

# Section 9: Supervised Classification

## Section Objective

Signature Collection is the first step in Supervised Classification. The resulting signature set will be evaluated in the next task and utilized during Supervised Classification. Unlike the process of Unsupervised Classification, the user creates the class type inputs, which are used to 'train' the classifier to recognize features with different spectral characteristics. You will learn how to perform a supervised classification by collecting sets of pixels to define spectral signatures. Then, evaluate the accuracy of those signatures and use them to classify an entire image. This will produce a thematic image.

## Tools Used

- |                             |   |
|-----------------------------|---|
| • Signature Editor          | Used to collect, store and evaluate spectral signatures |
| • AOI Tools                 | To digitize and select individuals or groups of pixels  |
| • Histogram & Mean Plots    | Used to evaluate signatures                             |
| • Image Alarm               | Performs rapid classification used to test signatures   |
| • Recode Tools              | Permits the merging of thematic classes                 |
| • Supervised Classification | Uses signature input to classify an image               |

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## *Class Notes*

# Supervised Classification

## Objective:

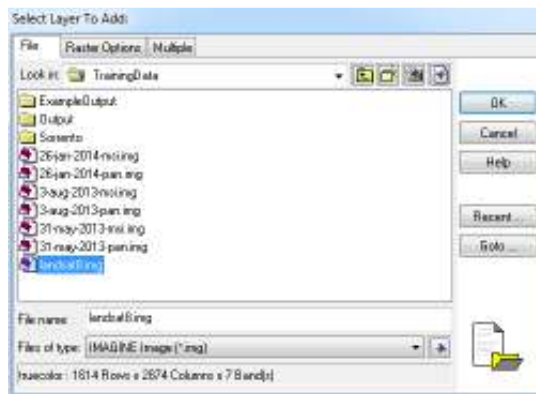
Signature Collections is the first step in Supervised Classification. The resulting signature set will be evaluated in the next task and utilized during Supervised Classification. Unlike the process of Unsupervised Classification, the user creates the class type inputs, which are used to 'train' the classifier to recognize features with different spectral characteristics.

## Task 1: Collecting Spectral Signatures

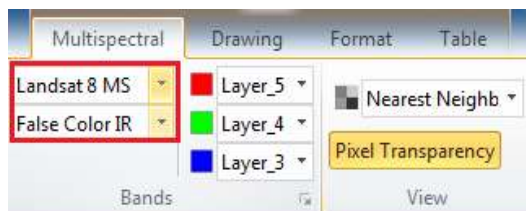
1. Right Click in a clear 2DView and **Open Raster**



2. Navigate to the TrainingData Folder and open **landsat8.img**



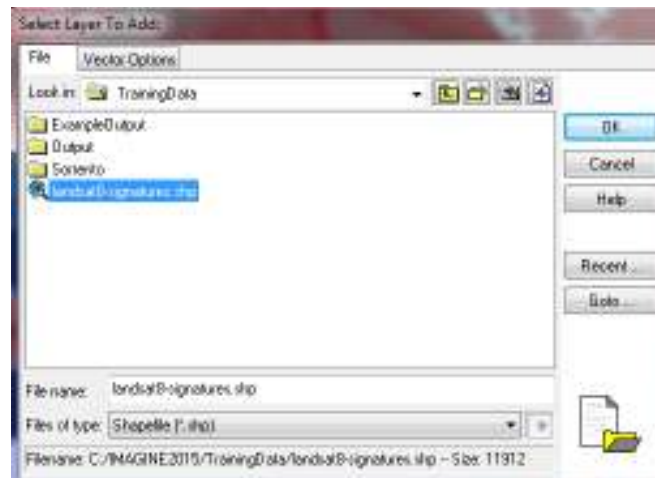
3. From the Raster Contextual Tab | Bands Group select from the Pull Down Lists:  
**Landsat 8 MS and False Color IR**



4. Right Click in the same 2DViewer and **Open Vector**



5. Navigate to your TrainingData folder and display **landsat8-signatures.shp**



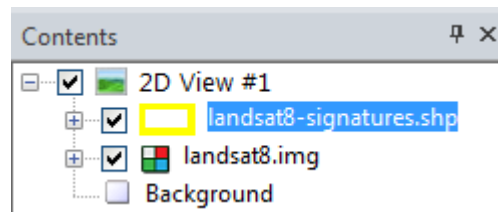
These signatures have previously been captured. Now we will examine the polygons to see where they are located. Later, you will capture additional signatures to ensure that you have sufficient samples to perform the most accurate classification possible.

