Tutorial in Determining the Ideal Location for a Production Facility

Naomi Mauss

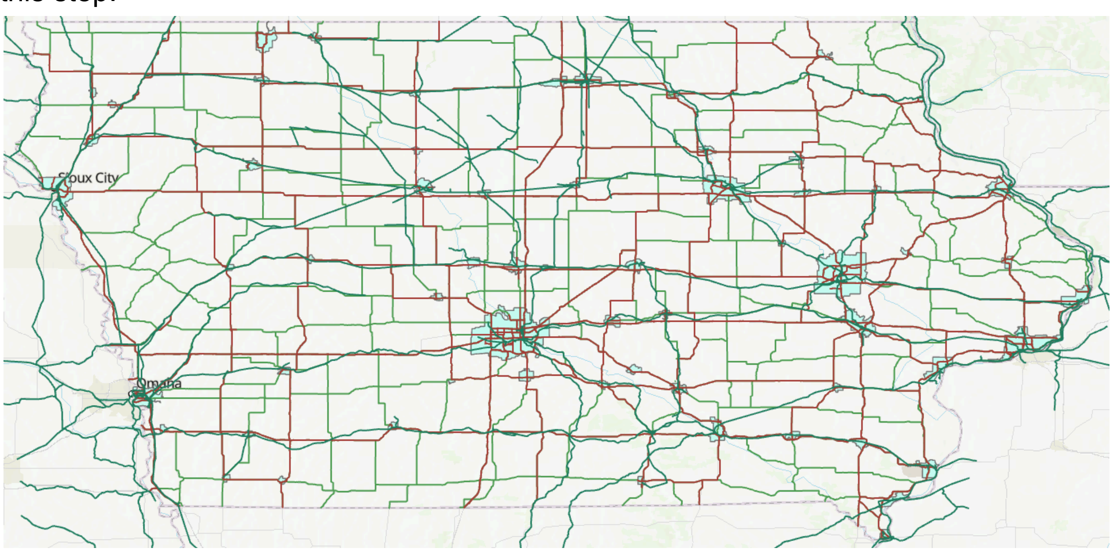
Using ArcGis is frequently more rewarding than it is challenging, but frustrations can certainly arise when one does not know how to locate a tool or function. For this reason, I highly encourage you to utilize the search bar at the top of the pane whenever you might feel lost. All of the tools and steps are named in this document as they appear in the ArcGIS desktop application, so entering any difficult term in the search bar should produce helpful results.

Before we start the project, we need to download the correct files!
The files needed for this project are listed on government website under the following names:

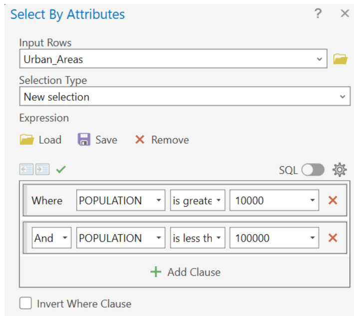
- Iowa_Stream_Order
- Urban_Areas
- Nationwide_Rivers_Inventory
- Rail_Line_Active
- National_Highway_System
- iowa_border
- Flood_Hazard_Area
- Airport
- National Highway System (This is provided and does not come from a government website.)

Before you begin, please make sure to create a new folder on your computer containing these files.

