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FACULTY OF ENGINEERING

COMPUTER ENGINEERING

CENG463 GEOGRAPHIC INFORMATION SYSTEMS

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1. Introduction

In this paper, a python-based plugin has been developed for QGIS. The purpose of the plugin is to find the distance between selected points with different distance metrics. Two different point selection formats are presented to the user in the plugin. In one of these methods, the user selects the points between which the distance should be found from the plugin interface. Second, points are selected via QGIS. Three different metrics are used to calculate the distance between the selected points in the plugin. These metrics are Euclidean distance, Manhattan distance and Chebyshev distance, respectively.

2. Interface

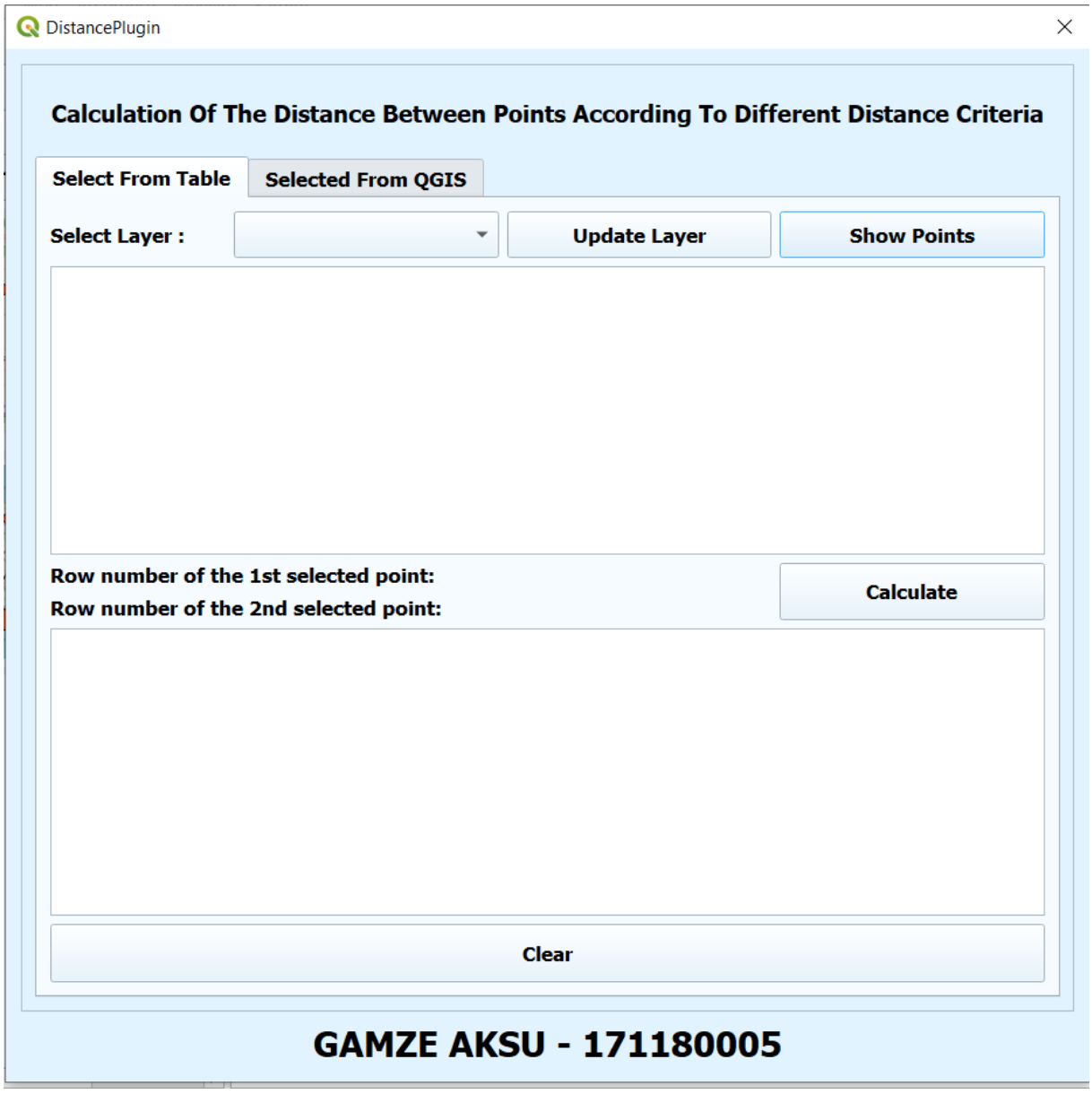

Figure 1: Tab1 - Select From Table

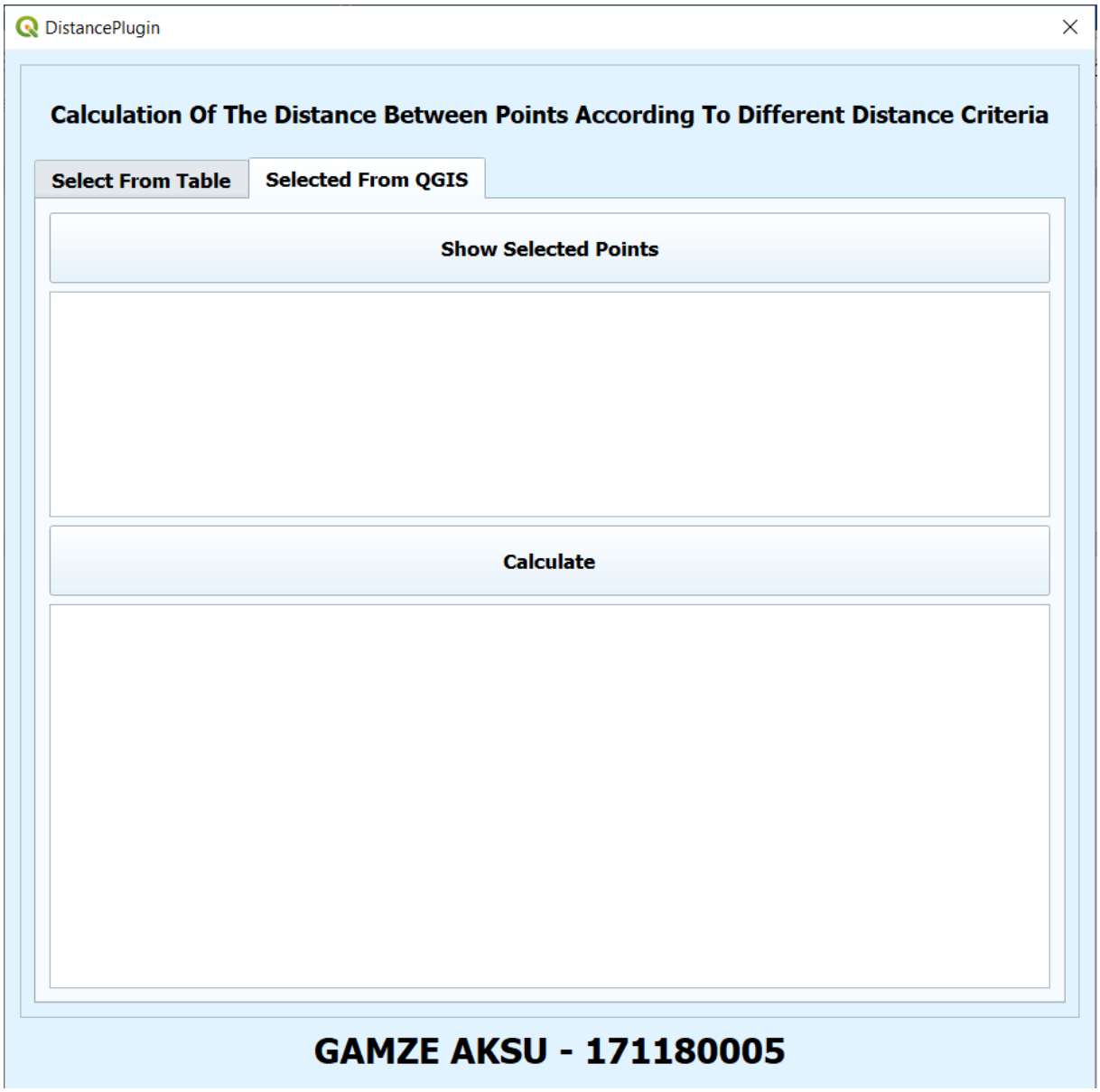

Figure 2: Tab2 – Selected From QGIS

3. Usage

3.1. Tab1 - Select From Table

3.1.1. Displaying the Points

If the plugin is opened without adding a layer, the layer names in the combo box will not appear. Because when the plugin starts, in the run method values are written into the combo box. If the Show Points button is clicked without adding a layer, the warning “A layer must be added first to show the points!” is displayed in a Message Box. When the layer is added and then the Update Layer button is clicked, the values in the Combo Box are updated. One of the layers in

the Combo Box with point geometry is selected. If the selected layer does not have point geometry, the warning "The layer you select must be a layer with a point geometry type only!" is displayed in a Message Box. Then the Show Points button is clicked. When the Show button is clicked, the points inside the selected layer on the Table Widget are displayed.

