Lab Report

Title: Lab 0
Notice: Dr. Bryan Runck
Author: Emily Cavazos
Date: 09/22/2021

Project Repository: https://github.com/cavaz020/GIS5571
Google Drive Link: **N/a**
Time Spent: 32 hours

Abstract

The purpose of this report is to compare and contrast buffering a network dataset using ArcGIS Pro tools, Jupyter Notebooks in ArcGIS Pro, and Jupyter Notebooks in ArcGIS Online. For my comparison, I utilized a 2012 Minnesota road network shapefile from the Minnesota GeoSpatial Commons clipped to the Hennepin County Boundary shapefile taken from Hennepin County GIS Open Data Site. For methods I created buffers of the Hennepin County roads dissolved into one feature.The steps I took to do so are thoroughly detailed below with accompanying screenshots and data flow charts. For results, I compared and contrasted all three methods based on various categories. Within the discussion, I detailed my experience working with the three methods as well as my experience setting up my GitHub repository. My sources are cited and I reported a self score at the end of the report.

Problem Statement

The Esri ecosystem has many different ways that you can access the same underlying functionality. Your objective is to compare and contrast performing the same simple activity - buffer a network dataset - using three different tools: ArcPro, Jupyter Notebooks in ArcPro, Jupyter Notebooks in ArcOnline.

Table 1. Datasets used in this lab

#	Requirement	Defined As	(Spatial) Data	Attribute Data	Dataset	Preparation
1	Road network	Raw input dataset from MNDOT	Road geometry		Mn GeoSpatial Commons	Clipped to next dataset
2	Hennepin County Boundary	Raw input dataset from Hennepin County GIS Open Data site	Hennepin County Boundary		Hennepin County GIS Open Data site	

Input Data

The input data is derived from road centerlines in Minnesota after construction was completed in 2012. This dataset is found on the Minnesota Geospatial Commons website. Specifically, this dataset is produced by the Minnesota Department of Transportation. The dataset has the projected coordinate system NAD83 UTM Zone 15N.

Table 2. Dataset from the Minnesota Geospatial Commons

#	Title	Purpose in Analysis	Link to Source
1	Hennepin County Roads	Clipped dataset around which buffers will be created	Mn GeoSpatial Commons clipped by Hennepin County GIS Open Data site

Methods

Before starting out, I clipped the Minnesota Roads dataset (shapefile) using the Hennepin County Boundary dataset (shapefile) so that I could focus more on one county rather than creating buffers on the entire state. I exported the resulting shapefile of roads clipped to just Hennepin County to use in the following three methods of creating buffers.