6. On the Home tab, click **Fit to Frame**



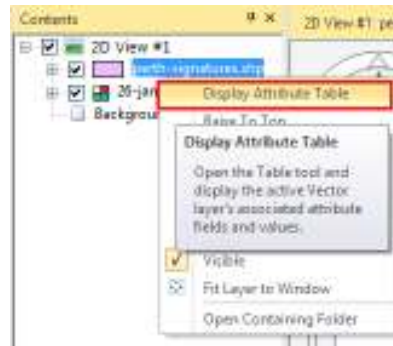


7. To help Identify where the polygons are, uncheck landsat8.img in the Contents pane to undisplay it. Now only the polygons are displayed in the View.



8. Toggle the shapefile polygon on and off by clicking on the check in the Contents pane. When you locate the polygons, zoom in on it and turn the imagery back on.
9. Toggle the polygon on and off again to see the imagery beneath it.

10. **Right-click** on **perth-signatures.shp** in the Contents pane. Select **Display Attribute Table**



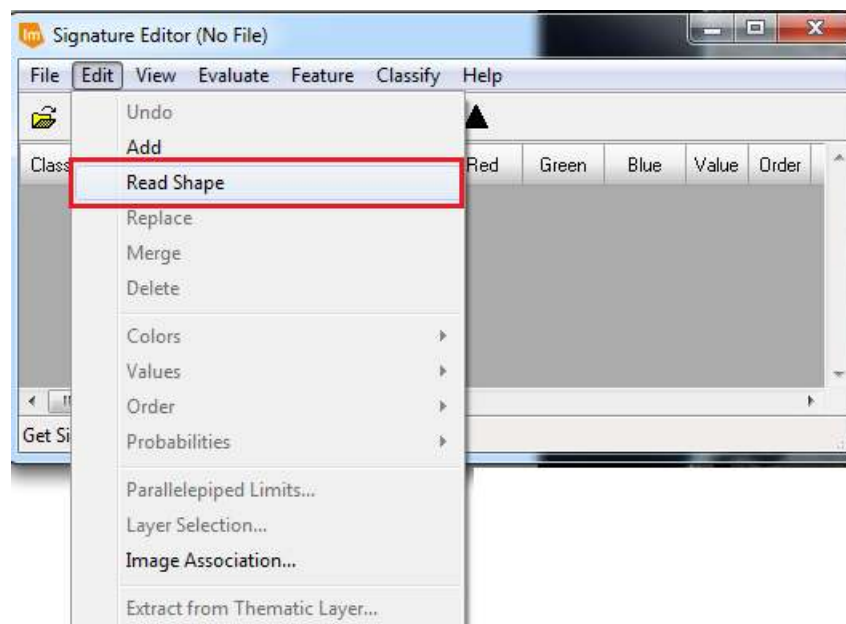
11. Click on a polygon to highlight that signature in the Attribute Table.
12. Zoom in on that polygon and toggle the imagery on again.
13. Continue to familiarize yourself with the signatures.
14. When you finish, **right-click** on **perth-signatures.shp** in the Contents panel and select **Remove Layer**

## Task 2: Image Association

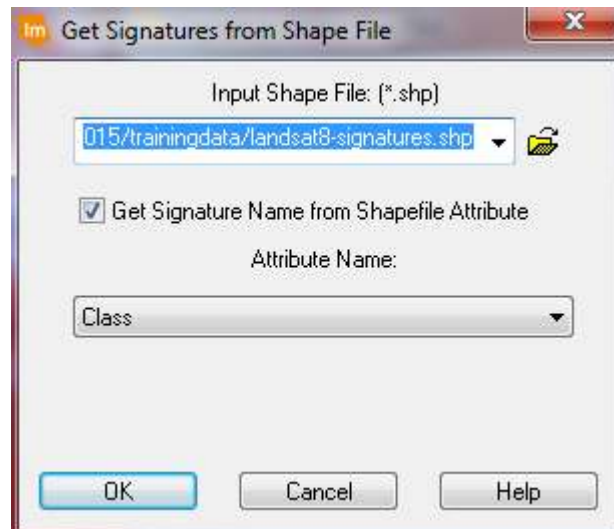
1. From the Raster Tab | Classification Group | Supervised Pull—down list, select **Signature Editor**



