Lab 10 Supervised Classification

Utilizes Textbook's Remote Sensing Digital Database: Chapter 9 data.

The objectives of this lab are to learn how to build training sites, understand the parameters that impact the accuracy of supervised classifications, and convert your raster classification map into a GIS vector polygon file (see Chapter 9 Digital Image Processing for discussion). The classification exercise will be done on a subscene of the Landsat 8 image used in the textbook (see Figures 9-28, 9-29, and 9-33 and Plates (29 and 30). This subscene is in the **Lab_10_Data** folder. The tasks we will complete with this lab are done with tools in the **ENVI Toolbox**.

Two digital files are to be uploaded to the instructor and six questions are to be answered on the last page of this handout.

The Landsat 8 image was acquired on September 23, 2014 of Martinez, California. The non-irrigated vegetation is dry. To successfully complete accurate supervised classification maps the analyst must have a knowledge of the types of features that are being spectrally classified.

1) *Start-up* ENVI. *File* > *Open* drive to the Lab_10_Data folder > *Select* "Martinez_Landsat8_6bnd_2PC_CLIP2_ENVI_"

A natural color image (OLI bands 4-3-2 as R-G-B) is displayed in View 1
Apply a contrast stretch to brighten the color image

Open "Data Manager" You see 6 VNIR-SWIR bands and two PC images (PC3 and PC4)
Let's look at all the bands.
Right-click on the 8-image Landsat file in the Layer Manager > *Band Animation*
Slow the flicker down…1 second delay maybe.

Question 1: Which of the 8 grayscale images are most different?

2) Let's look at the complete statistics between the 8 grayscale images
ENVI Toolbox > *Statistics* > *Compute Statistics*
Click-on "Histograms" and "Covariance" *Output to the Screen* > *OK*

Review the Correlation Matrix while looking at the "Band Animation"

Question 2: What features on the ground lead to the negative correlation between PC 4 image ("Band 8" in the correlation table) and Bands 1, 2, 3, and 4 (Hint: opposite graytones in the images - one has bright pixels and the other has dark pixels for the same feature).

In the upper left corner is the “Select Plot” drop-down menu. Select “Histogram 1” first, the “Histogram 2” and then “Histogram 3”.

Question 3: Are these three visible band images normal or slightly skewed to the left?

In the upper left corner is the “Select Plot” drop-down menu. *Select* “Histogram 4” first, the “Histogram 5” and then “Histogram 6” – the 3 reflected IR bands.

Question 4: What is unique about the histograms for the reflected IR bands compared to the visible light bands?

3) Let’s analyze the Landsat scene and define 8 land cover classes. We will then select training sites for each class using heads-up digitizing of polygons with ENVI’s ROI (regions of interest) tool. 8 is an arbitrary number for this lab. (17 training sites were developed for the textbook example that used a larger Landsat scene of this area).

What land cover classes do you find on the image?
Classes should be spectrally unique.
(This is a good exercise class exercise with the instructor copying the land cover classes on a White Board and everyone voting for the top 8).

Split the ENVI display into 4 Views and fill each with a different color composite using the Data Manager and highlighting (selecting with your cursor) each View to be filled.
Views > 2X2 Views
View #2 load a color IR image
View #3 load a enhanced color (Bands 7-5-3 as R-G-B)
View #4 load PC4-PC3-Band 6 as R-G-B
Link the Views *Views > Link Views > Link All > OK*
Zoom to Full Extent > Zoom–in and pan around

Placeholder Classes for processing in this exercise**

1) River water
2) Ponded water
3) Irrigated grass
4) Dry grass
5) Wetlands
6) Suburbs
7) Industry
8) Trees (on western slopes with dry grass and deep shadows in valleys)