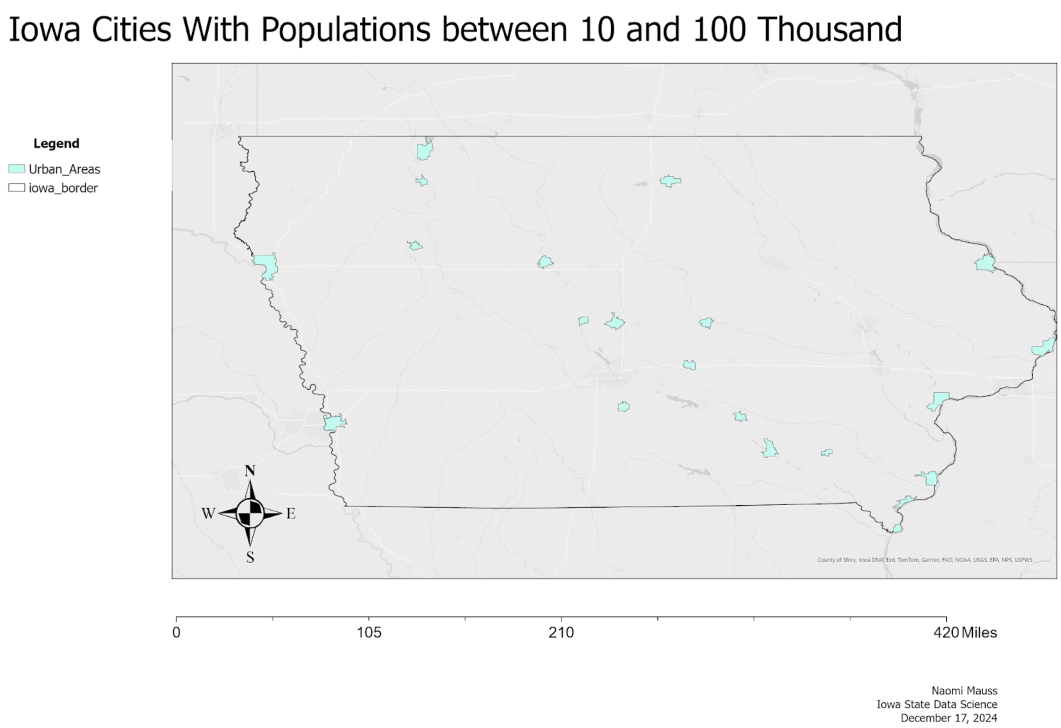
1. Open an ArcGis project and add the files for the national highway system, the railway system, the Iowa highway system, the Iowa border, and Iowa's cities. At this point, your project should look similar to the below image, though symbology is not very important at this step.



2. In the attribute table for Iowa's cities, use the 'Select by Attributes' tool to choose cities with a population between 10 and 100 thousand, as shown in the picture below.