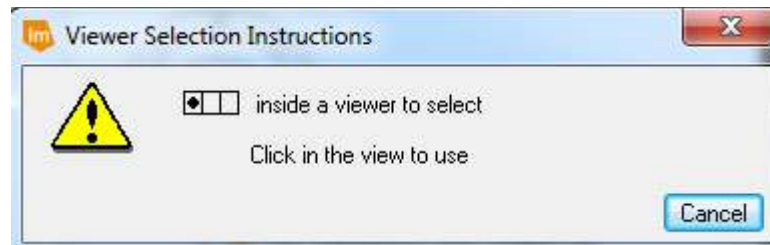
2. In the Signature Editor dialog, select Edit | **Read Shape**



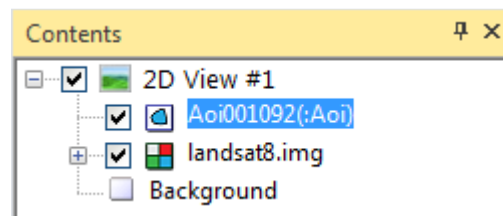
3. Select **landsat8-signatures.shp** from the TrainingData folder
4. Ensure that the Get Signature Name from Shapefile Attribute is checked and that the Attribute Name: is **Class\_ID**, then click **OK**



5. The Viewer Selection Instructions window will appear. Click in the View containing **landsat8.img** to associate the image with the Signature set



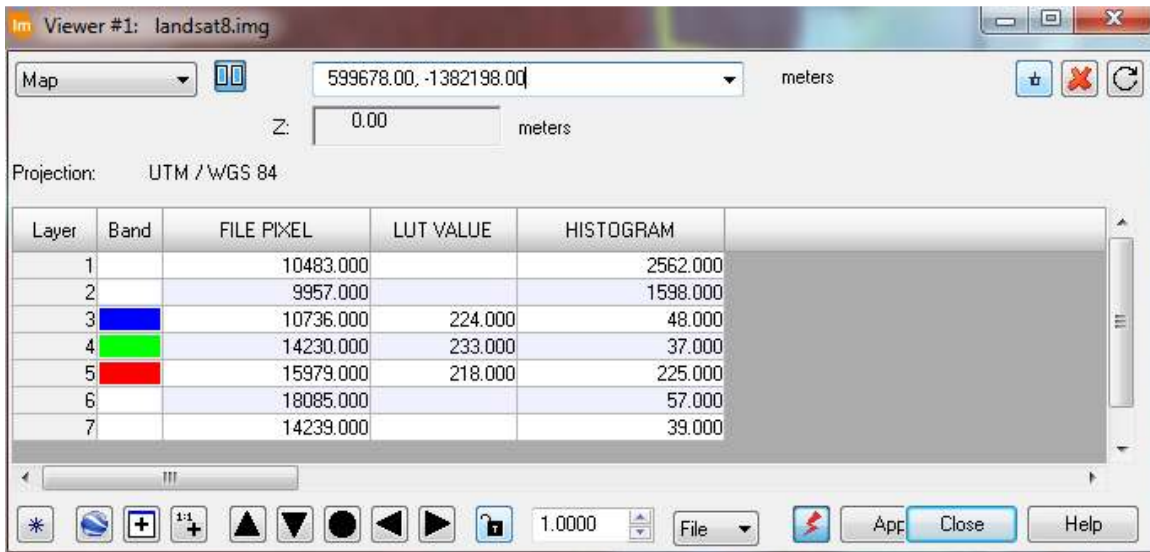
6. Your goal is to digitize another training signature for each of the output classes we will create. Note that the Read Shape process has created an AOI layer in the View with AOI conversions of the polygons.