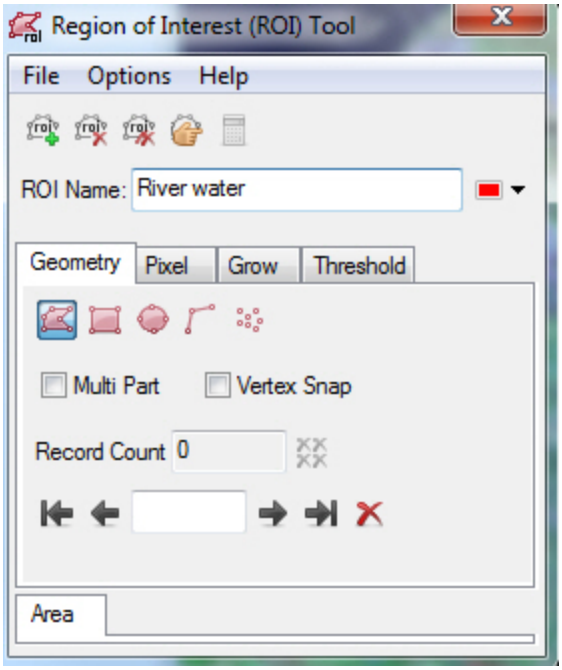
** *OK if class develops more or less classes and different classes for their processing*

4) Now we will generate training sites (ROIs) for the 8 land cover classes.

To give yourself more room to draw training sites (ROI polygons), let's Remove Views 2, 3, and 4. *Right-click* on Views 2, 3, and 4 in the layer Manager > *Remove View*

NOTE: ROIs should be neatly drawn so that the pixels inside the ROI are "pure" for the class being defined. Zoom-in and draw the polygon over only those pixels that correlate with the class being mapped. You should have more than one polygon for each training site. Try to draw ~5 polygons over pixels that represent a class.

Open the ROI tool (icon located at the top center of the ENVI display window)



Click on the "New ROI" icon, *change name* from ROI #1 to "River water".
We will accept default polygon drawing tool.
The "River Water" ROI is displayed in the Layer Manager and in the Data Manager.

Zoom-in to the feature of interest, and *draw* the around the pixels of interest. When done drawing the polygon, double-click your mouse, the polygon line will join both ends to create a closed polygon that is filled with a solid color.

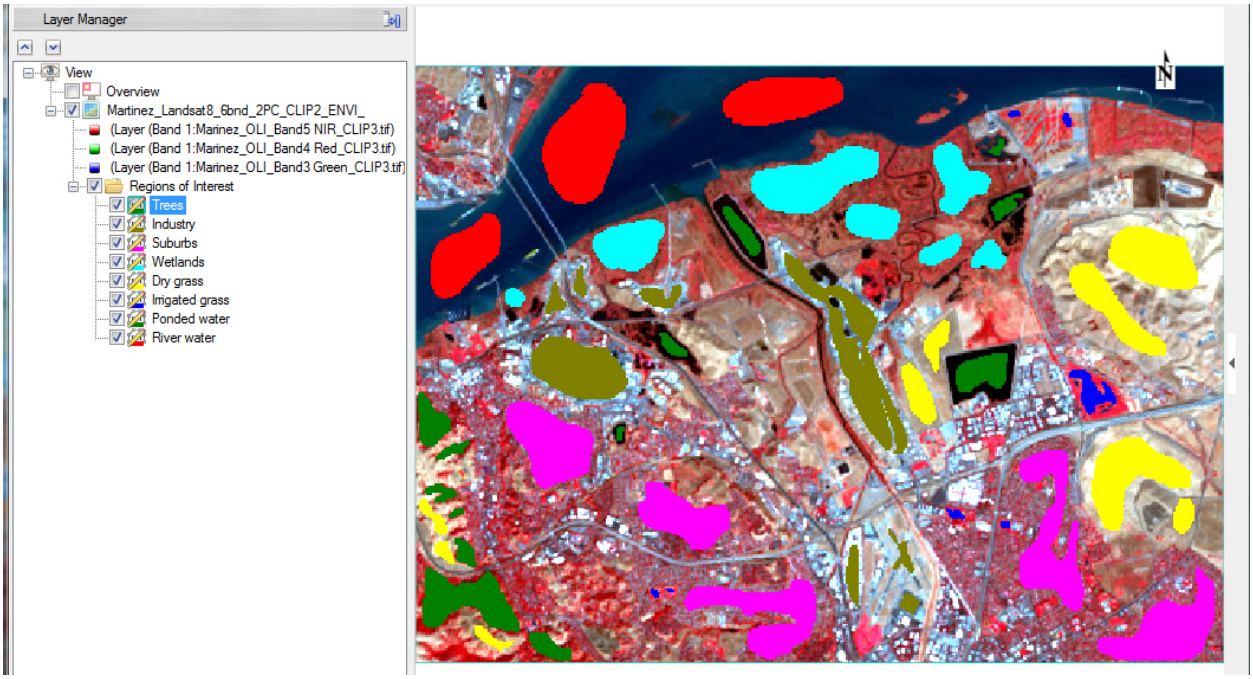
The ROI tool keeps track of the number of polygons in your class ("Record Count"). If you want to delete one of the polygons just use the counter with arrows at the bottom of the ROI tool to bring up the polygon and then you can that specific polygon using the "Delete Record" tool.

