Lab 2 - Part 2 Lab Report

Title: Lab 2 - Part 2
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Project Repository: https://github.com/blanders98/GIS5571/tree/main/Lab2
Google Drive Link:
Time Spent: 20 hours

Abstract

In part 2 of this lab, I used map algebra to create a cost surface model which shows optimal walking routes for Dory, an avid fly fisher who frequents Whitewater State park to fish. This model takes into account Dory's preferences, which include avoiding muddy fields and water bodies. I also analyzed how different weights affect the model's outcomes. This lab helps depict the power of spatial analysis in the decision making process, along with potential benefits of using these tools for environmental and LiDAR modeling.

Problem Statement

Dory is a fly fishing enthusiast who lives on a farm near Whitewater State Park. She wants to know the optimal walking route from her farm to the park's North Picnic area. This route must consider her specific preferences which include avoiding muddy farm fields, minimizing water crossings without bridges, and selecting paths with the most gradual slopes. Key goals of this lab include creating a cost surface model of the area from Dory's house to the north picnic area of Whitewater State park and analyzing how different weighting schemes affect the outcomes of the model.

Table 1. Data Used in this Lab

#	Requirement	Defined As	(Spatial) Data	Attribute Data	Dataset	Preparation
1	LiDAR Data	MN DNR NLCD Landcover Data	LiDAR		MN DNR Landcover Dataset	
2	Elevation Data	MN DNR 30m Elevation Data	Elevation		MN DNR Elevation Dataset	
3						
4						

Input Data

Table 2. Data Used in this Lab

#	Title	Purpose in Analysis	Link to Source
1	MN DNR NLCD Landcover Data	Landcover data to create cost surface model	MN DNR Landcover Dataset
2	MN DNR 30m Elevation Data	Elevation data to create cost surface model	MN DNR Elevation Dataset
3			
4			

Methods

Figure 1. Part 2 data flow diagram (Mermaidchart.com)

To begin, I used a get request to download landcover data and elevation data from the MN DNR server. I then created a feature class with two points, one for Dory's house and one for the north picnic area, essentially making start and end points. Creating these points will allow me to determine an area to create my cost surface model in. I created 10,000 meter buffers around the two points, which will define the area of interest. 10,000 meters is a partially arbitrary number, as I just wanted the buffers to be big enough to overlap one another to some extent, so I could create an area to walk between them, along with viewing the surrounding terrain and land use.

Next, I calculated the slope from the elevation dataset using arcpy.sa.Slope and saved it as a slope raster/DEM. I clipped this slope raster to the buffered area and reclassified it based on slope value ranges to simplify the input data (*Figure 2)*. I reclassed the data into 10 classes of slope ranges. I then defined 15 classes of landcover for the landcover dataset based on National Land Cover Database (NLCD) categories, assigned each class a value, and clipped it to the buffered area (*Figure 3)*.

Finally, I generated four cost surfaces by combining reclassified landcover values and slope values, multiplying them by four different weighting schemes (for landcover = 0.1, 0.25, 0.5, and 0.75, for slope = 1 - that value), and each being outputted to a new raster file *(Figures 4-7)*. I chose these four weighting schemes to see how a range of values from zero to one might create different outputs. This resulted in four different cost surface model outputs. I gave all four outputs the exact same symbology (green to yellow to red, with green being more favorable, and red being less favorable) to be able to see the differences between them. In these weighting schemes, 0.1 and 0.25 more heavily favor slope over landcover, meaning areas with gentler slopes will be prioritized. The 0.5 weight gives a balanced priority to both landcover and slope, meaning the cost surface model depicts lower values for areas with gradual slopes and avoids landcover types that Dory doesn't prefer. The 0.75 weight gives a favorable preference to landcover over slope, meaning areas that don’t have water or muddy farm fields are prioritized, despite if they have steeper slopes or not.

Results

Figure 2. Slope raster clipped and reclassified.

Figure 3. Landcover raster clipped and reclassified.

