FINAL PROJECT REPORT

Topic: Toolbox for automating the suitability analysis workflow for selection of the location of residence

Student: Edah Šahinović (matr. no.: 12047186)

Supervisor: Assoc.-Prof. Dr. Dirk Tiede

I. INTRODUCTION

For the IP Application Development course's final project, a toolbox was developed using ArcGIS. This toolbox automates the workflow for a multicriteria spatial analysis method, which considers various environmental and service factors to evaluate dwellings in the city of Salzburg.

II. PURPOSE

The purpose of this analysis is to determine which dwellings are most suitable for residence seekers and homebuyers based on their personal criteria. The resulting tool provides homebuyers with the ability to consider both service accessibility and environmental quality when selecting a home location. This method can be customized for use in different geographic and social contexts, and is beneficial for both customers and real estate agents. Due to lack of time, this project focuses more on technical specificities of the method conducted within a tool rather than on credibility of the results.

III. IMPLEMENTATION

The initial stage involved obtaining spatial data that mainly represents Salzburg's environmental and service conditions. After that, a user interface was designed in the form of an ArcGIS toolbox that allows the user to choose preferred criteria and corresponding sub-criteria, as well as to assign weights to each criterion. Lastly, a back-end Python script was developed using the ArcPy library to process the input and generate an output.

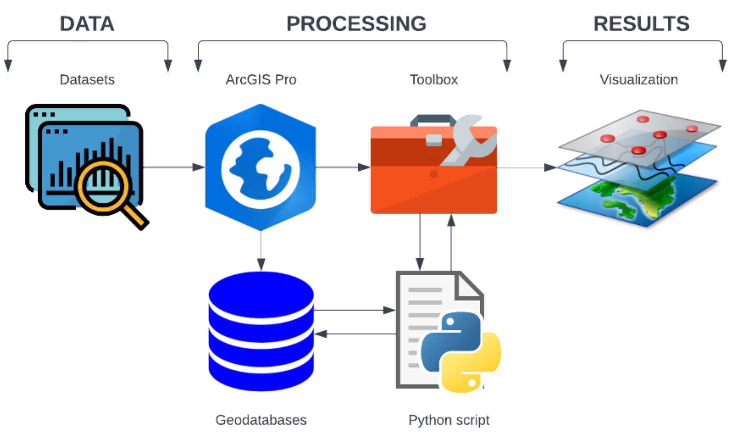

Figure 1. Simplified project architecture overview (source: own representation)

A. Data source

As previously noted, the tool prioritizes technical details over result accuracy, and therefore OpenStreetMap data was used to feed the tool. Using this data, point and polygon layers were extracted as weighting criteria for spatial factors, such as *major shopping malls*, *bicycle parking*, *bus stops*, *parks*, *restaurants*, and *schools* in the Salzburg area. Additionally, Salzburg city and buildings shapefiles were used for purposes of clipping and final visualization. As a pre-processing step, these layers were manually reprojected to corresponding MGI Austria GK M31 PCS, visually checked, and slightly modified for improved spatial representation of Salzburg's conditions. These layers ready for analysis can be found in the „input.gdb“.

B. Processing

A toolbox called ResidenceSelectionSalzburg was created for ArcGIS. It provides a user interface for entering decision-based values for each criterion, where each criterion includes a distance and weight input box. At this stage, the tool requires the user to input a total of five distance values, ranging from smallest to highest, and a total weighting sum of 100, regardless of the number of criteria considered. The project path is optional, but if a file path is broken, the script automatically handles the path using the os.getcwd() command.

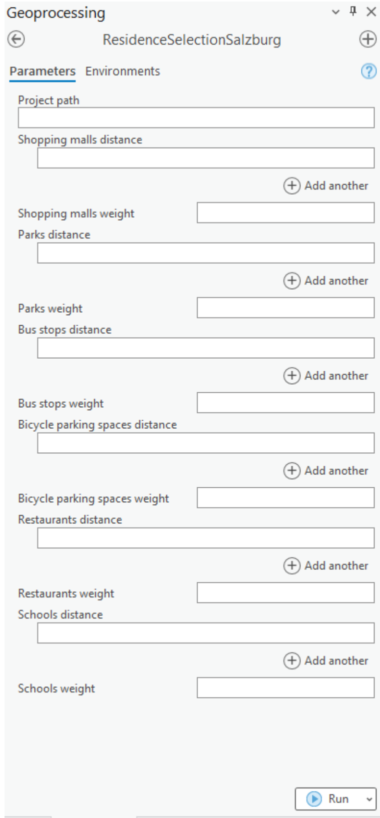

Figure 2. Toolbox interface

After running the tool, the script processes all the populated entries, excluding criteria where both (distance and weight) entries were not populated. The main function layer_processing() receives the distance and weighting values, processes each respective layer, creates buffers, clips the buffers to the extent of the Salzburg AOI, rasterizes the buffers with a cell size of 20m, reclassifies the values to corresponding ranking values, and appends them to a list that will be passed to the weighted overlay geoprocessing tool. Vector and raster layers that were parts of these conversions starting from beginning of layer processes to end product are stored in the „residuals.gdb“ in case these processing stages need to be revised.