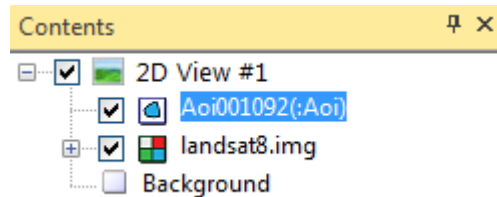


### Task 3: Collect Additional Signatures

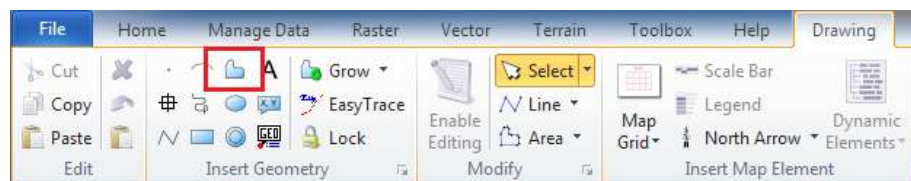
1. Ensure the image **landsat8.img** and the **AOI** layer is still in the viewer and select Home tab | Information Group | **Inquire Cursor**
2. Go to coordinate: **599678, -1382198**



3. Ensure your Signature File AOI layer is still selected in the Contents Panel



4. Select the Drawing tab | Insert Geometry group | **Polygon icon**



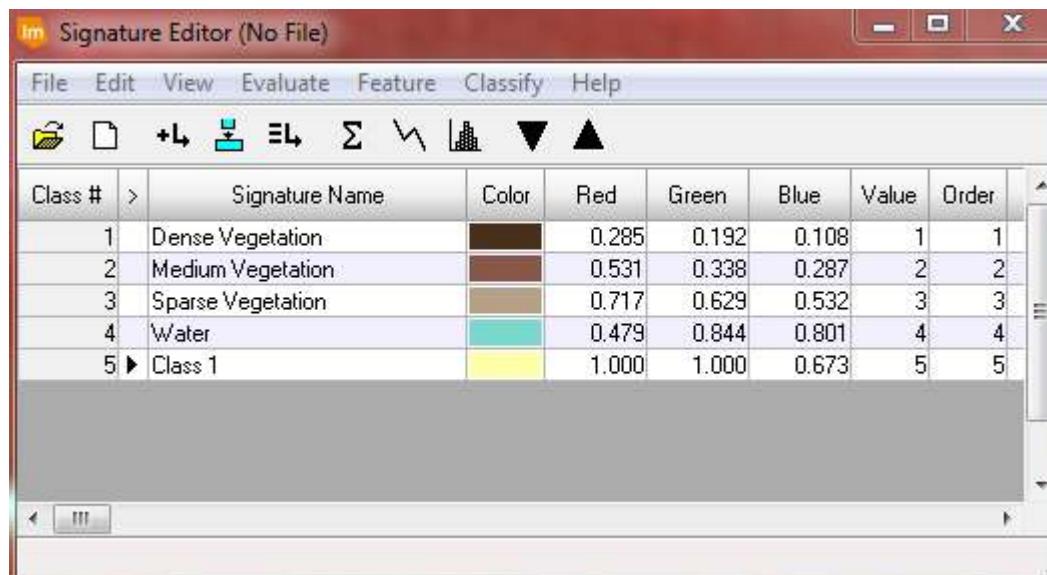
5. **Digitize a polygon** that creates a sample of the **Clearing**. Note this may be more visible if you use a False Natural Color band combination for display

Use the highlighted as area below:



Do not digitize too closely to the areas of other Land Cover Classes or else additional land cover types might accidentally be included.

6. When finished, **double-click to end the polygon**.
7. Click on the Signature Editor title bar to activate that dialog, then click the **Create New Signature(s) from AOI** icon



