

Lab Report 0

Title: *Comparing spatial operation workflows in three different environments: ArcGIS Pro, ArcGIS Online and ArcPy.*

Notice: Dr. Bryan Runck

Author: Maisong Francis

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Project Repository: <https://github.com/msongfrancis/GIS5572.git>

Abstract

Evaluating the spatial operation, buffer, in three environments, ArcGIS Pro, Jupyter Notebooks in ArcGIS pro, and ArcGIS Online, revealed similarities, advantages, and disadvantages. The network dataset used was the MN State Trail shapefile. The workflow for ArcGIS Pro and Jupyter Notebooks in ArcGIS Pro were the same aside from the code need for Jupyter. In the Jupyter for ArcGIS Online, there was an extra step where the user had to upload the raw dataset to ArcOnline first. Each environment had advantages and disadvantages that were specific to the user's need, whether it was working with one dataset, multiple datasets, or needing to have the dataset online. Overall all three environments were able to buffer the input network dataset and output the same result.

Problem Statement

The state trails in Minnesota must be buffered in each different environment (ArcPro, ArcOnline, Arcpy). Each environment may require a different process to perform the buffer operation.

Table 1. Summary of data required for lab analysis.

#	Requirement	Defined As	Spatial Data	Attribute Data	Dataset	Preparation
1	State Trail	State trails from the MNDNR	Line geometry		Mn GeoSpatial Commons	

Input Data

The Minnesota State Trails are maintained and collected by the MNDNR Division of Park and trails. It was collected from GPS, aerial imagery, and paper maps using data from 11/13/2009 to the present. The purpose of this data when it was collected was for maintenance, recreation planning and public access information. The coordinate system of this data is NAD83 UTM 15N. The attributes include trail name, usage, surface type, length in miles and meters, and more.

Table 2. Information about input data for analysis

#	Title	Purpose in Analysis	Link to Source
1	Minnesota State Trails	Network dataset to be buffered	Mn GeoSpatial Commons

Methods

ArcGIS Pro

In ArcGIS Pro, a folder connection was created to the unzipped MN state trails shapefile. From there, I added the state_trails into the map as a layer (state_trails_minnesota) and ran a buffer operation with 50 meters on each side as the buffer distance with default settings. The output result was a feature class containing the total 100-meter buffer (MNState_trails_buff_50m_arcpro) (fig 1a).

Jupyter Notebooks in ArcPro

- First the pathway to the MN state trails shapefile was inputted as a variable called in_feature. Other parameters were specified as variables (i.e. output feature name and buffer distance with the units).

```
in_feature = r"C:\Users\msong\Desktop\GIS5572\lab0\shp_trans_state_trails_minnesota\state_trails_minnesota.shp"
out_feature = "MNstate_trails_buff_50m_jupyter"
buff_dist = "50 meters"
```

- Using the arcpy.analysis.buffer function, the input feature was buffered 50 meters with default parameters (100 meters total) kept.

```
arcpy.analysis.Buffer(in_feature,
                     out_feature,
                     buff_dist)
```

- The output was a feature class containing the buffer features (MNstate_trails_buff_50m_jupyter) (fig 1b).