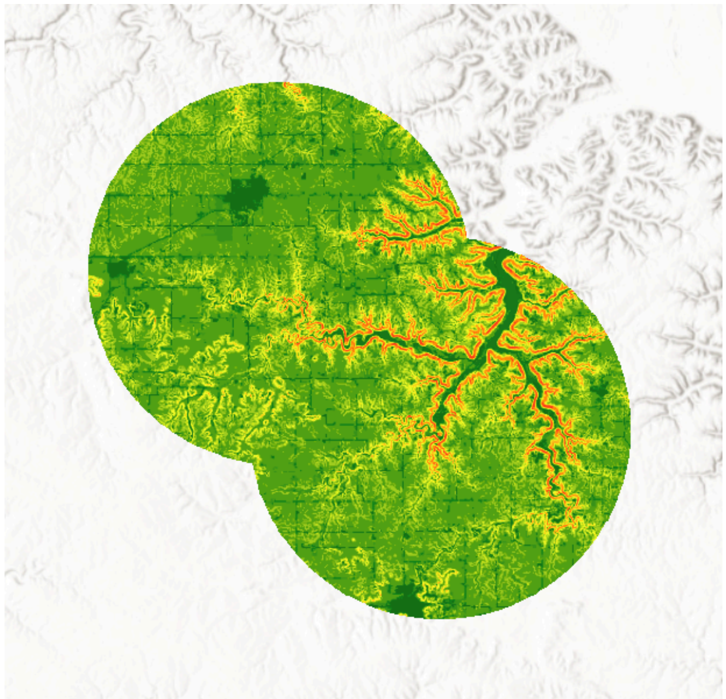

Figure 4. Cost surface #1 with a weighting scheme of landcover = 0.1, slope = 0.9, favoring slope heavily over landcover.

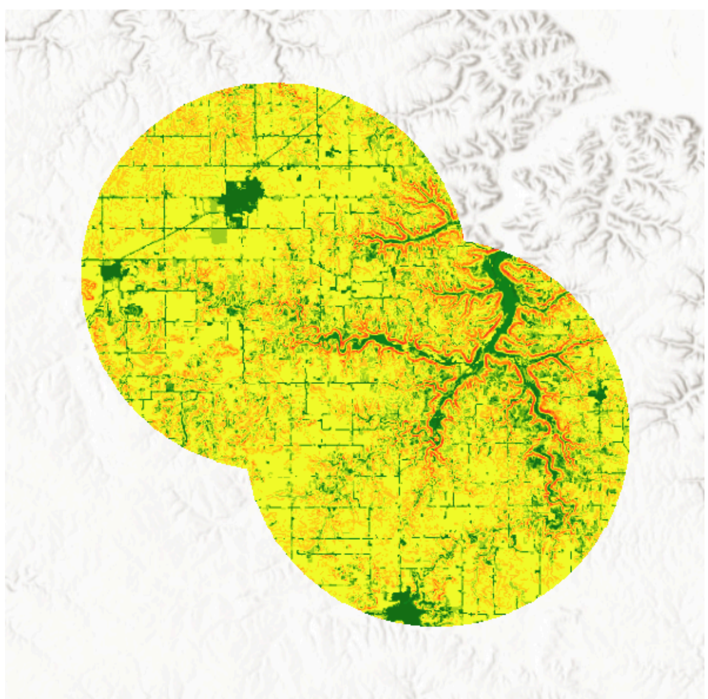

Figure 5. Cost surface #2 with a weighting scheme of landcover = 0.25, slope = 0.75, favoring slope slightly over landcover.