When done with one ROI, just click on “New ROI” and repeat the process.

When the “ROI Name:” turns blank while you are mapping the ROI, just click on the small down-arrow on the right to have your active ROI show up again in the tool. The name field turns blank sometimes when you use the Zoom and pan tools.

Make the polygons large in the suburbs, industry, dry grass, and river water so the program has the range of spectral values in the ROI.

As an example of training site polygons for the 8 ROIs, see below:



Let’s send our training sites to the instructor.

File > Chip View To > File *Choose* Output Format “JPEG”
Name the file “YourName_TrainingSites”

Upload the jpg to the instructor

Now we want to save the ROI file.
Regions of Interest (ROI) Tool > *Save As* > *Select All Items*
Name the ROI file “Landsat8_Martinez_8_ROIs”

5) Now that we have our training sites, we can start the supervised classification program.
ENVI Toolbox > Classification > Supervised Classification >

` The "Classification Input File" window pops-up.
Select our "…6bnd_2PC" dataset > *OK*

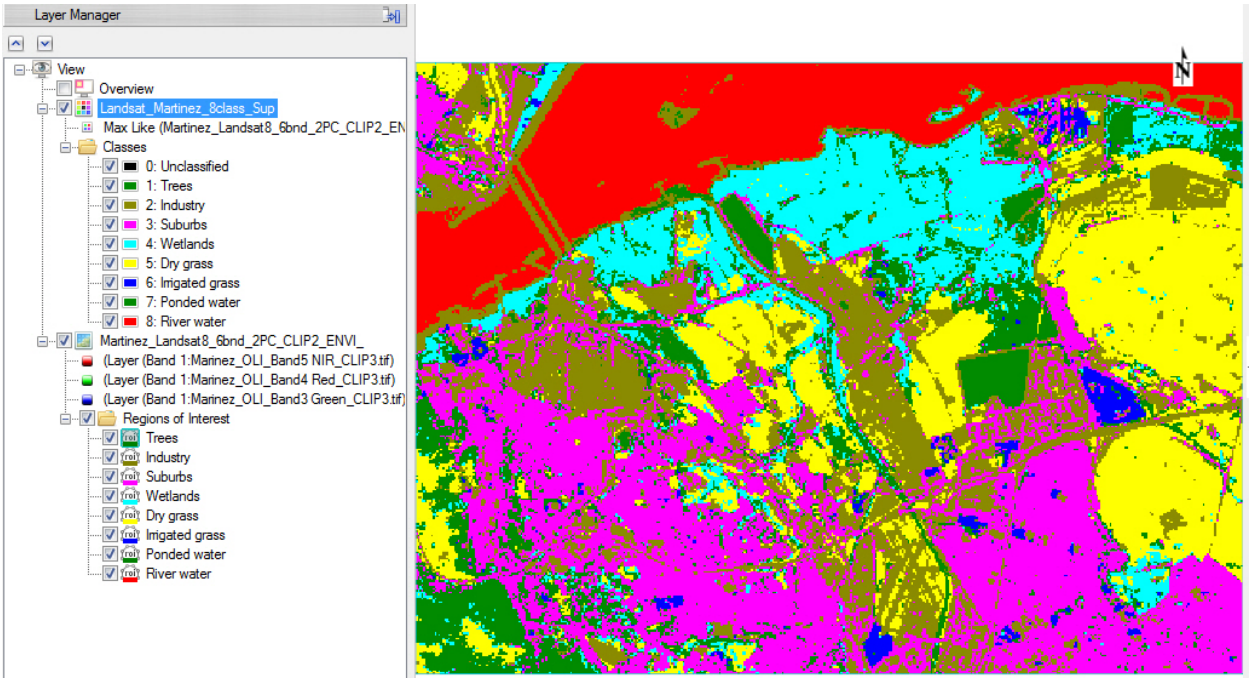
The "Maximum Likelihood Parameters" window pops-up > Click on **Help** for excellent information on the Maximum Likelihood algorithm.