Image 1. Raw Network Dataset

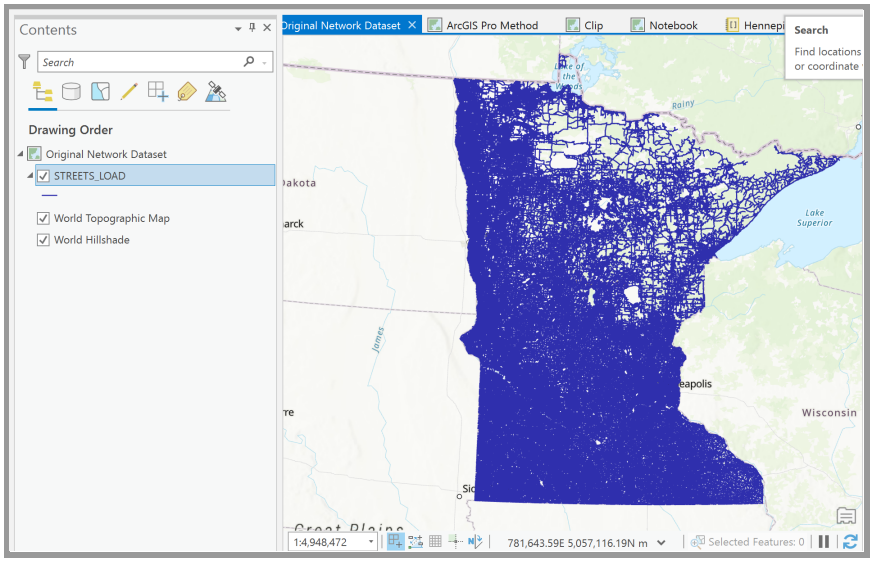


Image 2. Clip tool within ArcPro

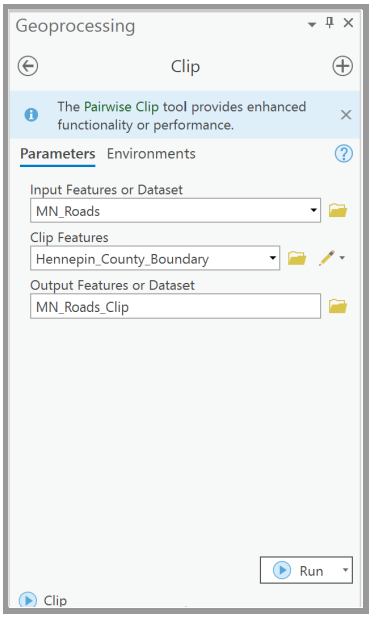
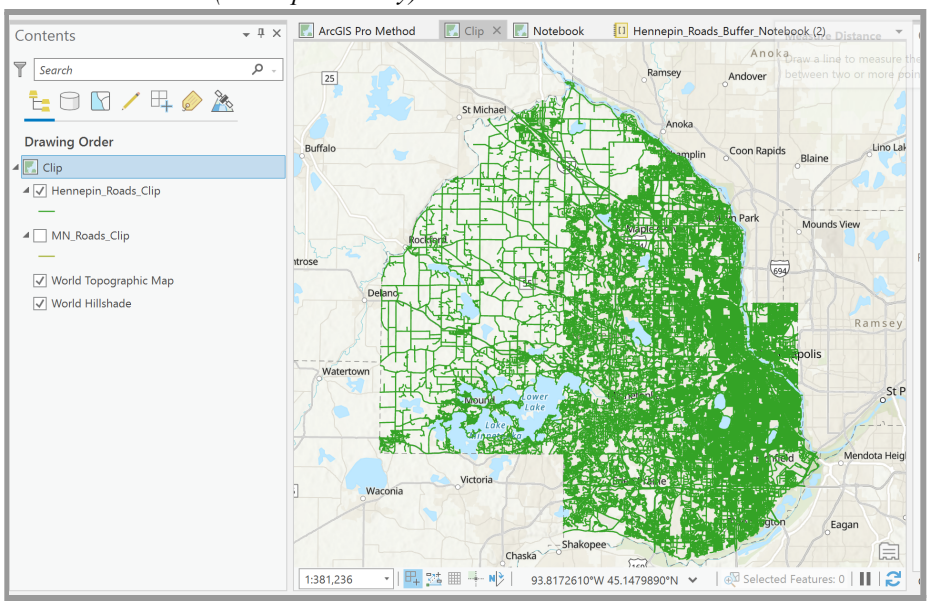


Image 3. Clipped Network Dataset (Hennepin County)



ArcGIS Pro

First, I added the road centerline dataset (shapefile) to ArcPro. Next, I opened the toolbox from the Analysis tab. I then searched for the buffer tool. I set the 'Input' layer to the shp file. I specified the 'Output Features' location and name, in this case, roads_buffer_300m. This output feature was a shapefile (.shp). I entered the Linear unit as 300, and set the units to Meters. Finally, I set the 'Dissolve Type' to 'Dissolve all to a single feature' and clicked 'Run'.

Image 4. Buffer tool after I filled it in as described above

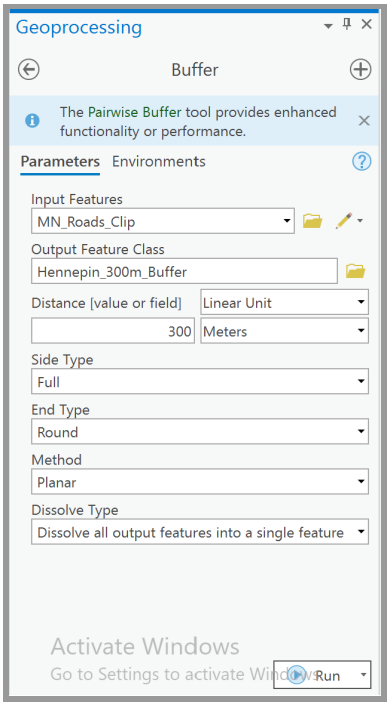


Image 5. Resulting Buffer Shapefile

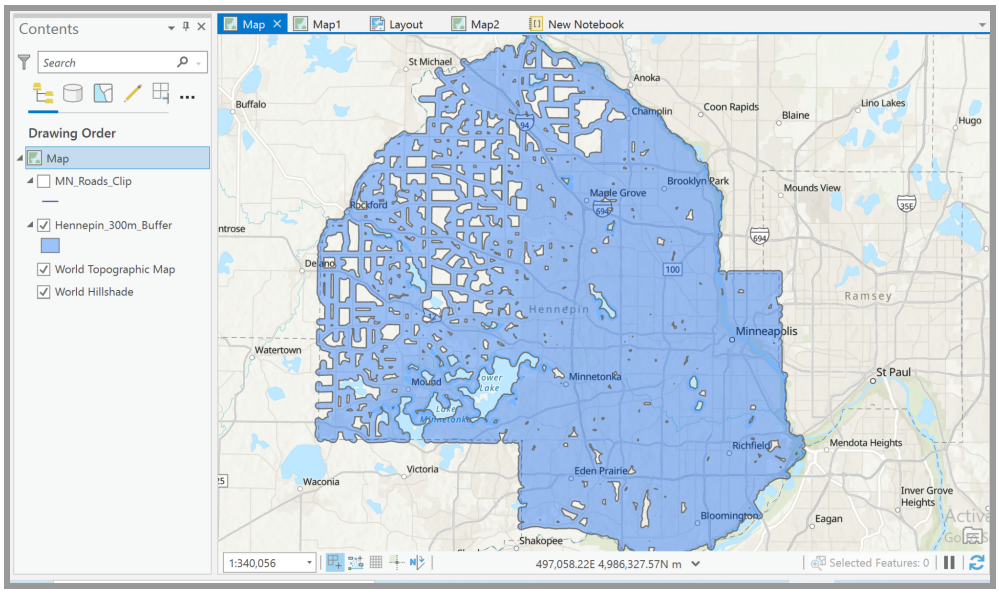
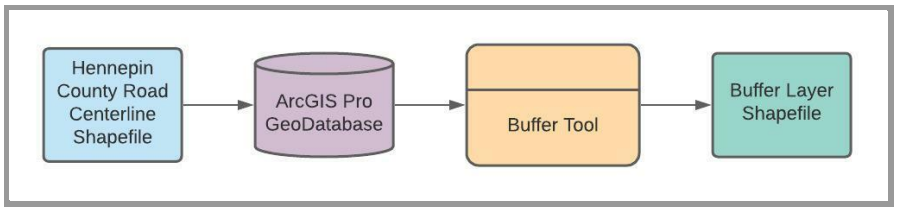