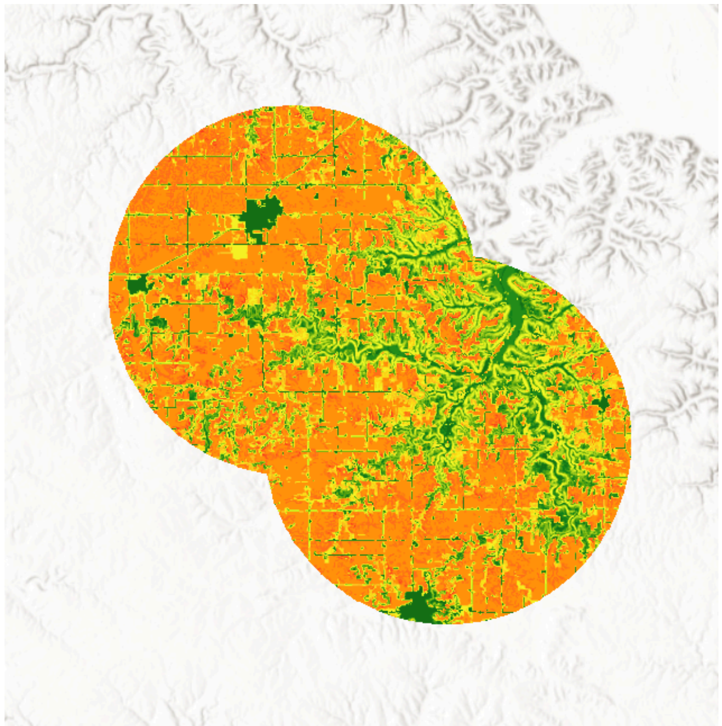

Figure 6. Cost surface #3 with a weighting scheme of landcover and slope = 0.5, a balanced prioritization of landcover and slope..

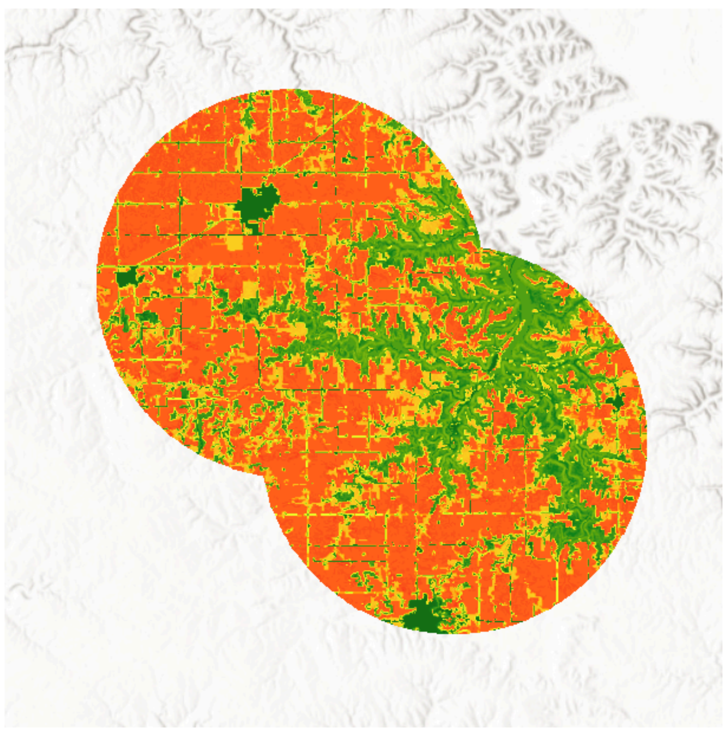

Figure 7. Cost surface #4 with a weighting scheme of landcover = 0.75, slope = 0.25, favoring landcover heavily over slope..

Results Verification

I verified results by comparing the four cost surface outputs to see if their expected differences in prioritizing slope or land cover were outputted and visualized properly. Consistent symbology across the four cost surface outputs made for clear comparison. Confirming slope was properly represented was also quite easy, while confirming if the landcover dataset was classified and visualized correctly was a little more difficult.

Discussion and Conclusion

In this lab, I successfully demonstrated the creation of multiple cost surface models which can help Dory identify routes to walk from her house to the north picnic area based on my interpretation of her preferences and four different weighting schemes. By outputting and viewing the four different weighting schemes, I was able to see how prioritizing landcover or slope changes the output. I suggest Dory follows my cost surface model #3 as it has a balanced prioritization of landcover and slope, and I reclassified the landcover data to take her preferences into account already. If she follows this cost surface, she should walk along the green and yellow areas while avoiding orange and red areas, which will help her avoid muddy farm fields, water crossings without bridges, and stay on more gradual slopes.

References

Multi-Resolution Land Characteristics (MRLC) Consortium. (n.d.). National land cover database class legend and description. Retrieved October 29, 2024, from https://www.mrlc.gov/data/legends/national-land-cover-database-class-legend-and-description

OpenAI. (2024). ChatGPT (October 8 Version) [Large language model]. Available at https://chat.openai.com

Self-score

Fill out this rubric for yourself and include it in your lab report. The same rubric will be used to generate a grade in proportion to the points assigned in the syllabus to the assignment.

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	**23**
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	20	**20**

	of comparison is clearly stated **(5 points)**, and the result of verification is clearly stated **(5 points)**.		
		100	**98**