Select All Items > Accept Defaults except "Output Rule Images? Change to "No"
Name the output file "Landsat_Martinez_8class_Sup"

The computer crunches the numbers and displays your supervised classification map

NOTE: Maximum likelihood classification assumes that the statistics for each class in each band are normally distributed and calculates the probability that a given pixel belongs to a specific class. Unless you select a probability threshold, all pixels are classified. Each pixel is assigned to the class that has the highest probability (that is, the maximum likelihood).
The many other classification algorithms have advantages and disadvantages, just as the Maximum Likelihood does. *Open* **Help** and *search* for "Classification workflow" **Read** about the different methods and review the "Classification Tutorial"

6) Your classification map could look like this:



This is a raster thematic map. It has 9 classes (one is "unclassified").

Let's look at the map's statistics.
Right-click on the "Classes" folder > *Statistics for All Classes….*
The "Data Selection" window pops-up *Select* our 8 class map > *OK*
*Scroll down t*o the "Class Summary" table (see below)

Class Summary	Pixel Count	Percent
Unclassified	0	0.000000
Trees	15038	10.828053
Industry	27280	19.642857
Suburbs	35315	25.428427
Wetlands	14867	10.704925
Dry grass	23858	17.178859
Irrigated grass	1976	1.422811
Ponded water	2388	1.719470
River water	18158	13.074597

Every pixel was classified.

The largest class is "Industry"

The smallest class is "Irrigated grass"

7) As with the unsupervised classification, let's minimize the "salt and pepper" appearance of this map by running a 3 X 3 majority filter across the scene.

ENVI Toolbox > Classification > Post Classification > Majority/Minority Analysis
Choose the 8-class supervised map > *Select* All items > *Accept* Defaults
Name the output file: "Landsat_Martinez_8class_Sup_maj" > *OK*

The generalized classification map displays on top of the raw map. *Swipe* to compare.
Let's look at the generalized map's statistics.
Right-click on the "Classes" folder > *Statistics for All Classes….*
The "Data Selection" window pops-up *Select* our 8 class Majority map > *OK*
*Scroll down t*o the "Class Summary" table (see below)

Class Summary	Pixel Count	Percent
Unclassified	0	0.000000
Trees	13502	9.722062
Industry	27225	19.603255
Suburbs	36491	26.275202
Wetlands	14779	10.641561
Dry grass	24333	17.520881
Irrigated grass	1884	1.356567
Ponded water	2437	1.754752
River water	18229	13.125720

Question 5: What class lost the highest percent of pixels and what class gained the highest percent of pixels when the majority filter is applied to the original classification image?

8) Move the color Landsat image beneath the majority-filtered classification map in the Layer Manager so you can compare with swipe and fade tools

Swipe the generalized map over the color Landsat image
(you

Fade the generalized map over the color Landsat image (Blend View tool)
These tools seen uncontrollable?! Too fast for analysis?

Stop the Blend Tool. Use the manual slider for transparency in the upper right corner of the ENVI display. Fade the map on and off to see what classes fit well, and what classes have errors (misclassified pixels)

To provide colors on the 8 classes that are easy to understand (i.e. dark green for trees, bright green for irrigated grass, blue for river water, etc.) *Right-click* on the majority classes folder in the layer manager > *Edit Class Names and Colors*

Display the Landsat as a grayscale image (OLI band 5 (SWIR1) is good) to provide an easy-to-understand backdrop to the faded/partially transparent color classification map.

Question 6: A. What class(es) do you interpret as least accurate?

B. What class(es) do you interpret as most accurate?

C. Why do think some classes are more accurately classified compared to others?

9) As with the unsupervised classification, this ENVI raster thematic image is not easily viewed by others. So we are going to convert it to an ENVI polygon vector file (.evf) and then convert the .evf to the universal .shp file.

ENVI Toolbox > Classification > Post Classification > Classification to Vector
Select the Input file "Landsat_Martinez_8class_Sup_maj" > *OK*
Select All Items in the "Raster to Vector Parameters" menu that pops-up
Accept Defaults (Output as Single Layer)
Name the ENVI vector file "Landsat_Martinez_8class_Sup_maj_vec" > *OK*

If the .evf file does not automatically load into the Layer Manager, *File > Open >* "…evf"

The .evf vector file should be displayed in the View. *Turn off* all the raster layers.