3.1.2. Selecting Points from the Table

Points inside the selected layer are displayed on the Table Widget. While each row of the table represents a point, column values show the X, Y coordinate values and attribute values of the points. When any cell of the selected point is clicked, the row value of the selected point is displayed on the label under the table. For example, when you want to select the point in the 2nd row, "Row number of the 1st selected point: 2" is written on the label. Similarly, when selecting the second point, any cell of the point to be selected is clicked. The row value of the selected point is written on the label under the table. When the cell of another point is clicked again without clicking the Calculate button, the first selected point is updated. The first and second selected points are updated with each click.

3.1.3 Calculation

After selecting the points, it remains only to calculate the distance between them. When the Calculate button is clicked, with the X and Y coordinate values of the selected points, the distance between them is calculated with Euclidean distance, Manhattan distance and Chebyshev distance. These distance values of the calculations are shown in a Table Widget table. The row values of the selected points are shown in the first column of the table, and then the calculated distance values are shown. When the Calculate button is clicked, the selected points and their values on the label are also deleted. After a calculation is finished, you can select different points again and calculate the distances between these points by clicking the Calculate button. This calculated value is written under the previous calculation in the table. Thus, the distances between the selected points can be compared.

3.1.4 Cleaning

The length of the table may increase as a new row is added to the table with each calculation. With the Clear button, the values in the tables are deleted. The shape of the table remains the same.

3.2. Tab2 – Selected From QGIS

3.2.1 Selecting Points from the QGIS

In order to be able to operate in Tab2, the layer from which the points will be selected must be selected as the active layer. The selected layer must be of point geometry type. If the selected layer is not of point geometry type, when the Show Selected Points button is clicked, the "The layer you select must be a layer with a point geometry type only!" warning is displayed with a Message Box. After selecting the active layer, at least two points must be selected on the layer. If less than two points are selected, when the Show Selected Points button is clicked, a Message Box will appear, and the "Please select two points in QGIS first!" warning is displayed. If the Calculate button is clicked without selecting two points, the "Please select 2 points before calculating!" warning is displayed.

3.2.2 Show Selected Points

If two points are selected on QGIS and the Show Selected Points button is clicked, the selected points on the Table Widget are displayed. If the selected points are more than two, the first two selected points are shown in the table. While each row value of the table represents a point, column values show the X, Y coordinate values and attribute values of the points.

