaurants))))
```

Amount of restaurants within 10 mins walking radius: **121**

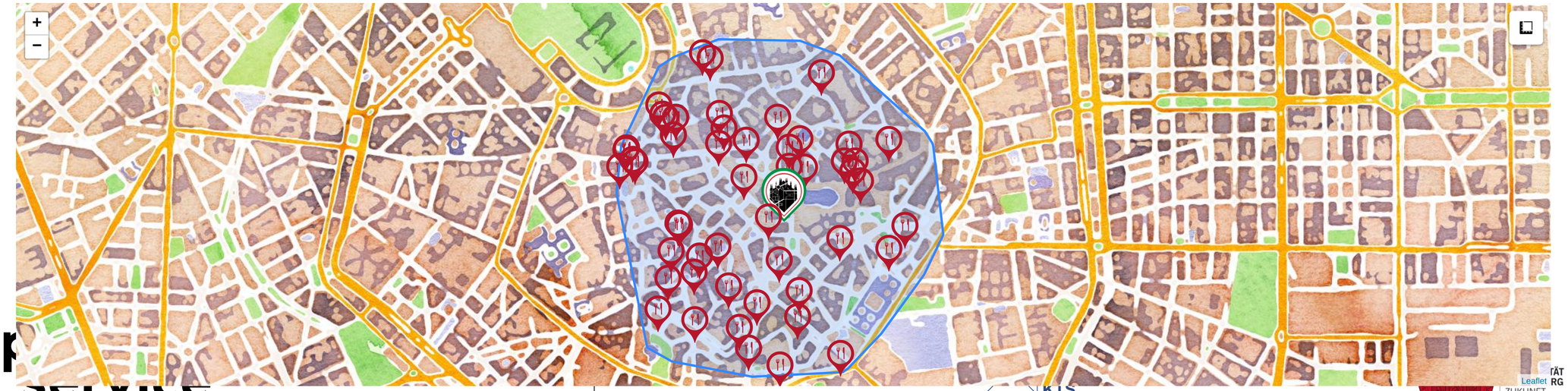
Yelp rating

- use the Yelp businesses API to query the reviews of our restaurants
- extract `name`, `rating` and `url` to feature popup

In [22]:
```
import branca

fig, m = createWidgetBaseMap('100%', '500')
for restaurant in sotm_restaurants:
    r_name = restaurant['properties']['osm_tags'].get('name', '')
    if r_name != '':
        r_coords = restaurant['geometry']['coordinates']
        yelp_return = yelp_response(r_name=r_name, # Call hidden function to retrieve Yelp results with rating >= 4 stars
                                    r_coords=r_coords)
        if yelp_return:
            restaurant['yelp'] = yelp_return
            restaurant_icon = folium.features.CustomIcon('https://openrouteservice.org/wp-content/uploads/2017/07/restaurant2.png',
                                                         icon_size=(50, 50))
            popup_html = '<h4>{0}</h4><strong><a href="{1}" target="_blank">URL</a><br>Stars: </strong>{2}'.format(r_name, yelp_return['url'], yelp_return['rating'])
            iframe = branca.element.IFrame(html=popup_html, width=300, height=100)
            popup = folium.Popup(iframe, max_width=300)
            folium.map.Marker(list(reversed(r_coords)), icon=restaurant_icon, popup=popup).add_to(m)
fig.add_child(m)
fig
```

Out[22]:



op

service

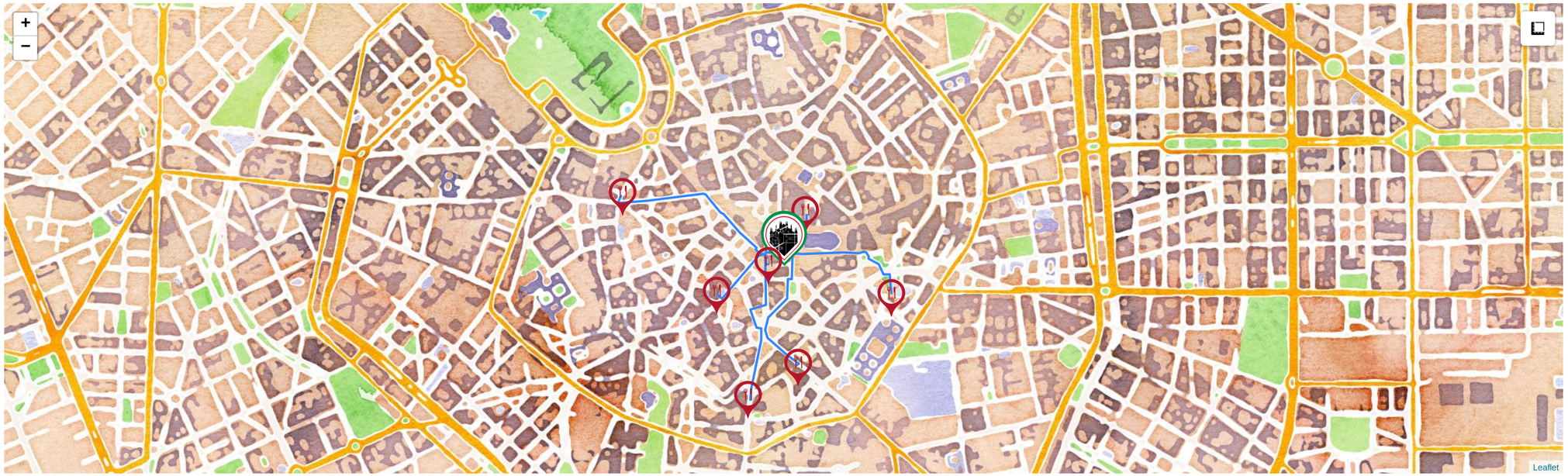
IPython widget

The final product is a drop-down widget to query the directions to nearby restaurants by restaurant category:

In [25]:
```
category_titles = []
for restaurant in sotm_restaurants:
    if restaurant.get('yelp', '') != '':
        category_titles.append(restaurant['yelp']['categories'][0]['title'])

widget_dd = widgets.Dropdown(options=set(category_titles)) # Create widget with categories in drop-down
widget_dd.observe(on_category_change, names='value') # Hidden method is called by the listener
display(widget_dd)
```

Pizza



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- **Pelias** and **GraphHopper** crews for developing cutting-edge open-source tech!
- **Damian Avila** for the `rise` development which powers this presentation
- **Jupyter** development crew
- **Yelp** for providing a free attractions API

The source code and PDF of this presentation can be found here:

https://github.com/nilsnolde/sotm2018

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[Github ORS backend]
[Github ORS frontend]

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 @realNilsNolde

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Software & business development

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