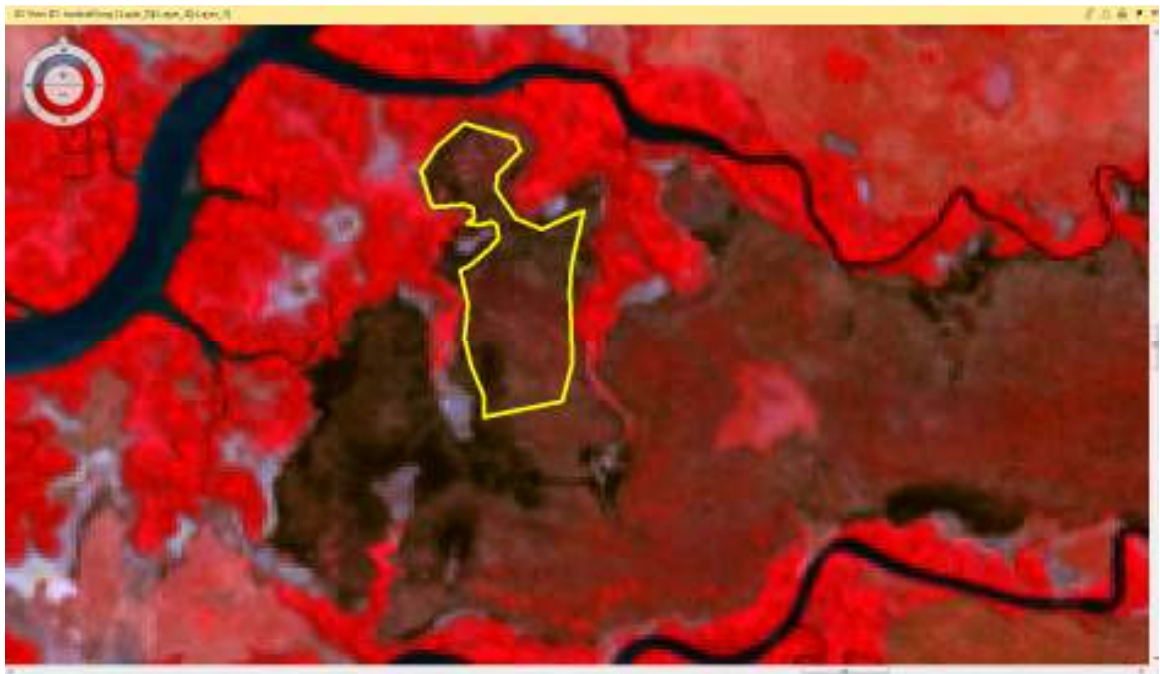
Notice that the entry is added to the end of the file and it is called Class 1

8. Change the Class 1 name to **Clearing**
9. Click in the Color box associated with the new signature. Select **Beige** from list of predefined colors
10. Repeat the procedures in the last few steps to create a new signatures for Fire Scar using following Inquire coordinates:

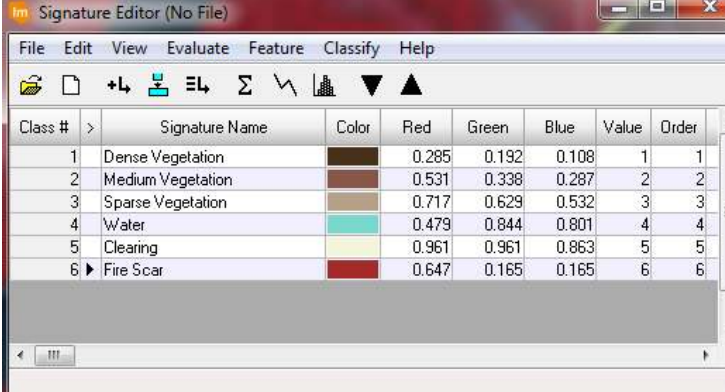
**Fire Scar    616020, -1387638**



An example of the polygon to digitize as below:

