

# Web-Based Visualization of Large Semantic Graphs

## Client

Gabe Fierro (gtfierro@mines.edu)

## Project

Semantic graphs are a kind of knowledge base used to model large cyber-physical systems like buildings, smart grids and transportation systems. These graphs are increasingly found at the center of IoT orchestration and data analytics platforms where they help software programmatically data points and other resources. Visualizations are one way of interacting with semantic graphs; these help users learn the structure of the graph, observe patterns, and query for specific information. However, semantic graphs are difficult to visualize because of the inherent complexity and inter-relatedness of the systems they represent.

The goal of this project is to develop a web-based visualization engine and UI for semantic graphs. The visualization engine will support the following features:

- load and store graphs via user upload or remotely via URL
- execute SPARQL queries and return results
- transform and filter graphs using the SPARQL query language; save the results of the transformations and filters as new graphs
- save and load graph queries using URLs to allow sharing queries

The UI will support the following features, as enabled by the visualization engine:

- interactive visualization of the chosen graph using force-based layouts or similar approaches
- tabular output of queries against the graph, using existing libraries

We will be working with a collection of modern, cutting-edge technologies, including a Rust-based RDF database which can be compiled to WebAssembly and run in the browser:

<https://github.com/oxigraph/oxigraph>. The team will work closely with the client to design a web-based software stack that facilitates the development and extension of the features above.

The client has built some parts of these tools before (<https://gtfierro.github.io/223p-web-sparql/>) but is looking for students who are excited to "do it right". This project is an opportunity to learn cutting edge semantic web technology and create a tool that will be used by developers and researchers around the world.

## Team Size

3-5 students

## Skill Set

None of these skills are required if you are willing to put in the effort to learn! We will be using technologies that are very likely new to you (e.g. RDF data model, SPARQL query language) so coming in with at least one of the skills below is recommended:

- experience with 1 or more of the following programming/assembly/markup languages:
  - Python, JavaScript, Rust, WebAssembly, HTML, CSS
- experience developing web frontends (especially if you know Vue.js or any Javascript graph library)
- experience with graph database and/or query languages (especially triple stores or RDF databases, and the SPARQL query language)
- experience in designing user experiences on the web

## Location

Mines campus

## Expected Outcomes

At the end of the project, the team will be expected to make a presentation and demo on the tool to researchers from NREL, PNNL, LBNL and NIST, who will be using the tool for an ongoing project applying semantic graph technology to modeling smart buildings.