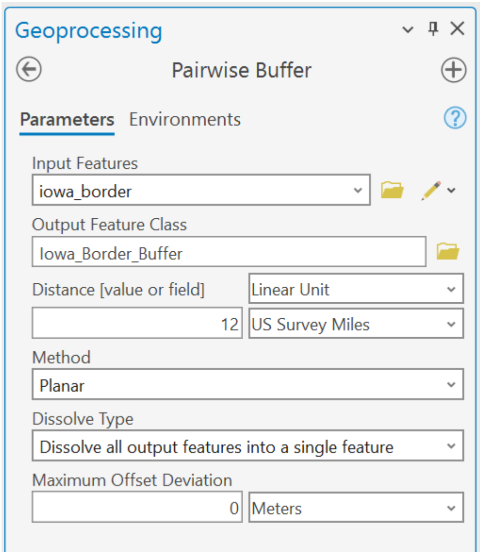


3. The resulting map should look similar to the one shown directly below.

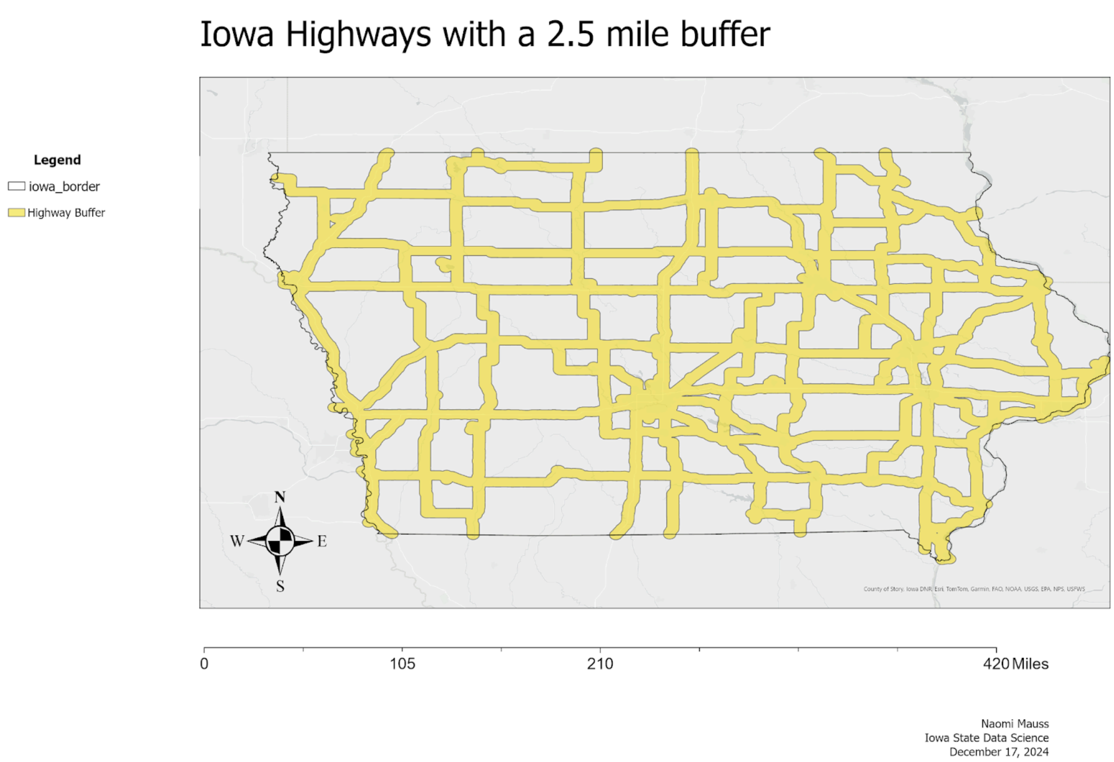


4. Upon selecting those cities, use the 'Switch' tool at the top of the attribute table to select all the cities which do not meet those criteria. Then, delete them. They will not be needed for the rest of this project.
5. We next need to filter out areas which are within 12 miles of the Iowa border. To do this, use the 'Pairwise Buffer' tool to make a new layer as is shown below. For the scope of this project, the difference between US survey miles, statute miles, and international nautical miles is not the most important. It is important, however, that the same method

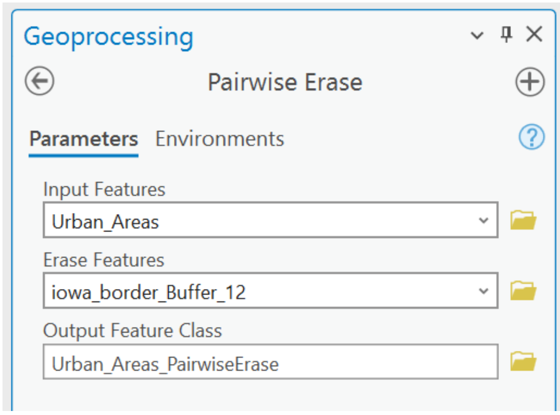
of measuring a mile is used each time this step is performed.



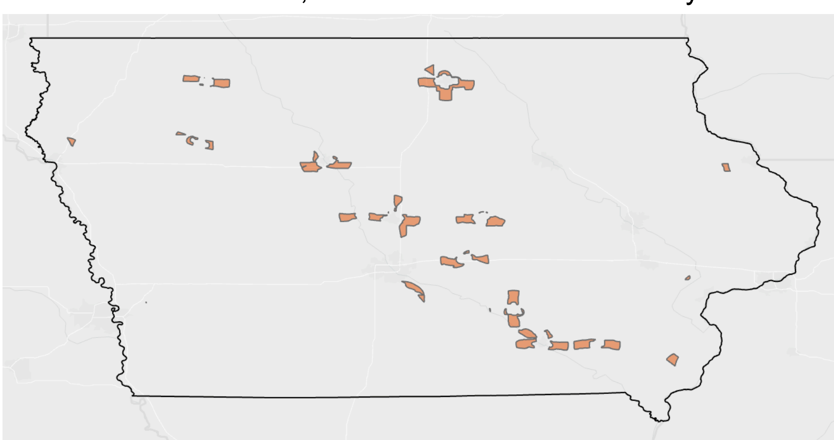
6. Repeat step 5 and create a 2.5 mile buffer around highways, a 3 mile buffer around active rail lines, a 10 mile buffer around urban areas, and a second 1.25 mile buffer around urban areas. An example of the highway buffer is attached below as a reference.



7. Once you have created the Pairwise Buffer tool, use the ‘Pairwise Erase’ tool to remove all potential building areas which are within the 12 mile buffer. Be sure to edit the same feature class throughout steps 7, 8, and 9.

