PMS 509 Knowledge Technologies
Class Project. **Due on: March 21**

Design Mobile Applications using Copernicus Service Products that are made available as Linked Geospatial Data

(Grade: 25%)

February 5, 2018

Copernicus (http://www.copernicus.eu/main/overview) is a European Union Programme aimed at developing European information services based on satellite Earth Observation (EO) and in situ (non-space) data. Vast amounts of global data from satellites and from ground-based, airborne and seaborne measurement systems are being used to provide information to help service providers, public authorities and other international organisations improve the quality of life for the citizens of Europe. The information services provided are **freely and openly** accessible to its users.

The Copernicus Services transform this wealth of satellite and in situ data into value-added information by processing and analysing the data. Datasets stretching back for years and decades are made comparable and searchable, thus ensuring the monitoring of changes; patterns are examined and used to create better forecasts, for example, of the ocean and the atmosphere. Maps are created from imagery, features and anomalies are identified and statistical information is extracted.

The Copernicus programme is a cornerstone of the European Union's efforts to monitor the Earth and its diverse ecosystems, whilst ensuring that we are prepared and protected in the face of a natural or man-made disaster. But Copernicus can also drive economic growth (http://publications.europa.eu/resource/cellar/cb805ac6-bc49-11e6-a237-01aa75ed71a1.0001.04/DOC_1), because it can act as a data source for applications and services. It is a symbol of European strategic cooperation in space research and industrial development. The images and data from a constellation of satellites and in-situ components are used by a wide range of economic sectors with applications in precision farming, civil protection and insurance, oil & gas exploration, meteorology or urban monitoring, to name just a few. Sales of data, value added services and applications related to Earth Observation, are undergoing a remarkable growth with an average annual rate of more than 13%. The close link between satellite images and the wider geoinformation products sector reinforces the strength of these downstream markets. The increasingly central role of Big Data is leading to the downstream development of commercial activities.

While Copernicus data are very useful, they have not been officially released in formats or via tools popular among mobile developers, nor have they been offered as linked open data. Offering intuitive tools the community can use to link its information to Copernicus data will make Copernicus an increasingly essential node in the web of data, which means it will see more exposure and usage by the crowd without the need for additional investment.

The H2020 project "Copernicus App Lab" provides an easy data access platform that brings together the scientific Earth observation (EO) community and mobile developers. At the end of the project, a proof-of-concept will provide data from the Copernicus Land, Marine Environment, and Atmosphere Monitoring Services as linked open data to promote the inclusion of EO data into value-added services and/or mobile applications. The overall objective of the Copernicus App Lab is to demonstrate a user-driven evolution in services that can be integrated seamlessly into the existing service architecture. This means that Copernicus contributes to the development of innovative applications and services by making the vast majority of its data, analyses, forecasts, and maps freely available and accessible in order to make our world safer, healthier, and economically stronger.

This project will be carried out in two stages:

STAGE 1: Transformation into RDF (Due on: March 4)
Transforming data into the RDF model consists of two basic steps: (i) design an ontology and (ii) use this ontology to transform the data using a parser. For this task we provide you a general purpose ontology for Earth Observation products, that you will use to transform your data.

When facing the transformation problem in Linked Data, in most cases it is easy and straightforward to transform the data in RDF using the tool GeoTriples. GeoTriples is a tool for transforming data from their original formats (e.g., shapefiles or spatially-enabled relational databases) into RDF and can also handle geospatial information. The following input formats are supported: spatially-enabled relational databases (PostGIS and MonetDB), ESRI shapefiles and XML, GML, KML, JSON, GeoJSON and CSV documents.
In our case the datasets come in a format that is not yet supported by the tool, but you might need it to transform other datasets that you want to use in STAGE 2. For this stage to transform the data you need to design a parser to transform the data to RDF from their original format, using the given ontology. A sample parser written in Python, can be found here. You can adjust this parser to your needs, or build your own in a programming language of your choice.
Each team will select one of the following datasets and will transform the data into the RDF model:

- European-scale air quality analysis from model ensemble - ozone
- European-scale air quality analysis from CHIMERE - PM10
- European-scale air quality analysis from EMEP - nitrogen dioxide
- European-scale air quality analysis from EURAD - sulphur dioxide
- European-scale air quality analysis from EURAD - carbon monoxide
- Global forecasts of aerosol concentrations - sulphates
- Global forecasts of aerosol concentrations - organic carbon
- Global forecasts of aerosol concentrations - PM10

All datasets are available in the Copernicus Atmosphere Service portal (https://atmosphere.copernicus.eu/catalogue#/). You can also find other atmosphere related datasets there to select from, for this stage of the project. For each dataset you will find detailed information with description and metadata to assist you in the transformation. You will download a small part of the datasets for a period of a few days and then using your parser and the provided ontology, will transform the data into RDF.

***** IMPORTANT *****

You have to send us an email until February 12, with the team members and a list of three datasets in order of preference. We will inform each team with a response on the dataset that you will work with for STAGE 1.

STAGE 2: Application Design (Due on: March 21)
In this stage you will be provided with all the data that have become available as RDF from the first stage from all the teams. You can also use all the available Linked Data that you can find here.

Using these data, along with any other source of Linked Data that you see fit (e.g., DBpedia), you will design a mobile application that shows how Earth Observation data can be enhanced and assist us in our scientific or societal needs. You do not need to implement a full working application. You can create a mockup with some of the functionality that will help us understand your scenario, the use of EO data and the role of the application.

You will also create a map using the tool Sextant, that illustrates some of the GeoSPQRQL queries you used in your application. Sextant is a web based and mobile ready platform for visualizing, exploring and interacting with linked geospatial data. The core feature of Sextant is the ability to create thematic maps by combining geospatial and temporal information that exists in a number of heterogeneous data sources ranging from standard SPARQL endpoints, to SPARQL endpoints following the standard GeoSPARQL defined by the Open Geospatial Consortium (OGC), or well-adopted geospatial file formats, like KML, GML and GeoTIFF.

Finally, you will make a presentation of your work in a date that will be announced. For this presentation you will prepare some slides that present the data that you used and your idea for the application, along with the mockup/app and the map that you have created with some sample GeoSPARQL queries in Sextant.