Exercise 8: Unsupervised Classification

34 Points scaled to 20 Points

Introduction

In this exercise, you will undertake an unsupervised classification of a Sentinel-2 Multispectral Instrument (MSI) multispectral image collected on 8/4/2020 over the city of Alexandria, Egypt using ArcGIS Pro and the Image Analyst Extension. Your goal is to differentiate four informational classes: developed/impervious, vegetation, rock/sand, and water.

Objectives

- *Use unsupervised classification techniques to cluster an image into spectral classes*
- *Interpret imagery and unsupervised classification results to merge spectral classes into informational classes*
- *Visually assess classification error and spectral confusion between informational classes*

Prerequisite Materials

- ❖ Modules: Classification
- ❖ Videos
    - o Lab 8 Intro: https://youtu.be/xrWw6zIviLc
    - o Unsupervised Classification: https://youtu.be/CCPFAHAXq-g
    - o Raster Reclassify: https://youtu.be/u4zwIUbxq_I

Data

- ❖ **s2_2020_08_04_alexandria.tif:** Sentinel-2 image covering the city of Alexandria, Egypt and the surrounding area. The bands have been stacked into a single, multiband image. See the table below for additional information. Note that the 60 m bands were not included in the stack (Coastal Aerosol, Water Vapor, and Cirrus Cloud). All 20 m bands were resampled to 10 meters.

Note: The Pittsburg map in the provided project file provides an example of unsupervised classification output. The Sentinel-2 image (s2_2020_9_8_pittsburgh.tif) was collected on 9/8/2020. The pitt_unsup.tif file shows the result of the unsupervised classification, which differentiates 23 spectral classes or clusters. The pitt_class.tif file represents our remapping of the unsupervised classification result to four spectral classes. You do not need to do anything with this map. It was just provided as an example for reference.

Band	Included	Band Number in Stack	Native Spatial Resolution
Band 1 (Coastal Aerosol)	No	NA	60 m
Band 2 (Blue)	Yes	1	10 m
Band 3 (Green)	Yes	2	10 m
Band 4 (Red)	Yes	3	10 m
Band 5 (Red Edge 1)	Yes	4	20 m
Band 6 (Red Edge 2)	Yes	5	20 m
Band 7 (Red Edge 3)	Yes	6	20 m
Band 8 (NIR)	Yes	7	10 m
Band 8A (Narrow NIR)	Yes	8	10 m
Band 9 (Water Vapor)	No	NA	60 m
Band 10 (Cirrus Cloud)	No	NA	60 m
Band 11 (SWIR 1)	Yes	9	20 m
Band 12 (SWIR 2))	Yes	10	20 m

Background Questions

Question 1. Explain the difference between supervised and unsupervised classification. (4 Points)

Question 2. Explain the difference between spectral and informational classes. (4 Points)

Question 3. Explain the difference between *k*-means and ISODATA unsupervised classification methods. (4 Points)

Required Steps

To complete this exercise, you will need to do the following:

- ❖ Open the project file.
- ❖ You may want to experiment with changing the band combinations. See the table above for the layer designations. The image is currently displayed as Red = NIR, Green = Red, and Blue = Green.
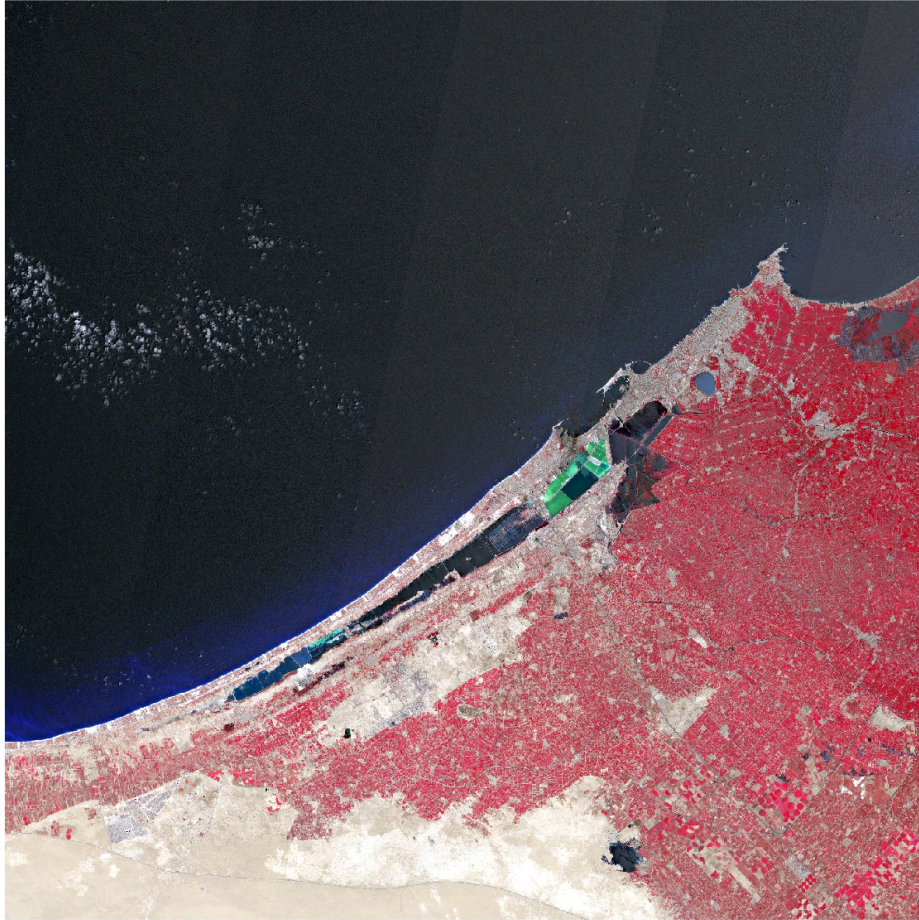
Figure 1. Sentinel-2 image used in lab exercise.

- ❖ Obtain a model definition file for ISODATA unsupervised classification using the Train ISO Cluster Classifier Tool. Set the maximum number of clusters to 25. You can leave all other settings to the default arguments.
- ❖ Use the Classify Raster Tool, image, and trained model definition file to cluster the data.
- ❖ Use the resulting unsupervised classification, image, manual photo interpretation, and the Reclassify Tool to map the spectral categories to the four information categories: developed/impervious, vegetation, rock/sand, and water.

Question 4. Based on a visual assessment of your results, what were the most obvious sources of confusion between the four informational classes? (8 Points)

Question 5. List and explain two methods that could be explored to potentially improve the classification results. (4 Points)

Deliverable 1. Create a map layout that includes 3 separate map frames that show (1) the input imagery, (2) the unsupervised classification result, and (3) the remapped result to the four informational classes. Make sure to include a legend explaining the symbology for the four spectral classes. The layout will be judged based on neatness, presentation, and use of space. (10 Points)