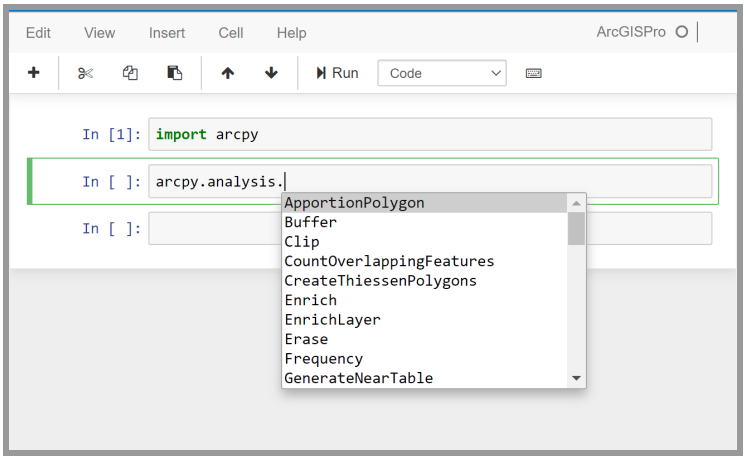
Figure 1. Data flow diagram of creation of a buffer layer shapefile in ArcPro



Jupyter Notebooks in ArcPro

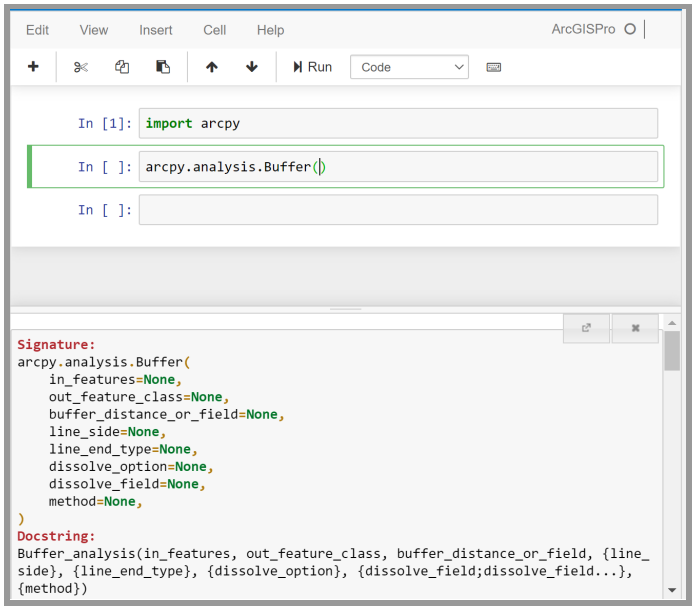
To open Jupyter Notebooks in ArcPro you simply click the 'New Notebook' button in the 'Insert' ribbon bar. To access the Buffer tool, you will need to import arcpy. The next step is to use the analysis toolbox and to find the Buffer tool. This uses arcpy as you can see in the image below. By hitting the tab key while your cursor is left after the period, you can open up a dropdown menu from which to choose a tool.

Image 6. Drop down menu opened by hitting the tab key



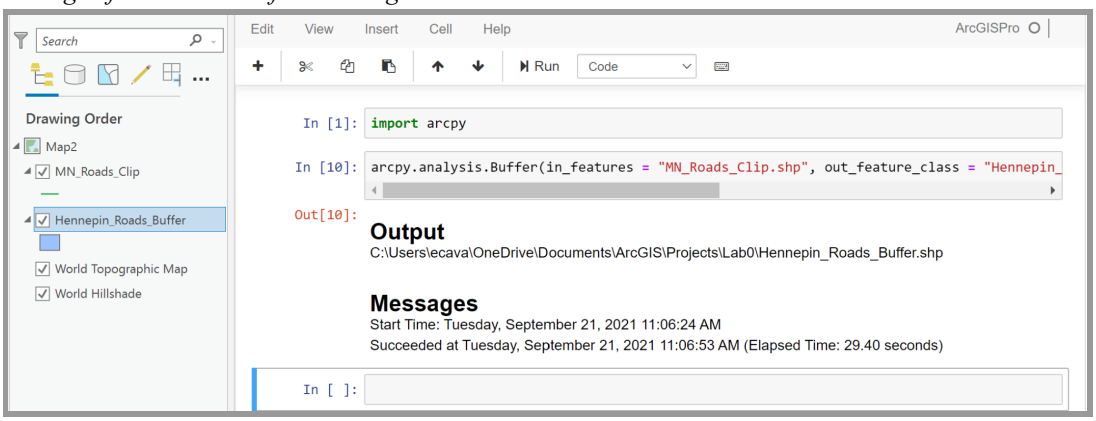
After finding the Buffer tool, I wanted to make sure I knew all of the input options for the Buffer tool so I hit Shift + Tab within the parentheses after 'Buffer' as pictured in the image below. This opens up a help window that describes all of the possible input options for that tool.

