# Lab 4
# Supervised Classification

Due March 21

## Learning Objectives:

- Utilize multispectral imagery to create and edit a training dataset for supervised classification.
- Perform a supervised classification on an segmented image.

## Preparation

For this assignment I have prepared a dataset for you that consists of a portion of a NAIP multispectral image and a corresponding training data set. You will complete the training data setup and then perform a maximum likelihood classification.

# Supervised Classification with QGIS SCP

### *Semi-Automatic Classification Plugin (SCP)*

While the SCP tool is great for completing classification tasks, there is no inherent method of using it for GEOBIA. However, you could integrate your object information in as an additional raster layer.

1. You will need to add the Semi-Automatic Classification Plugin (SCP) to QGIS. To obtain that you need to go to Plugins - Manage and Install Plugins. Search All and find the plugin. Select install. Correct installation will show up as a dropdown at the main task bar at the top of QGIS called SCP.
2. Next, add the SCP Dock panel. To do this, navigate to the View menu, then Panels, and select the SCP Panel from the list. You will use this later on.

### *SCP Add Image Data and Create ROIs*

3. In QGIS browser, navigate to the NAIP image. Add the image to the raster layers (.TIF) by dragging and dropping them into the Layers Panel.
4. Open the SCP band set menu. You should see the image layers listed under the band set menu. However, if you do not, you can add them manually through the green and yellow folder tool.
5. On the SCP Dock select the Training Input menu.
    a. Select either Create New ROI file. For this step you have been given a set of training classes I have already created. It is located in the ROI folder.

b. There are two types of classes available in the SCP, MC are Macro Classes and C are Classes (regular). The Macro Classes are parent-classes if you are familiar with hierarchical tree nomenclature.

6. Assign the class name for MC 1 to Forest and create your ROIs.
    a. To create the ROIs, there is an orange ROI tool in the toolbar above the image. You can select that tool and then digitize your polygon by clicking on individual vertices. To complete the polygon, right-click on the last vertice.
    b. Once you have selected all the ROIs for the class, you can then click on the Signature button in the lower right hand corner for the Training Input tool.

### *Edit ROIs from a Segmented Image*

You can use image segmentation vector file to create training data for classification in QGIS.

7. Load your vector file in QGIS.
8. To edit the vector file you will need to Right-click on the file in the Layers panel. Then select Toggle Editing. This will allow you to edit the file directly either through the attribute table or the Identify Results panel. I recommend editing through the Identify Results Panel.
9. Open the Attribute Table. Click on the Add Column button.
    a. Add two columns to correspond to the MC ID. You will populate these columns with the thematic codes. I used MC_ID for an integer-based class, and MC for the Text-based class.

**Table 1. Classes used in the creation of the ROI file**

| **MC** | **MC_ID** |
|---|---|
| Impervious | 1 |
| Vegetation | 2 |
| Water | 3 |

    b. To isolate a polygon, click on it in the map frame using the ID tool. The resulting feature information will populate in the Identify Results panel.
    c. Right-click in the Identify Results panel and select Edit Feature Form or click on the corresponding form button at the top of the panel. An editable window with that feature's information will pop up and you can add the thematic information.
    d. Make sure to save your edits through the attribute table regularly so that you do not lose any of the edits you made!
    e. Once you have completed your selection of training data, you can export the file as a shapefile.

i. Open the Attribute Table and Select/Filter Features. The easiest way to filter out the polygons that you want is to use MC 'is not missing' for the property. This will select all polygons with a MC assigned to them. You can see how many polygons are selected in the title of the Attribute Table Menu. Close the Attribute Table.
ii. Right Click on the Segment shapefile again. Select Save Vector Layer As.. and name your file. Make sure to check Save Only Selected Features before saving the file or you will end up saving the entire dataset.

### *Alternative: Import ROI polygons*

If you already have a set of ROIs saved as a shapefile you can integrate them into the classification process in SCP. The instructions for this follow.

10. On the SCP Dock select the Training Input menu.
    a. Select either Create New ROI file. For this step you have been given a set of training classes I have already created. It is located in the ROI folder.
    b. Next, under the SCP tool go to the Basic Tools - Import Signatures tool. Select Import Shapefiles at the bottom of the menu.
        i. You will need to have fields for the MC ID, MC Info, C ID, and C Info. You may use the same field for both MC or both C fields. You do not need 4 separate fields.
    c. Make sure that Calculate Sig. is checked so that the spectral signature will be calculated for each of the classes. Finally click Import Shapefile.
        i. The Training Input field should appear and be populated with your shapefile training classes.
    d. You can now continue classification.

### *Alternative: Integrating a Point-based Thematic data with Polygons*

In some cases you may have point data that contains your thematic information. In order to add this thematic information to your training polygons you can do a Point in Polygon query.

1. From the main QGIS menu, go to Vector - Analysis Tools - Points in Polygon.
2. In the dialog, make sure that the Input Polygon Vector Layer.
3. Then make sure that the Input Point Vector Layer.
4. You may change the "output count field name" or accept the default: PNTCNT
5. Finally make sure you identify the Class field so that information is carried over to the polygon as well.
6. Click Run

### *Supervised Classification with ROIs*

To complete the Supervised Classification with SCP you will use the Classification toolbar.