3.2.3 Calculating

When the Calculate button is clicked, the distance between the selected points shown in the first table is calculated. This calculation is made according to different distance measurement formulas such as Euclidean distance, Manhattan distance and Chebyshev distance. Each result is shown in the table with the id values of the selected points.

When different points are selected on QGIS and the Show Selected Points button is clicked without closing the plugin, the coordinate and attribute values of the new points are shown in the table. When the Calculate button is clicked, the distance between the newly selected points is calculated and added to the table. If the Calculate button is clicked without clicking the Show Selected Points button when the new points are selected, the old result is added to the table again.

4. Tools

The created plugin was developed for QGIS. QGIS is an open source Geographic Information System (GIS) software. It enables operations such as data viewing and editing. Supports Python and C++ plugins. QGIS provides a powerful Python API. The Python API provided by QGIS is called PyQGIS. A Python-based plugin has been developed within the project.

PyQt was used for the interface required for the developed plugin. Qt is a toolbox that offers different tools needed to develop interfaces. The Python interface, which includes classes and functions used by Qt to interact with components, is called PyQt.

5. Application Steps

It was mentioned that the plugin consists of two different tabs, each tab a different point selection method. Different show and calculate functions have been created for each tab.

5.1. Tab1 - Select from Table

In the Select from Table tab, firstly, the layers in the project are listed on the Combo Box. The necessary codes have been added to the run() function so that the layers can be displayed when the plugin is opened.

When the Update Layer button is clicked, the values in the Combo Box are updated. When the Update Layer button is clicked, the update() function is called.

When the Show Points button is clicked, the X, Y coordinates and attribute values of the points of the selected layer in the Combo Box are listed in the Table Widget table. For this, the show() method, which is called only when the Show Points button is clicked, is used. In the show() method, the selected layer is determined with the index value taken from the Combo Box. Then, all the features in the layer are accessed with the getFeatures() method of the selected layer. Here, the X and Y value and attribute values of each point are taken and added to the values list. All the values in the Values list are accessed and the values are added to the Table Widget table.

To select a point from the table, the select() function is called when the table is clicked. There is a count variable used in the select() function and it increments each time the table is clicked. With the help of this count variable, the first and second point selection distinction is made. The coordinates of the selected points are assigned to the coordinates variable.

When the Calculate button is clicked, a different function is called for each distance criterion and coordinate variable values are given to these functions as parameters. Returned results are also added to the Table Widget table.

5.2. Tab2 – Selected From QGIS

In the Selected From QGIS tab, the Show Selected Points button must be clicked to show the selected points. When the button is clicked, the showPoints() function is called. In this function, the selected points in the layer are reached with the selectedFeatures() method of the active layer, and the X, Y coordinate values and attribute values of the points are added to the values list. The values in this list are shown in the table.

When the Calculate button is clicked, the same operations of the calculate method in Tab1 are performed.

6. Distance Criteria

6.1. Euclidean Distance

Euclidean distance is the linear distance between two points in a multidimensional Cartesian data space. It is measured by the linear connection method. It is generally expressed by the following formula.

$$d(\mathbf{p},\mathbf{q}) = d(\mathbf{q},\mathbf{p}) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2 + \cdots + (q_n - p_n)^2}$$

$$= \sqrt{\sum_{i=1}^{n} (q_i - p_i)^2}.$$

6.2. Manhattan Distance

Considering that there are perpendicular lines passing through the points, the Manhattan distance is the sum of the lengths of these perpendicular intersecting line segments. Manhattan distance between points p(x1,y1) and q(x2,y2) was measured using the formula |x1 - x2| + |y1 - y2| .

6.2. Chebyshev Distance

The Chebyshev distance is the largest of the line segments formed when perpendicular lines are drawn along the coordinate dimension, as in the Manhattan distance. Distance from manhattan between points p(x1,y1) and q(x2,y2) is measured using the formula max{ |x1 - x2|, |y1 - y2| }.

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