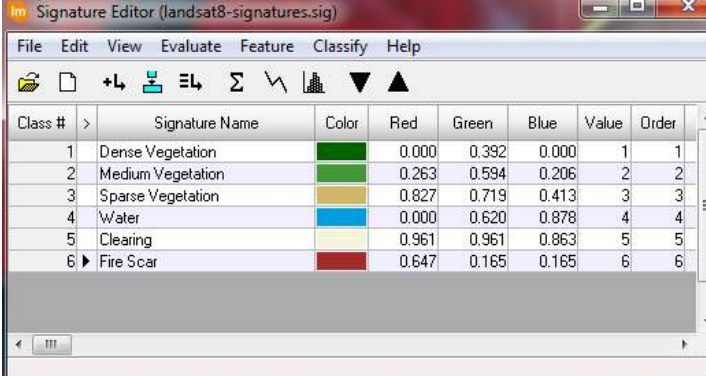


11. Choose appropriate color for the new signature and rename to **Fire Scar**



Class #	Signature Name	Color	Red	Green	Blue	Value	Order
1	Dense Vegetation	Dark Green	0.285	0.192	0.108	1	1
2	Medium Vegetation	Light Green	0.531	0.338	0.287	2	2
3	Sparse Vegetation	Yellow-Green	0.717	0.629	0.532	3	3
4	Water	Blue	0.479	0.844	0.801	4	4
5	Clearing	Yellow	0.961	0.961	0.863	5	5
6	Fire Scar	Red	0.647	0.165	0.165	6	6

12. Before saving, go through and update the colors of vegetation and water classes to more appropriate (clear) colors as shown. A rich green is selected for Dense Vegetation



Class #	Signature Name	Color	Red	Green	Blue	Value	Order
1	Dense Vegetation	Rich Green	0.000	0.392	0.000	1	1
2	Medium Vegetation	Light Green	0.263	0.594	0.206	2	2
3	Sparse Vegetation	Yellow-Green	0.827	0.719	0.413	3	3
4	Water	Blue	0.000	0.620	0.878	4	4
5	Clearing	Yellow	0.961	0.961	0.863	5	5
6	Fire Scar	Red	0.647	0.165	0.165	6	6

13. From the Signature Editor File menu, select **Save as**, and name the file TrainingData\Output Folder\landsat-signatures.sig
14. Leave the Signature Editor open for the next exercise.

## Task 4: Evaluating Signatures

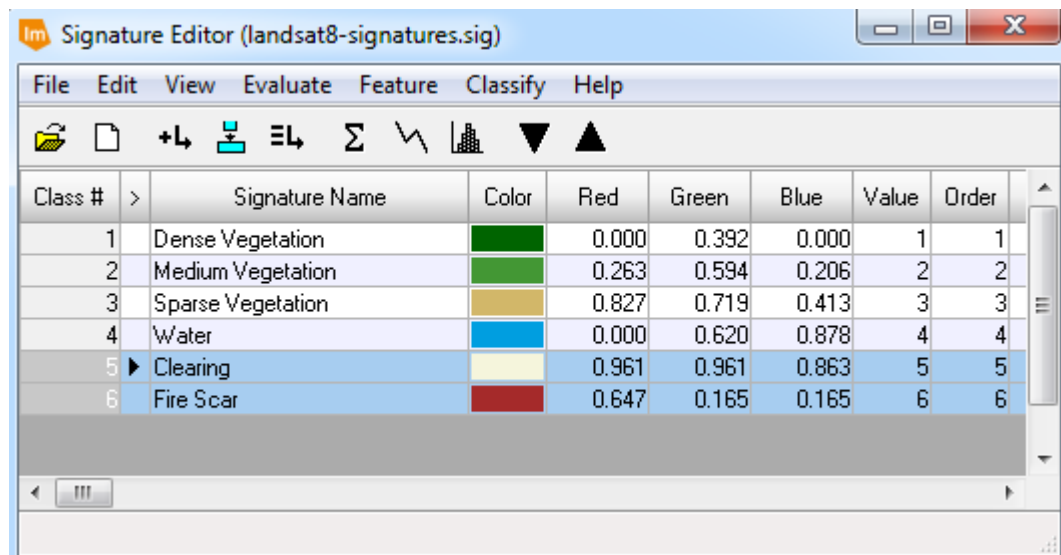
In the next few steps, you will be introduced to some tools that will allow you to evaluate the quality of your signatures. You may find that some classes are spectrally confused

The previously created signature file should be open in the Signature Editor

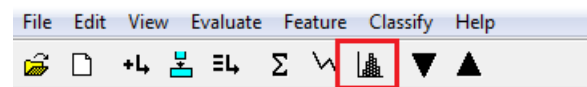


1. Shift + Left Click and select two classes that have very different spectral responses, such as **Clearing** and **Fire Scar** and Clearing.