Image 7. Help window opened by hitting Shift + Tab



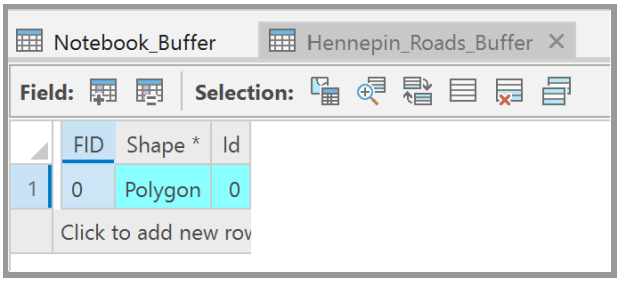
Next, I filled in the options. As I did within ArcGIS Pro in the section prior, I buffered around the Hennepin County Roads with a buffer size of 300 meters and dissolving into one feature. I named the output shapefile 'Hennepin_Roads_Buffer.shp'. The other fields I didn't enter and just let them use the default. I then pressed the 'Run' button at the top of the notebook. After the tool ran, the output shapefile appeared in the contents.

Image 8. Image of what results after running the notebook



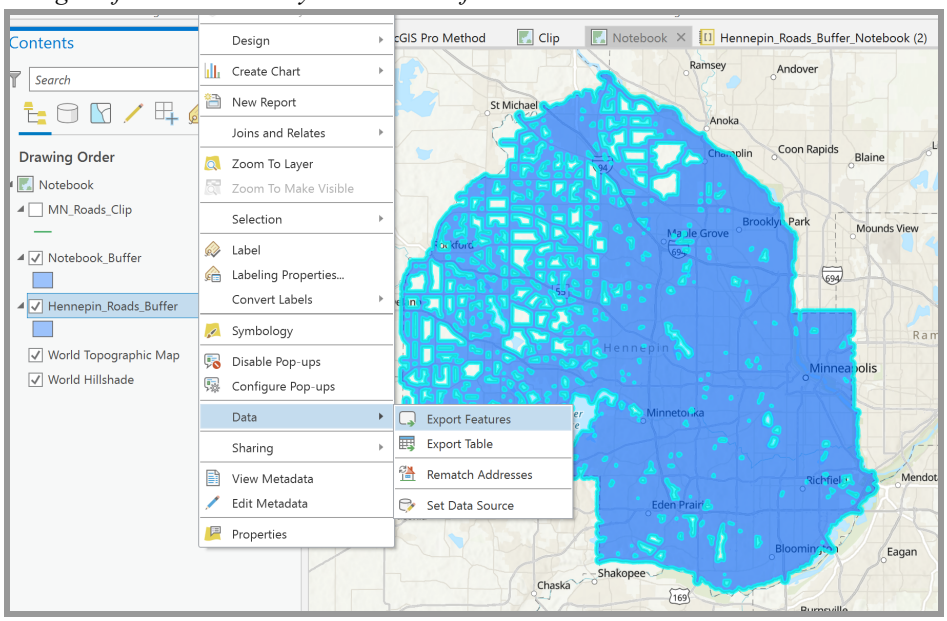
When I opened the attribute table of the resulting shapefile, I saw something strange - the attribute table held no content at all. This is shown in the image below. I am not sure if I did something wrong or if this is what results every time you create a shapefile using Jupyter Notebooks in ArcPro.

Image 9. Attribute Table of the Resulting Shapefile



I knew I wanted to compare the area of this resulting shapefile to the area of the other two resulting shapefiles so I decided to try exporting the features to create a new shapefile.

Image 10. Exporting the features to remedy the absence of an attribute table



This idea worked and the attribute table of the new shapefile ‘Notebook_Buffer’ had a working attribute table so I called this the final Buffer Layer Shapefile.

Image 11. Resulting Buffer shapefile

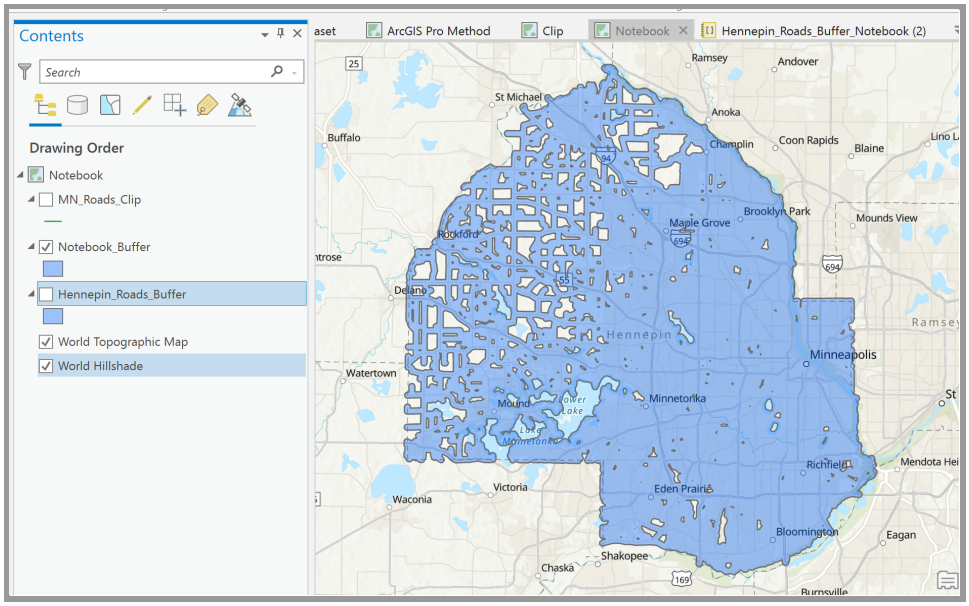
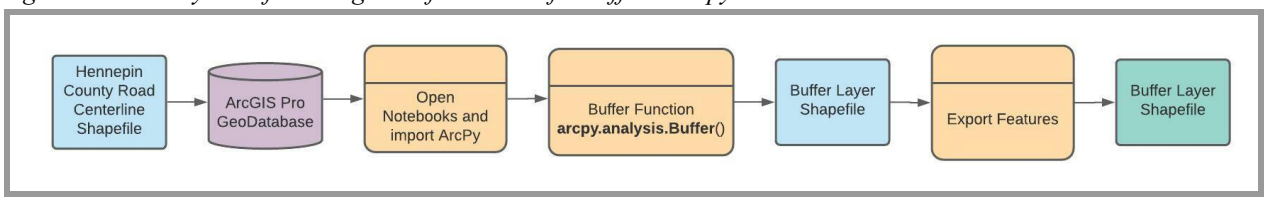