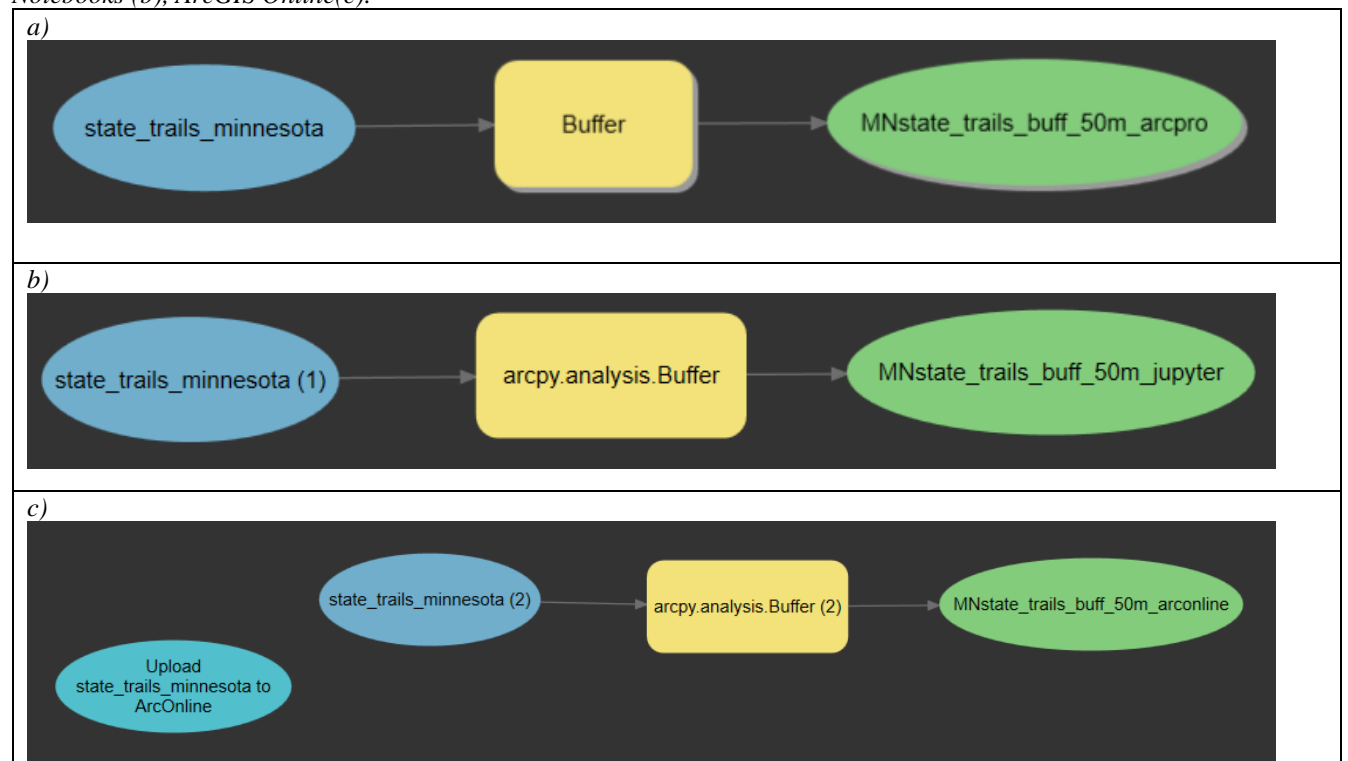
Jupyter Notebooks in ArcOnline

- First the MN state trails shapefile was uploaded into ArcGIS Online and a hosted feature layer was created. Now it was able to be used in ArcGIS online notebooks.
- In Notebooks online, first the code retrieved the feature layer collection of the Mn state trails as a variable.
- Then using the features.use_proximity.create_buffers() function with specified parameters, an output feature layer collection of the 100-meter buffers was created.

```
from arcgis import features
features.use_proximity.create_buffers(item,
                                     distances = [50], |
                                     units = "Meters",
                                     output_name = "MNstate_trails_buff_50m_arconline")
```

- This output layer was saved into my Contents in ArcGIS online (fig 1c).

Figure 1. Data flow diagram for buffering state trails in each environment respectively: ArcGIS Pro (a), ArcGIS Notebooks (b), ArcGIS Online(c).




Results

In ArcGIS Pro and Jupyter Notebooks in Arcpro, the methods were very similar. The only difference was the way the user was interacting with the different functions and inputting the parameters. One thing I like about the Jupyter Notebooks is I did not have to create a folder connection, but instead specified the file pathway. Both produced a feature class containing the 100-meter buffers saved to the project file geodatabase and viewable in the ArcGIS map project.

In contrast the ArcGIS notebooks online was a lengthier process. The zipped data containing the shapefile was uploaded into ArcGIS online contents first. Once the uploaded material was retrieved in the code the process was very similar onwards. However, to view the data I would either need to navigate to the buffer feature class in Contents and view it in Map Viewer or create an in-line map to the notebooks. Also due to the nature of ArcGIS Online, the map looked different compared to the ArcGIS Pro desktop ones since the data was projected as WGS84.