11. Go to the Classification Menu. You can access it directly from the Dock or go through the SCP Menu and Band Processing.
    a. Select the Class types you want to use for your classification (MC and/or C ID)
    b. Make sure the correct Band Set is selected. In most cases, you ill only have the NAIP image open and then it would be Input Band Set 1.
    c. Select the classification type to be Maximum Likelihood.
    d. You can preview the result of the classifier using the “Activate classification preview pointer” tool inthe Classification toolbar along the top of the image. It looks like a block of four colors with a plus sign in the middle.
    e. You can manipulate the settings until you are happy with the preview results. Once you are happy then run the classification. You will be prompted when you click Run to set the name of your output classification image.

# Supervised GEOBIA Classification with SAGA GIS

1. Open the SAGA GIS tool, not the QGIS extension.
2. Load your raster data set as grids to this tool.
    a. You should add the bands individually and not as a stacked image.
3. Perform image segmentation using the Imagery - Segmentation - Object Based Image Segmentation tool.
    a. Your Grid System is your image.
    b. Features are the individual raster bands.
    c. Select Normalize
    d. You can change the other options or leave them to their defaults. Then Click OK
4. Open the Segments Polygon and zoom in to see the polygons resulting from the segmentation. (NOTE: You can change the opacity of the polygons to see the image underneath)

## *Create ROI using SAGA GIS*

1. Right-click on the Segment file. Go to Attributes and select Show. You should see the attribute table open.
2. Add a column to your Attribute Table using the Add Column button
3. Next, close the attribute table and then select the Actions (arrow) button.
4. Right-click on the Segments vector file and select Attributes - Show.
5. Click on an object within the segments map and your attributes panel should populate with the individual polygon’s attributes including the new Class column, though it is blank.
6. To populate the Class column, double click in the Value box and add the class information. Repeat this step for the polygons you wish to use as training data.

7. To classify the image go to Shapes - Table - Supervised Classification
8. You will need to set the following parameters
    a. Shapes - your segmented shape file
    b. Features - the attributes from that segment file that you want to use in classification. You should use your spectral band data.
    c. Training-classes - select your Training Class attributes from the segment shape
    d. Classification - you can leave the default value
    e. Method - For this case select Maximum Likelihood Classification
9. Click OK to run the classification.

## GEOBIA with ArcGIS Pro

The last method of performing maximum likelihood classification that we will examine is using ArcGIS Pro's Image Classification Toolkit.

1. To begin, open your raster dataset. You will need to have the image selected for the ArcPro Imagery Tab to be available.
2. Next, select Segmentation under the Classification Tools menu. ArcGIS Pro uses the mean-shift algorithm to perform the segmentation. You will need to set the parameters. Refer to the Segmentation exercise for an explanation of this process. The output of a segmentation in ArcPro is a raster file.
3. With the raster output selected, go to the Classification Tools menu and select Training Samples Manager.
4. The default NLCD land cover classification scheme is provided, but you can create your own by editing that classification scheme directory or clicking on Create New Schema.
    a. For the urban image I have removed several of the NLCD classes and ended up with the following classification schema

**Training Classes for Urban Image in ArcPro**

- Water
- Developed
- Forest
- Herbaceous

5. Once you have your schema saved, it is time to create your samples. Select the first class from your schema to begin class selection.
    a. To create a sample, select one of the editing tools from the toolbar. Most of the time the free hand tool is going to be the best tool to use.
    b. Create polygon training sites for each of the classes by dragging the pointer around the image where you would like to define a training site.
    c. Repeat this until you have enough training sites for a class. Select the next class and repeat this digitization process for all classes.

    d. Save the class training data as a shapefile by using the Save button above the training data table.
6. To perform the classification, go back to the Classification Tools menu and select Classify.
    a. Select the classification method. There are three supervised classification methods available (SVM, Maximum Likelihood, and Random “Trees”) and one unsupervised classification method (ISO Data).
    b. Select the training shapefile you created for the Training Samples input (NOTE: If it does not show up in the folder you believe it should be in try using the refresh button).
    c. Select your Segmented Image. (NOTE: If you wanted to perform a pixel-based image analysis you would not select a segmented image.)
    d. You can select a number of segment attributes to include in the classification. The basic selection should be the Mean digital number value.
    e. Set your output Classified Dataset and the Output Classifier Definition files and then select Run.
7. You can review your results in ArcPro, using the Raster Layer - Appearance tool to change the symbology and transparency of the layer.

# Assignment

Your assignment for this tutorial is to conduct an OBIA supervised classification using SAGA GIS. I am providing you with a point dataset that contains thematic information about post-fire treatments for a fire that occured in 2012.

1. Obtain the 2020 NAIP data for this site from Earth Explorer (https://earthexplorer.usgs.gov/). You can use the following coordinates for your search box. You may need to download more than one image.
    a. Upper Right: -85.3975, 46.7000
    b. Upper Left: -85.47148, 46.6838
    c. Lower Right: -85.3975, 46.6361
    d. Lower Left: -85.47148 , 46.6361
2. Clip the image using the MTBS burn boundary shapefile. This shapefile extends beyond the area that you have data for, but an intersection between the earth explorer data within the boundaries above, and the burn boundary should reduce the raster size by enough to make it manageable for analysis.
3. Perform an object based image analysis using SAGA or ArcPro.
    a. You can perform the segmentation in SAGA (Geoprocessing - Imagery - Segmentation - Object Based Image Segmentation) or use the segmentation tools in QGIS - OTB.
    b. If you use the QGIS-OTB segmentation tools. Export the segment polygon file as a shapefile.
    c. Open the shapefile in SAGA using File - Shapes - Load.

4. Export your final classification image and save it to a PDF or word document.  Upload the final result to the form here.