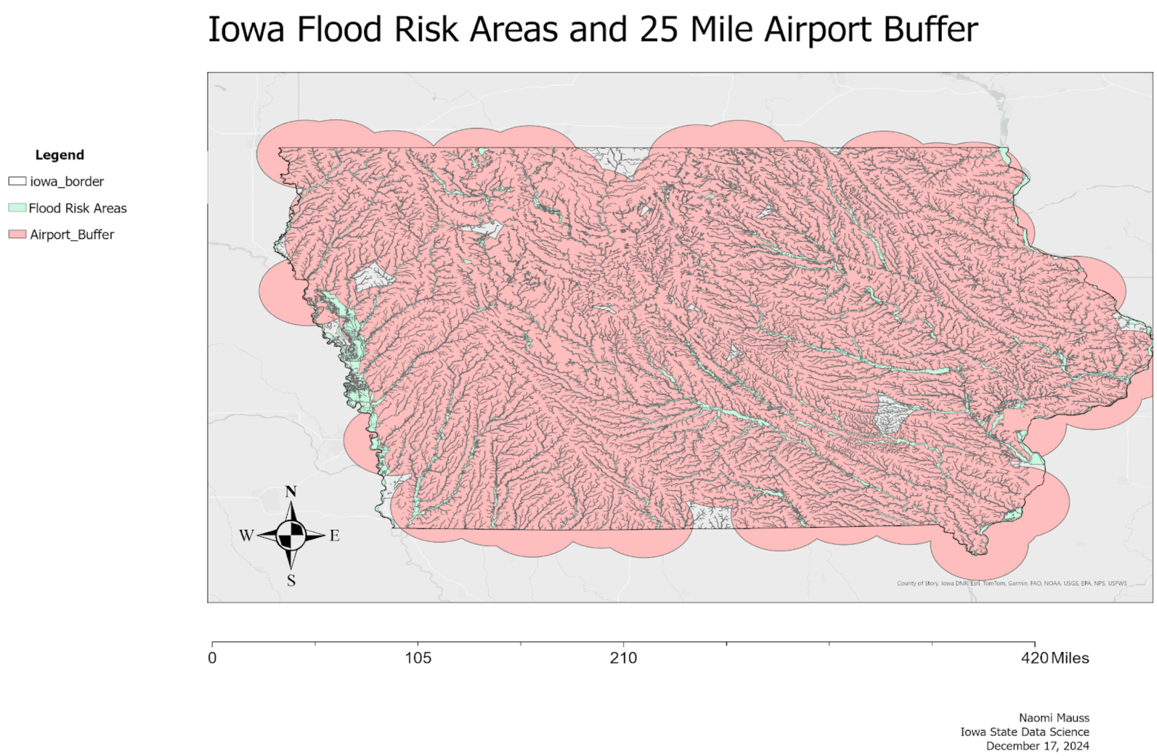


8. Use the ‘Pairwise Erase’ tool again. This time, the input feature should be the 10 mile buffer around urban areas, and the erase feature should be the 1.25 mile buffer around urban areas.
9. Use the ‘Pairwise Intersect’ tool to find the intersection of the highway, rail line, and urban areas buffer.
10. Select all the polygons, and use the ‘Explode’ tool. This tool does not require any input other than the selected polygons, and it will make each non-continuous polygon a new element. This way, we will know which polygons are less than 1000 continuous acres.
11. Now, open the attribute table and right click a column. Select the ‘Calculate Geometry’ tool, and calculate the area of each polygon in acres. Use the ‘Select Attributes’ tool to find all polygons with an area less than 1000 acres. Once they are selected, delete those polygons.
12. At this point, your project should look similar to the below image. We have now found areas between 1.25 and 10 miles of urban areas within a population over 10,000 but less than 100,000. We are only considering areas within 2.5 miles of a highway, within 3 miles of active rail lines, and more than 12 miles away from Iowa’s state border.