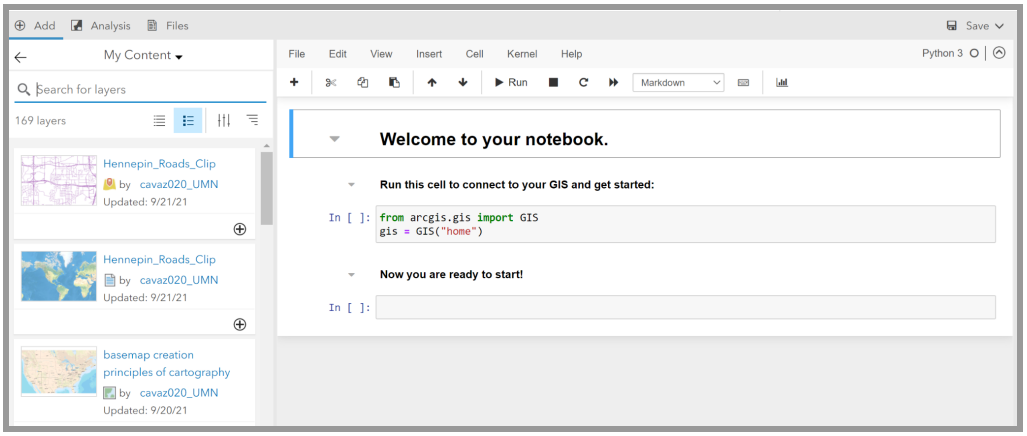
Figure 2. Summary data flow diagram of creation of a buffer in Jupyter Notebooks in ArcPro



Jupyter Notebooks in ArcOnline

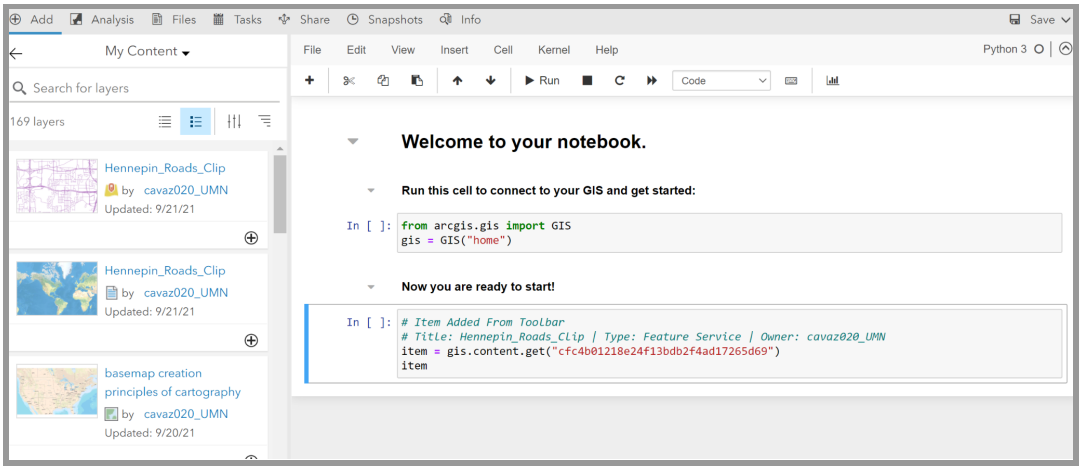
First, I had my clipped Hennepin County Roads shapefile uploaded to ArcGIS Online. Next I opened a new notebook. This automatically holds code to connect to your ArcGIS Online account as seen in the image below. The next step was to add the shapefile to this notebook. This was easy to do by pressing the 'Add' button in the top left. From there I could see the shapefile that I uploaded to my content.

Image 12. Searching for the clipped roads layer within my content



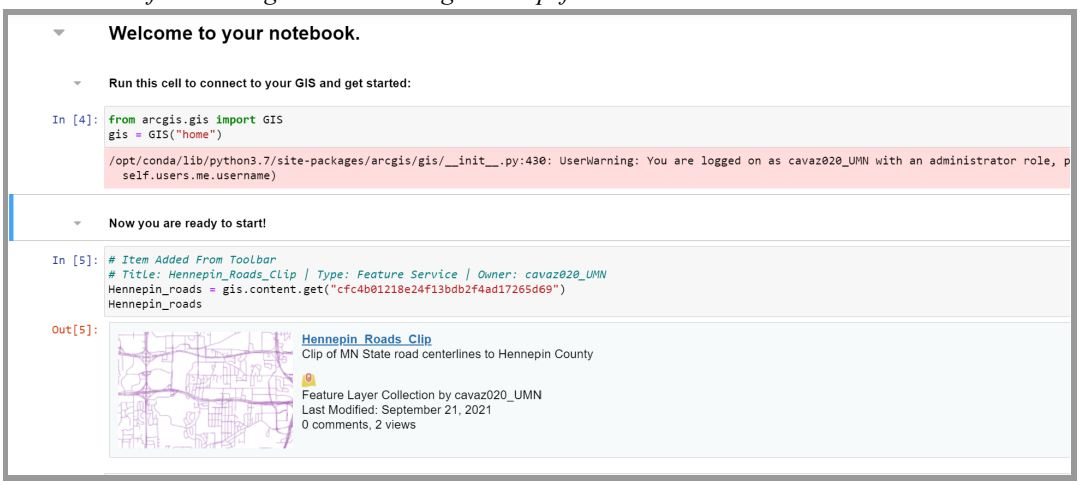
I added that shapefile to my notebook by clicking the plus sign in its lower right corner.

