PMS 509 Knowledge Technologies
Homework III
Due: January 20, 2022

1. The first step in this homework is to install Strabon (`http://strabon.di.uoa.gr/`) and store the datasets Rivers and Lakes of Greece and Greek Administrative Geography from the portal Greek Linked Open Data (`http://www.linkedopendata.gr/`). (You will receive further instructions on how to install and use Strabon). Once you have stored the two datasets in Strabon, answer the following queries using stSPARQL or GeoSPARQL. Note that depending on the kind of answer that is expected from the query (e.g., a set of geometries), you should choose an appropriate way to view your answer (e.g., a map).

   (a) First execute the following queries against the Greek Administrative Geography dataset.

      i. Find the names and geometries of all municipalities (δήμοι) that are included in a given rectangle.
      This is a simple and useful query that is typically issued by drawing a rectangle in visual query interfaces based on maps. To make your query more concrete try the following rectangle specified in WKT:

```
"POLYGON((23.148193359375 36.177978515625,
23.13720703125 34.43115234375,
27.00439453125 34.442138671875,
26.993408203125 36.14501953125,
23.148193359375 36.177978515625));
http://www.opengis.net/def/crs/EPSG/0/4326"
^^<http://strdf.di.uoa.gr/ontology#WKT>
```

      ii. Display on a map the geometries of all municipalities of the regional unit of Heraklion (Περιφερειακή ενότητα Ηρακλείου).

      iii. Find the names of all municipalities of the regional unit of Heraklion (Περιφερειακή ενότητα Ηρακλείου) that have geometries disjoint from the geometry of the municipality of Hersonissos (Δήμος Χερσονήσου).

      iv. Compute the total area of all municipalities of the region of Crete.

   (b) Now run the following queries against the Rivers and Lakes of Greece dataset:

      i. Find all the rivers and lakes and show the results on a map.

      ii. Find the five biggest rivers of Greece and show them on a map.

iii. Find all the lakes and rivers which intersect each other and display them on a map.

(c) Now run the following queries using both datasets:

i. Find all the municipalities that are crossed by a river. Display the results on a map.

ii. Find all the municipalities that intersect with a lake. Display the results on a map.

iii. Find all the rivers that cross through at least two municipalities. Display the results on a map.

iv. Find all the rivers in the region of Crete (ΠΕΡΙΦΕΡΕΙΑ ΚΡΗΤΗΣ). Show the results on a map.

v. Find all the rivers in the region of Crete that are entirely contained in a single municipality of Crete.

vi. Find all the lakes in the region of Western Greece (ΠΕΡΙΦΕΡΕΙΑ ΔΥΤΙΚΗΣ ΕΛΛΑΔΑΣ).

vii. Find the ten bigger lakes of Greece and the regions they belong to.

viii. Find all the rivers that cross through the municipality of Heraklion (Δήμος Ηρακλείου).

2. OpenStreeMap (OSM) is an open and free map service created by volunteers (`https://www.openstreetmap.org/`). In this exercise you will build an OWL 2 ontology for a part of OSM.

   Please start by reading the following Web pages/documents:

   - `http://wiki.openstreetmap.org/wiki/`. Read the Beginners Guide and browse the Map Features documentation.
   - `http://download.geofabrik.de/osm-data-in-gis-formats-free.pdf`. This document describes OSM data using terminology from the area of Geographic Information Systems something that we also did in the lecture on linked geospatial data. This document will be used for understanding which OSM features should be covered by your ontology. Your ontology should cover **only** the following features of OSM:
     - Places (Section 4.1 of the document)
     - Natural Features (Section 4.3 of the document)
     - Waterways (Section 5.3 of the document)
     - Land use and land cover (Section 6.2 of the document)
     - Bodies of water (Section 6.3 of the document)

   After you have read the above documents and understood what the ontology will be about, start developing it using the ontology engineering principles we would have covered in the lectures. Your ontology should be an extension of the GeoSPARQL ontology we have presented in the linked geospatial data lecture.

3. **Project:** For this project you will use the tools GeoTriples, Strabon and Sextant that were presented in the lectures. You can download all the latest versions of the tools and find instructions on how to install and run them in the website `http://ai.di.uoa.gr/`.

   Your first task is to go to the data portal `https://geodata.gov.gr/en/dataset` and find one dataset of interest that is available as SHAPEFILE. You will have to download this dataset and use the tool GeoTriples to transform it into the RDF model.

   Now you can store the dataset in the tool Strabon, along with the Kallikratis dataset that you used in the previous exercises.

   The final step is to use the tool Sextant and create a map with at least five layers, using a GeoSPARQL query for each layer, to demonstrate the two datasets that you have used. The queries should be interesting ones that showcase the links between the two different datasets.