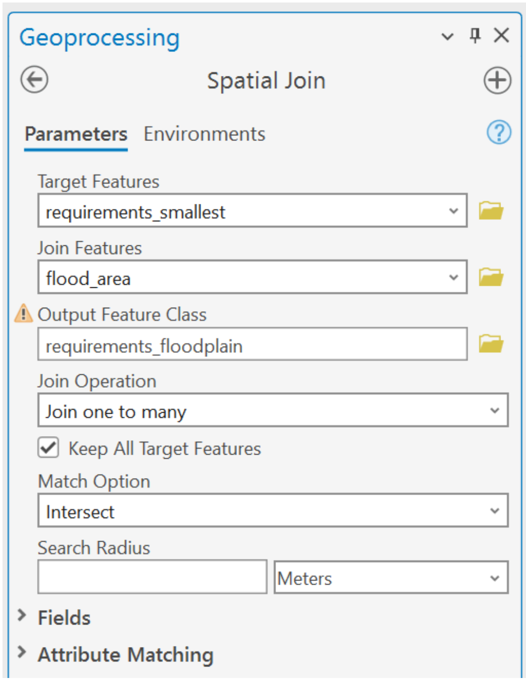


13. Now, we want a site which is within 25 miles of an airport. Import a layer containing all the airports in Iowa, then create a 25 mile buffer surrounding the points. Repeat step 4 to do this. This is because if we assume a standard speed limit of 45 miles an hour,

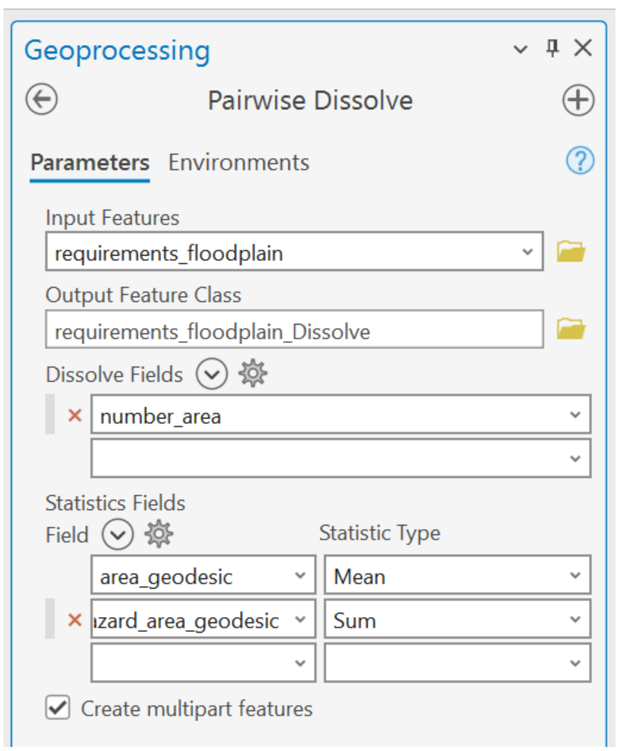
everything in this buffer will be within approximately half an hour drive of an airport. The result should be similar to the image below. We can clearly see that none of the potential development areas are more than 25 miles away from an airport, as well as the flood zones we will consider in the next step.



14. We want sites which are near water. However, insurance increases significantly when buildings are constructed in a flood zone. Therefore, we want to find and remove any sites which have more than 20% of the site in a flood zone. To do this, we first need to import the layer of flood zones in Iowa.
15. As was done earlier, use the ‘Pairwise Intersect’ tool to discard any and all flood areas outside of the potential build sites.
16. Similarly to what was done in step 11, calculate the area of each flood site in acres, using the same unit of measurement that you used to calculate the area of each potential build site.
17. Now, create a new column in the attribute table of potential build sites called ‘numbering’ or something similar. This is done so that when we perform a spatial join in the next step, each flood polygon will have a corresponding potential build site, from which we will perform a pairwise dissolve.
18. Use the ‘Spatial Join’ tool to join the layers of potential build sites and of floodplains. Be sure to select the ‘Join one to many’ join operation, or this will not work properly. It should look similar to the image below.