Image 12. After adding the clipped roads layer to my notebook



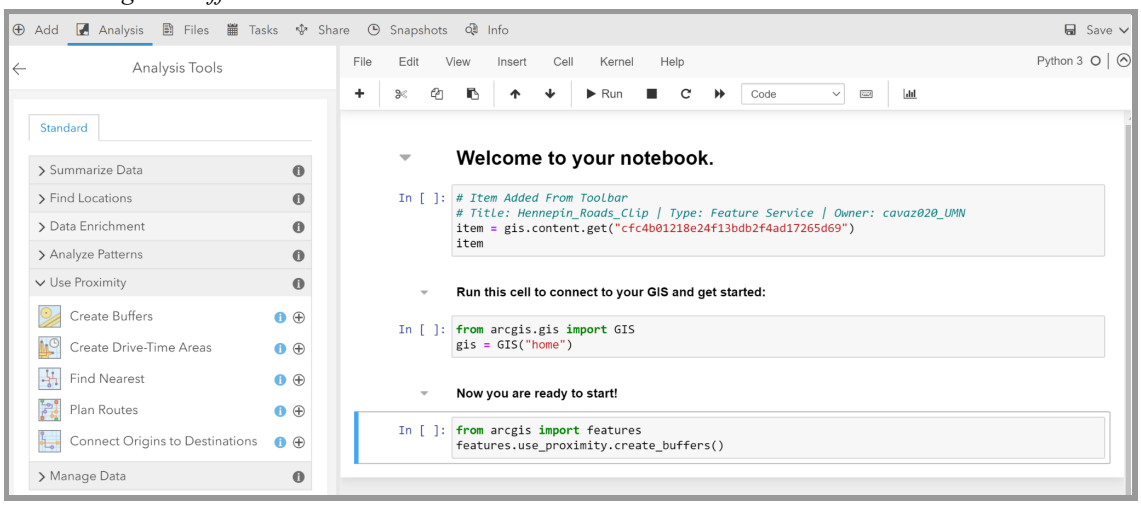
I pressed run to see what would result after inserting the shapefile into my notebook.

Image 13. Notebook after running the code adding the shapefile



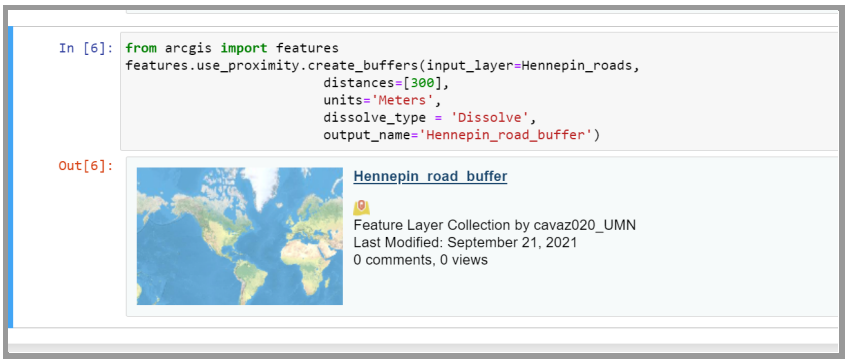
Next, I accessed the Buffer tool by clicking the ‘Analysis’ button and opening up the ‘Use Proximity’ tools and clicking ‘Create Buffers’.

Image 14. Adding the Buffer Tool to the Notebook



I filled in the different input options as I did in the last two sections. I buffered around the Hennepin County Roads with a buffer size of 300 meters and dissolving into one feature. I named the output shapefile 'Hennepin_road_buffer'. The other fields I didn't enter and just let them use the default options. I then clicked 'Run'.

Image 15. Filling in the Buffer Attributes



Finally, I tried clicking on the output shapefile just to see what it looked like. I liked that it was already automatically uploaded to ArcGIS Online and accessible through the map viewer.