ENVI Toolbox > Vector > Classic EVF to Shapefile

The "Select Input EVF files" menu pops- up.

Locate and select your "Landsat_Martinez_8class_Sup_maj_vec.evf"

File > Open

The "Output EVF Layer to Shapefile" window pops-up.

Name the shapefile "Landsat_Martinez_8class_Sup_maj_GIS" > *Open* > *OK*

If the .shp file does not automatically load into the Layer Manager, *File* > *Open* > "Landsat_Martinez_8class_Sup_maj_GIS.shp"

10) Let's display the hillshade DEM of this Martinez area under our land cover shapefile in ENVI.

From the ENVI display window *File* > *Open*

Drive to the Chapter 9 folder in the Remote Sensing Digital Database and open the DEM folder

Ch_9_Image_Processing \ Plates 29-30_Spectral_Classification \ DEM

Select "DEM_Martinez_GIS_hs045_30elev.tif" > *Open*

The hillshade DEM displays in the ENVI View.

Drag the hillshade DEM below the landcover shapefile so the vectors show up on top of the DEM.

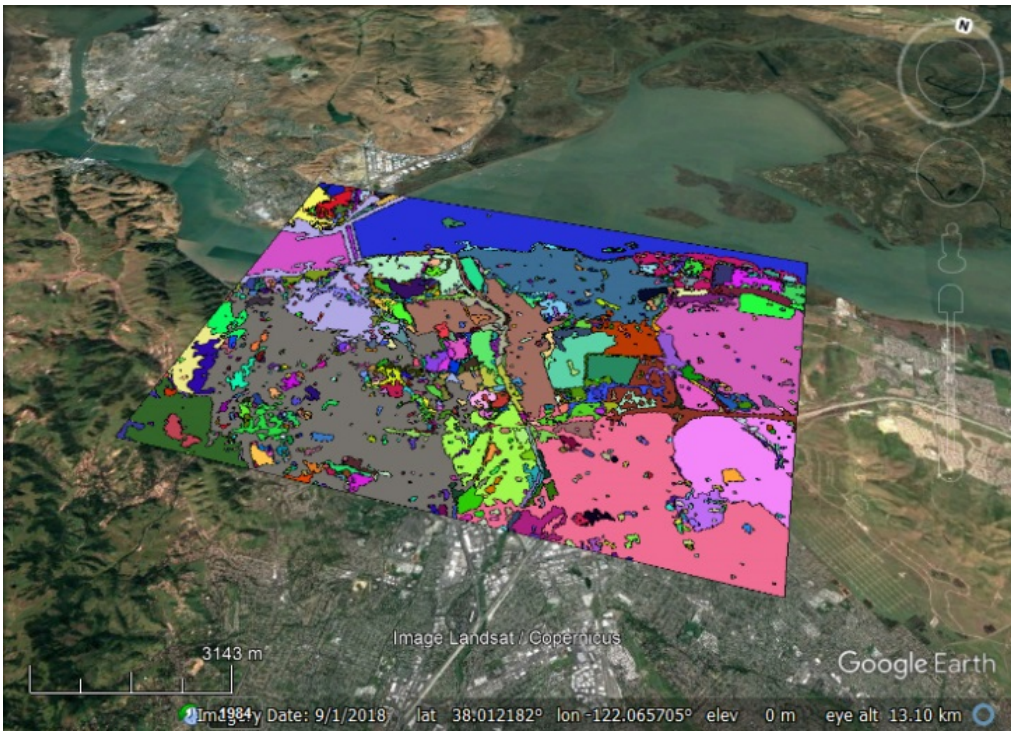
Let's send this display of vector land cover map over the hillshade DEM to the instructor

File > Chip View To > Image Select "JPEG" uncheck "Display result"

Name the vector map + hillshade DEM graphic

"YourName_landcover_hs-DEM" jpg

11) If you have access to Google Earth, *import* the land cover shapefile (see below)



Select and right-click on the imported shapefile in the Google Earth Places list > *Save Place As* > Accept default name. > *Save*

Your shapefile is now in the .kmz format (a universal format)
Upload the kmz to your instructor.

Lab 10 Supervised Classification Name:

Upload the following files to the instructor:

(4) “YourName_TrainingSites” jpg

(10) “YourName_landcover_hs-DEM” jpg

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