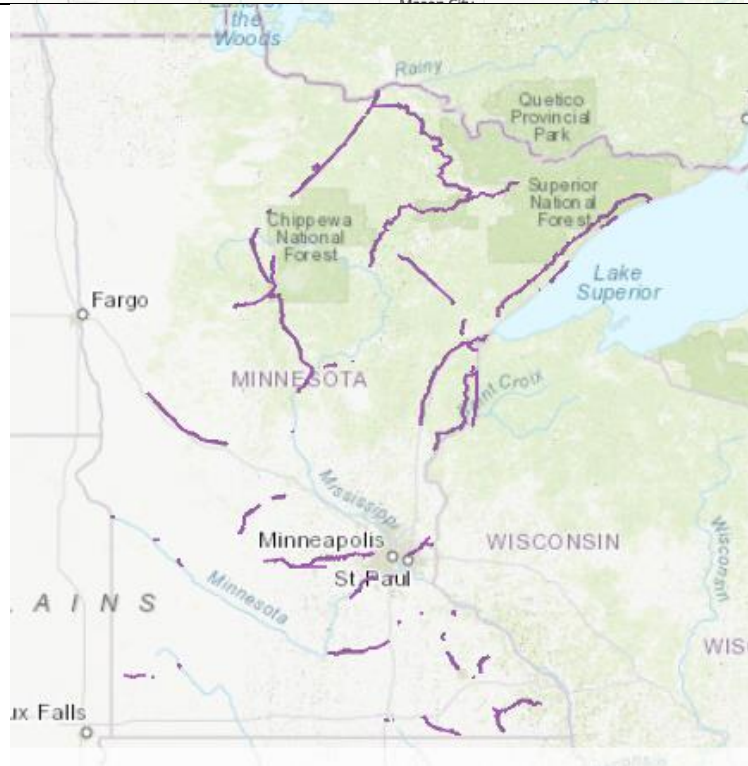
Table 2. Output 100-meter buffer features of MN State Trails mapped in each environment.

Environment	Output
ArcGIS Pro	

Jupyter Notebooks in ArcGIS Pro



Jupyter Notebooks in ArcGIS Online



Results Verification

To verify the results were correct, in ArcPro and using the Jupyter Notebooks in ArcPro, I could measure the width of buffer. Additionally, the original line features of the MN state trails could be overlaid on top of the buffers. They were centered in the middle of the buffer and measured 50 meters on each side. For the results from the Jupyter Notebooks in ArcGIS online, I wasn't able to measure the distance in the notebooks, however I was able to open up the feature layer collection of the buffers in Map viewer to measure it. It was 100 m in width.

Discussion and Conclusion

GitHub

Setting up GitHub went well. I had prior experience using Git in GIS Programming where I learned how to clone, commit code and files to a repository, and fetch and pull from a repo.

ArcGIS Pro, Jupyter Notebooks in ArcPro, Jupyter Notebooks in ArcOnline

When comparing the three environments, I saw benefits of using all three. The ArcPro environment was useful if I was working with one dataset and the user interface was very intuitive. With the Jupyter notebooks in ArcGIS Pro, I thought this was more useful if I was running the same processes on multiple datasets because the input could be a whole feature dataset. In both ArcPro environments, the visualization of the output feature class was useful for verification.

With the ArcOnline, I think this environment is most useful if the data I was working with needed to be shared or lived online or had a large scale (due to the coordinate system). I think a few downsides are having to be connected to the internet, having to upload data first, and additional code to visualize the output in the notebooks.

I preferred the Jupyter Notebooks in ArcPro because the code ran quickly without having to do multiple clicks and I could adjust it to apply to multiple datasets if needed. I had never used Notebooks in ArcOnline, but I found the user interface was very helpful, especially in locating the feature layer collection ID to use the uploaded data. I also liked that I didn't need to unzip the data. Lastly I liked ArcPro desktop because if there were multiple steps, I could visualize each step.

References

ESRI. (n.d.). Buffer (Analysis). ArcGIS Pro. Retrieved January 31, 2021, from <https://pro.arcgis.com/en/pro-app/latest/tool-reference/analysis/buffer.htm>

ESRI. (n.d.). Getting Started with Notebooks. ArcGIS Online. Retrieved January 31, 2021, from <https://doc.arcgis.com/en/arcgis-online/get-started/components-of-the-notebook-editor.htm>

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	24
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	28
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	20
		100	100