Image 16. Open Output Shapefile in Map Viewer

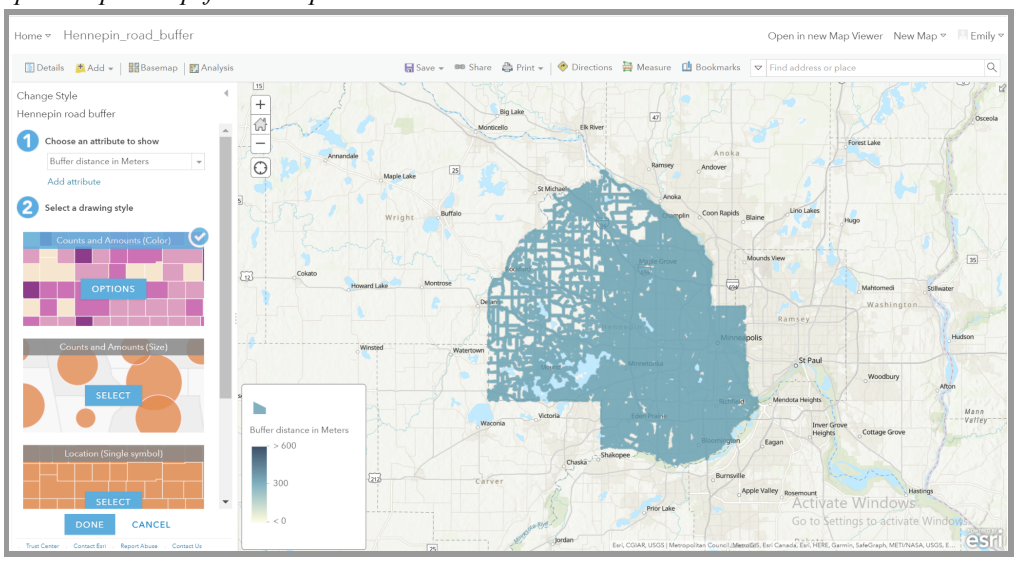
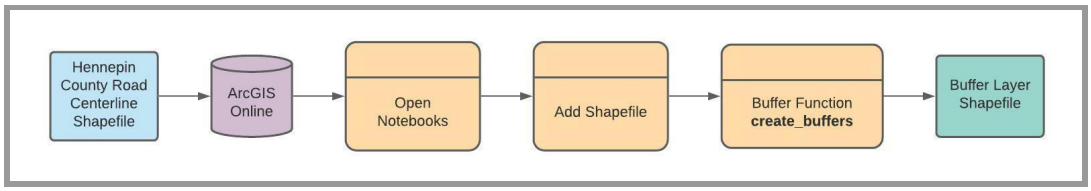


Figure 3. Summary data flow diagram of creation of a buffer layer shapefile in Jupyter Notebooks in ArcOnline



Results

The table below shows my thoughts on the differences between the three tools in performing the same function.

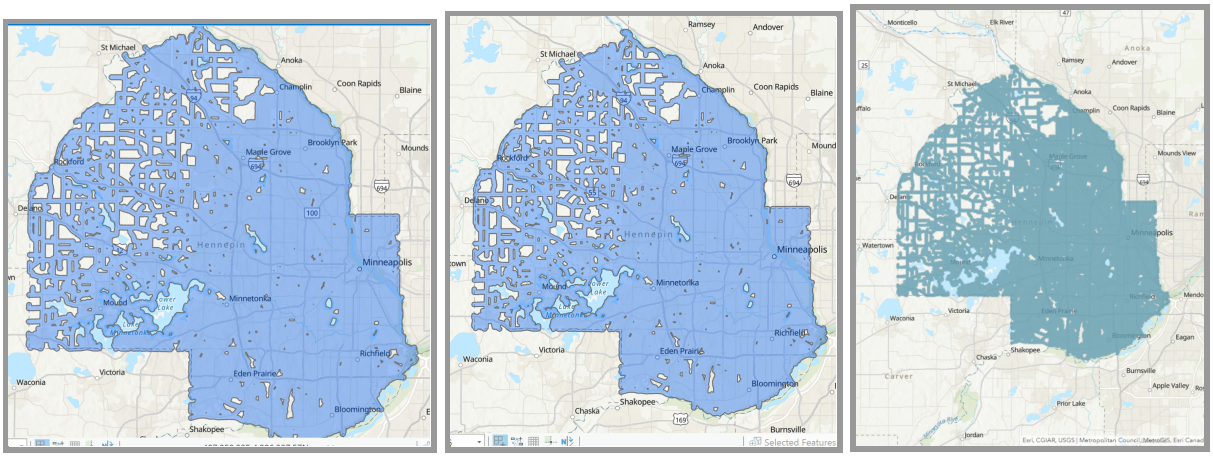
Table 1. Comparison between the three options for creating a buffer layer

Method	Ease of Navigation	Cost	MacOS or Windows?	Sharing	Buffer Area
ArcGIS Pro	Easiest- Simply requires clicking a button and filling in the prompts	Cost of ArcGIS Online + $700/year	Requires Windows	Export feature class to shapefile	Mid-size
Notebook in ArcGIS Pro	Most difficult - I had to look up full documentation to fill out the input fields of the Buffer tool and the resulting shapefile required me to export the features to view attributes.	Cost of ArcGIS Online + $700/year	Requires Windows	Export Features then Export Feature Class to shapefile	Smallest
Notebook in ArcGIS Online	Second Easiest - The shapefile and buffer tool could be added with the click of buttons. I did have to look up documentation to fill out the input fields into the Buffer tool.	$500/year	Either MacOS or Windows works	Automatically saved to ArcGIS Online (would have to be downloaded to use in ArcPro)	Largest

Results Verification

As you can see in the below screenshots, the resulting buffer layers are almost identical visually. It is hard to see any differences.

Image 17-19. Screenshots of the resulting buffer layers (From left to right: ArcPro, Notebook in ArcPro, and Notebook on ArcOnline)



However, as mentioned in the table in the previous section, I also decided to look at the resulting areas of the buffer layer shapefiles to try and find some differences. The different areas are pictured below. As seen in the table, the shapefile created on ArcOnline was the largest and the shapefile created in Notebooks in ArcGIS Pro was the smallest. I'm really not sure of the accuracy and what this all means but this would need further study to make meaningful conclusions.