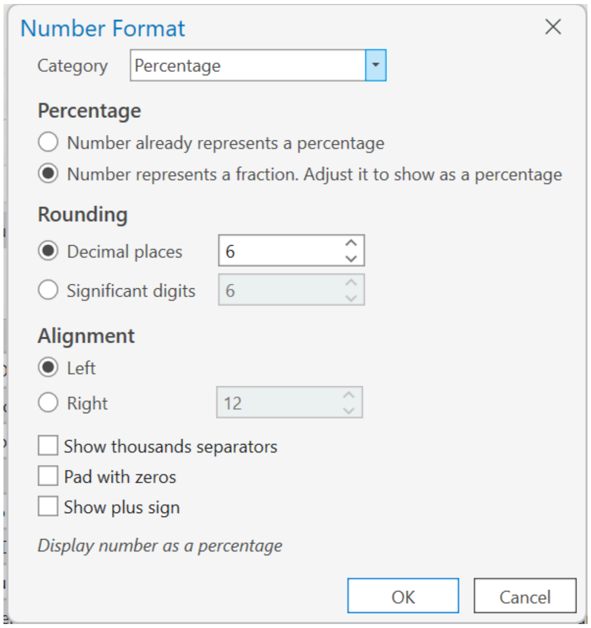


19. Now, perform a ‘Pairwise Dissolve,’ dissolving the number field created earlier. Be sure to retain the original area of the build site and sum the floodplain areas, as is shown in the image below.



20. Next, we’re going to want to calculate the percentage of each build site which is in a floodplain. To do this, enter the ‘Field View’ and create a ‘percent_floodplain’ column which is a double. This should be a percentage instead of a numerical value, and should

represent a fraction, with the same settings as is shown in the image below.

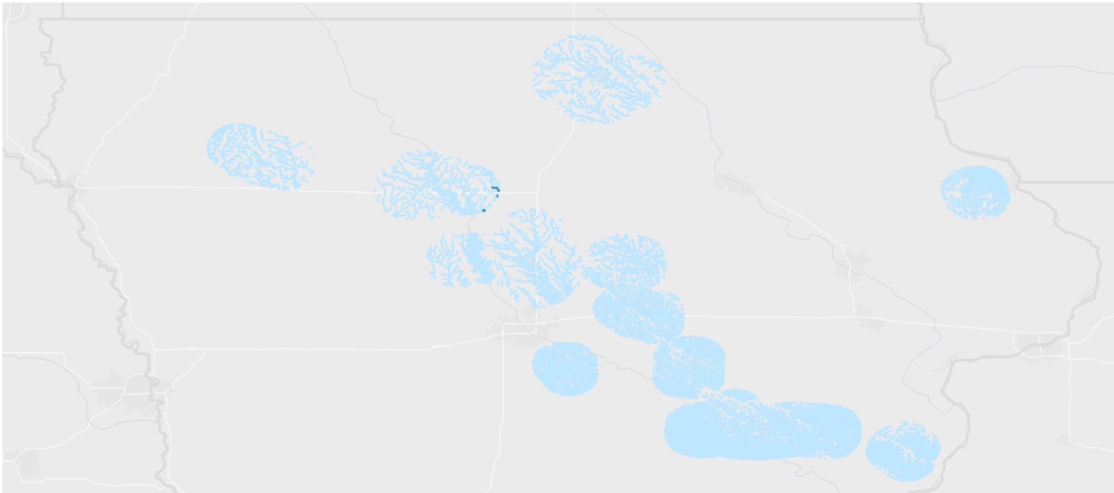


21. Now, use the ‘Calculate Field’ tool to find the percentage of each area which is a floodplain, dividing the summation of the floodplain areas by the total area of each build site, as is shown below.

```
percent_floodplain =
!SUM_hazard_area_geodesic! / !MEAN_area_geodesic!
```

22. Then, use the ‘Select by Attributes tool to select any areas where the percent of land located in a floodplain is greater than 20%. Delete those selected areas.
23. Now add the shapefiles of rivers and streams. Create a 12 mile buffer around all potential sites using the ‘Create Buffer’ tool, but, this time, do not dissolve all features into a single output feature.
24. Use the ‘Pairwise Intersect’ tool on the rivers layer in conjunction with the 12 mile buffer you just created.

25. Repeat step 24 with the streams layer, so that your waterways look like the image below.



26. Now, right click on the buffer's feature layer and, under joins and relates, use the 'Spatial Join' tool to add the streams and rivers.
27. Once they have been added, the streams and rivers will both have join counts. As you did earlier, enter 'field view' and create a new field named "total_water_features." Then, use the 'Calculate' tool to sum the water features in a given buffer.
28. Use the 'Feature to point' tool to turn the buffer into a point. Now in the layer of potential sites, under joins and relates, spatially join the buffer layer.
29. In the attribute table, sort the sites in descending order of number of water features. The site with the most water features should be marked as the best option, the second as the second best option, and so forth. The final project should look similar to the image below.