Once these layers have been converted, the weighted overlay tool produces the results, which are transferred to each dwelling within a Salzburg AOI. This is achieved by converting each raster cell value of the analysis to point geometry and joining it with the SpatialJoin tool, which considers intersections between points as joint features and dwellings as target features. If an intersection does not occur, the search radius is set to 10m (as the raster cell size is set to 20m), which means that the dwelling receives the value of the closest point in proximity. Final result is stored and can be found in the „output.gdb“.

C. Results

After assigning the distance and weighting values to the considered variables, a resulting building layer is displayed within map template of the working project with only those buildings where intersection of all the considered layers occurs. For demonstration purposes I will perform the analysis for two scenarios: first reflecting the preferences of a young family with a child and in possession of a car as a mode of transport considering residences in proximity of schools, parks and shopping malls; second one being a student which uses bicycle and buses as a mode of transport and considers residences in proximity of parks and restaurants. Their environmental and service considerations can be depicted in the tables below:

Table 1. Dwelling ranking based on criteria for Case 1

Variable	**Weight**	**Distance 1**	**Distance 2**	**Distance 3**	**Distance 4**	**Distance 5**
Shopping malls	30	100	200	500	1000	2000
Parks	20	50	100	200	500	1000
Bus stops	not accounted					
Bicycle parking spaces	not accounted					
Restaurants	not accounted					
Schools	50	100	200	300	500	10000

Table 2. Dwelling ranking based on criteria for Case 2

Variable	**Weight**	**Distance 1**	**Distance 2**	**Distance 3**	**Distance 4**	**Distance 5**
Shopping malls	20	50	100	200	500	1000
Parks	10	100	200	300	500	1000
Bus stops	30	20	40	80	150	300
Bicycle parking spaces	30	10	20	30	50	100
Restaurants	10	100	200	300	400	500
Schools	not accounted					

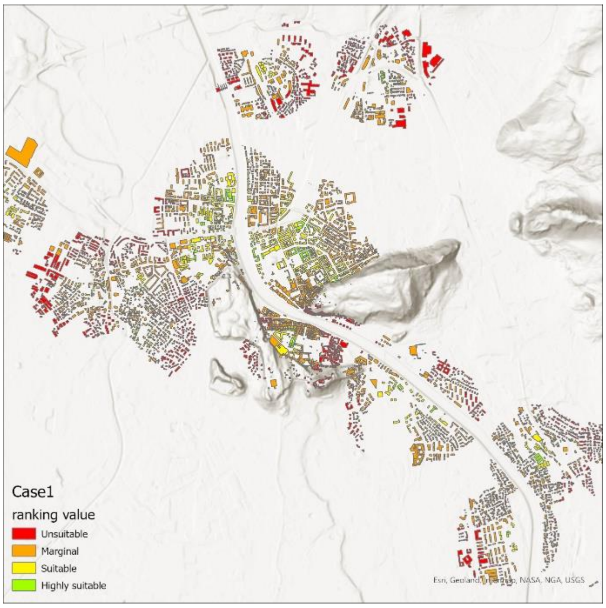

Figure 3. Map of residence suitability based on Case 1

Figure 4. Map of residence suitability based on Case 2

D. Challenges

- If the project does not contain a map template during the initialization of the tool, the final ranked buildings results will not be displayed automatically. Unfortunately, this issue cannot be addressed through automation since arcpy does not support the automatic creation of a template.
- In case the *ERROR 010240: Could not save raster dataset to <> with output format FGDBR.* occurs, this means that in the „main.py“ script in line 121 or in line 171 the name of the output raster dataset is too long to handle in the geodatabase. This can be mitigated by shortening the name of the output datasets directly in the script in the lines mentioned or by having these layers to be saved in a standard folder, not in the geodatabase.

E. Future Considerations

In order to improve the user experience, as well as the technical and methodological aspects of this project, there are a number of tasks that can be undertaken, such as:

- Interface: Consider replacing some of the current toolbox elements with more intuitive and specific input boxes related to distance values. This will make the interface more user-friendly.
- Data: It is possible to acquire datasets that depict the Salzburg environment more realistically, which could lead to obtaining more informative results.
- Processing: Replace multiple ring buffers with road network buffers to ensure a more realistic analysis. For instance, if a point is located next to a river, buildings on the other side of the river should not be evaluated unless there is a bridge connecting the two areas.

- Visualization: Use verbal descriptions for ranked values from 1 to 5, such as 1 – „not suitable" and 5 – „highly suitable", to improve the clarity and understandability of the resulting layer.