Image 20. Attribute table of the shapefile created using ArcGIS Pro Buffer tool

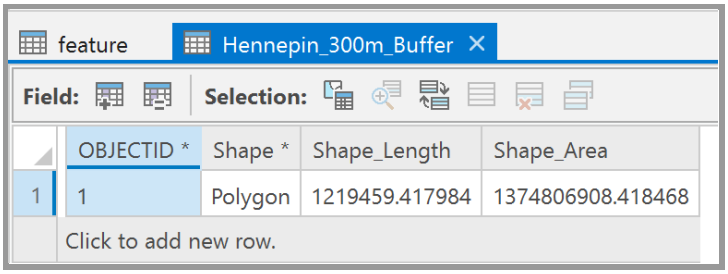


Image 21. Attribute table of the shapefile created using Notebooks in ArcGIS Pro

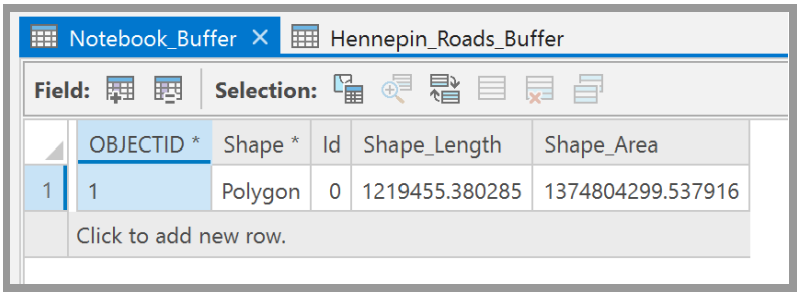


Image 22. Attribute table of shapefile made using Notebooks on ArcGIS Online

Hennepin_road_buffer (Features: 1, Selected: 1)

Buffer distance in Meters	Area in Square Kilometers
300	1,375.59655032

Discussion and Conclusion

GitHub

Overall the GitHub tasks and tutorials were harder than I expected. I have had a little bit of experience with GitHub so I thought it would simply be intuitive. However, I learned quickly that using the terminal on my computer was something new and somewhat frustrating. I had to look up information about add, commit, and push commands for the terminal. I wish GitHub was more intuitive because I feel that there can be a steep learning curve that isolates and feels unwelcoming to beginners which doesn't help when programming is also somewhat of an intimidating area. I also feel that things took me longer because I would procrastinate when things weren't immediately understandable. I then felt very accomplished when I figured things out. However, this made me feel frustrated and guilty because I felt that I was internalizing that success as part of my self worth which could lead to an acceptance of and participation in a hierarchy based on success which I view as antithetical to equity and liberation.

Section 2: Comparing 3 Systems

This lab went well for me. The most difficult part was making decisions about things such as choosing the aspects I should compare the three methods on, figuring out what details to include in the dataset tables and which network shapefile would be okay to use. I also struggled with making sure that I included all of the pieces required and that I uploaded all of the necessary documents to the GitHub repository. I enjoyed trying out different approaches to accessing the Esri ecosystem. I liked seeing how Jupyter Notebooks and Python tie in more to the Esri ecosystem because I have worked with python but not inside of ArcPro or ArcGIS Online. As I stated in the results table, I did have to look up the required inputs and the formats of said inputs for both of the notebook methods which made things a bit harder. Overall, I found the ArcPro method to be the simplest but I think that is mostly because I am biased as I have used that method much more often than the notebook methods. Perhaps after this semester my thoughts on which method I preferred will be completely different.

References

1. "Roads, Minnesota, 2012 - Minnesota Geospatial Commons." n.d. Accessed September 22, 2021. https://gisdata.mn.gov/dataset/trans-roads-mndot-tis.
2. "Hennepin County Boundary." n.d. Accessed September 22, 2021. https://gis-hennepin.opendata.arcgis.com/datasets/hennepin-county-boundary-1/explore?location=45.014739,-93.474700,10.54.
3. "Notebooks in ArcGIS Pro—ArcGIS Pro | Documentation." n.d. Accessed September 22, 2021. https://pro.arcgis.com/en/pro-app/latest/arcpy/get-started/pro-notebooks.htm.
4. "Arcgis.Features.Use_proximity Module — Arcgis 1.9 Documentation." n.d. Accessed September 22, 2021. https://developers.arcgis.com/python/api-reference/arcgis.features.use_proximity.html#create-buffers.

Self-score

Category	Description	Points Possible	Score
Structural Elements	All elements of a lab report are included **(2 points each)**: Title, Notice: Dr. Bryan Runck, Author, Project Repository, Date, Abstract, Problem Statement, Input Data w/ tables, Methods w/ Data, Flow Diagrams, Results, Results Verification, Discussion and Conclusion, References in common format, Self-score	28	**28**
Clarity of Content	Each element above is executed at a professional level so that someone can understand the goal, data, methods, results, and their validity and implications in a 5 minute reading at a cursory-level, and in a 30 minute meeting at a deep level **(12 points)**. There is a clear connection from data to results to discussion and conclusion **(12 points)**.	24	**22**
Reproducibility	Results are completely reproducible by someone with basic GIS training. There is no ambiguity in data flow or rationale for data operations. Every step is documented and justified.	28	**27**
Verification	Results are correct in that they have been verified in comparison to some standard. The standard is clearly stated **(10 points)**, the method of comparison is clearly stated **(5 points)**, and the result of verification is clearly stated **(5 points)**.	20	**15**
		100	**92**