**Research Journal**

My attempt to solve this assignment went as follows:

I decided that I would attempt to include every motor vehicle bridge within the Pittsburgh city limit. This includes on and off ramps and bridges not over water. My first google searches for bridges in Pittsburgh were relatively fruitless. I eventually stumbled upon this site:

<https://bridgehunter.com/category/city/pittsburgh-pennsylvania/exhibit>.

I was able to pull information from the page source that I put into an ipython notebook. Then I cleaned the data until I had a table of 45 motor vehicle bridges. The notebook can be viewed here:

<https://github.com/juwanno/Bridges/blob/master/Untitled.ipynb>.

I realized that 45 bridges was far below the amount that I was looking for so I abandoned this data. I continued my search and found these two websites: <https://skeetidot.cartodb.com/tables/pittsburgh_bridges/public/map>

<http://pghgis.pittsburghpa.opendata.arcgis.com/datasets/60b25e95c256460592304758b59de19c_0>.

I downloaded the datasets and began the process of merging them while removing duplicates, demolished bridges, and bridges that did not service motor vehicles. The first link gave me the data for the two CartoDB\_Bridges files while the second provided the information for the Pittsburgh\_Bridges\_GIS files. I then combined these into the Pittsburgh\_Bridges\_Merge file. This data produced around 140 bridges. I worked mostly with excel.

At the same time, I discovered the National Bridge Inventory and downloaded the dataset for every bridge in the United States:

<https://www.fhwa.dot.gov/bridge/nbi/ascii.cfm?year=2015>.

I was able to look up the FIPS codes for Pittsburgh and pull out the bridges I was interested in. I also used the National\_Bridge\_Inventory\_Manual to determine which bridges were for motor vehicles as well as to determine how the latitudes and longitudes were represented. I then converted these to decimal degrees for use in my mapping tool. This produced around 300 bridges, which seemed like the correct number. I also used excel for this step.

I used ArcGIS to map out all of my data. The map can be viewed here:

<http://arcg.is/22ekzIa>.

I first mapped the National Bridge Inventory data. Unfortunately, many of the data points were outside of the city limits. I removed these points from my edited file. The coordinates were also not accurate enough to properly locate the bridges on the map. They were given down to the hundredth of a second, so I assume the error occurred at the time they created the coordinates. This led to this data set becoming relatively useless for mapping. I then decided to use the data merged from the CartoDB and Pittsburgh Bridges data. These seemed to be much more accurate when I mapped them out, though not always perfect. The provided map contains multiple layers representing each of these steps labeled by which file I used to create them.

Now that I had my data, I had to decide how to map it/determine the best route. Google Maps and Google Earth did not seem to be efficient options at first. I searched for a Google Maps traveling salesman problem solution and came upon this site:

<http://gebweb.net/optimap/>.

It allowed me to enter around 50 locations at a time and determine the optimal route between a set starting and ending point. It also allowed me to move the points manually if they were not quite where they needed to be as well as add new points not included in my data. These two features were very useful for filling in some of the bridges from the National Bridge Inventory dataset. This website is able to return a reordered list of coordinates, an estimated time of travel, and a list of turn by turn directions. I decided to break up the points by region.