The rows should highlight in blue



2. Click the Display Histograms Window icon



3. In the Histogram Plot Control Panel, click the **All Selected Signatures** radio button and Click the **Plot** button



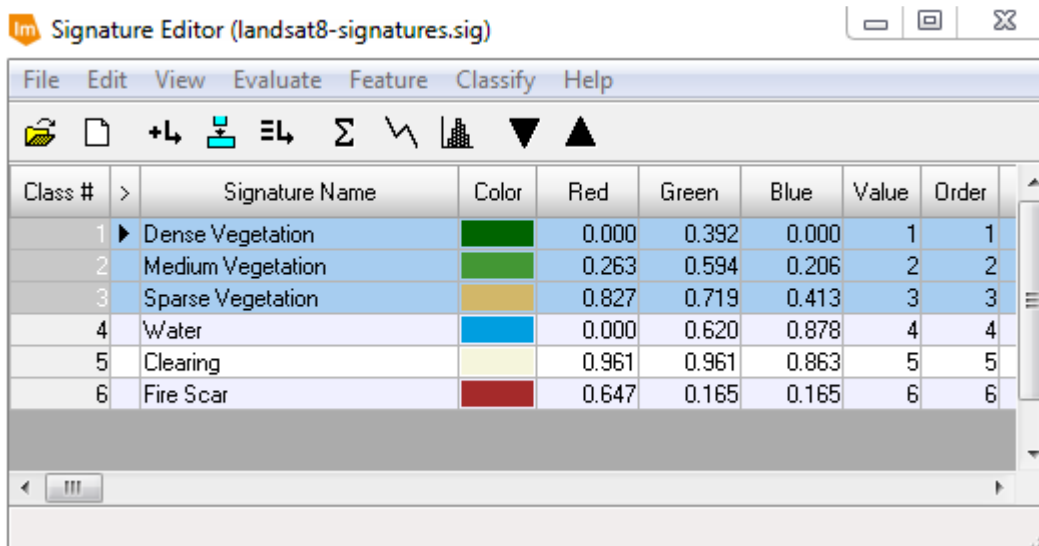
4. Rearrange the histogram plots so that all of them are visible
5. The screen should now have a series of plot windows showing two histograms in each. The color of the histograms will reflect the color of the corresponding signature. You want your histograms to bell-curved and separate.
6. In the Histogram Plot Control Panel, click the Close button to remove all histogram windows from the screen.



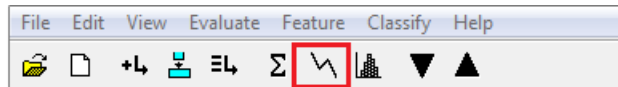
## Task 5: Mean Plots

Mean Plots chart the Mean Signature Value against each Band Number. In this task, you will view the signature mean plots for three signatures

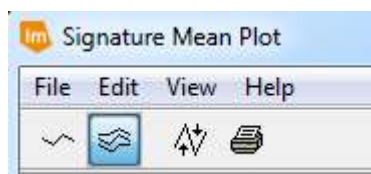
1. Select the signatures for **Dense, Medium and Sparse Vegetation**



2. From the Signature Editor tool bar, click the Display Mean Plot Window icon



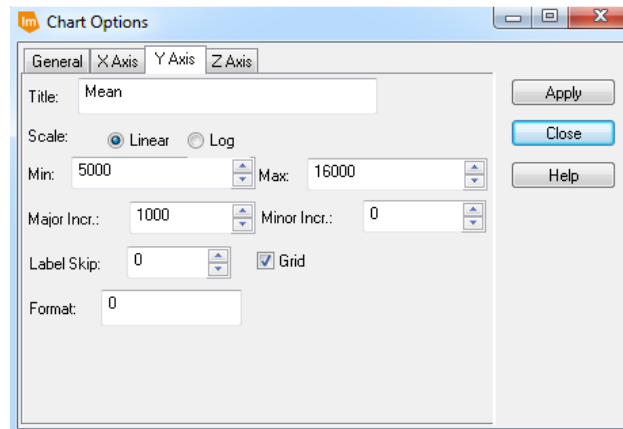
3. To view all of the signatures that you have highlighted in the Signature Editor, click the Switch Between Single and Multiple Signature and Multiple Signature Mode icon



4. To adjust the chart parameters, select Edit > **Chart Options**

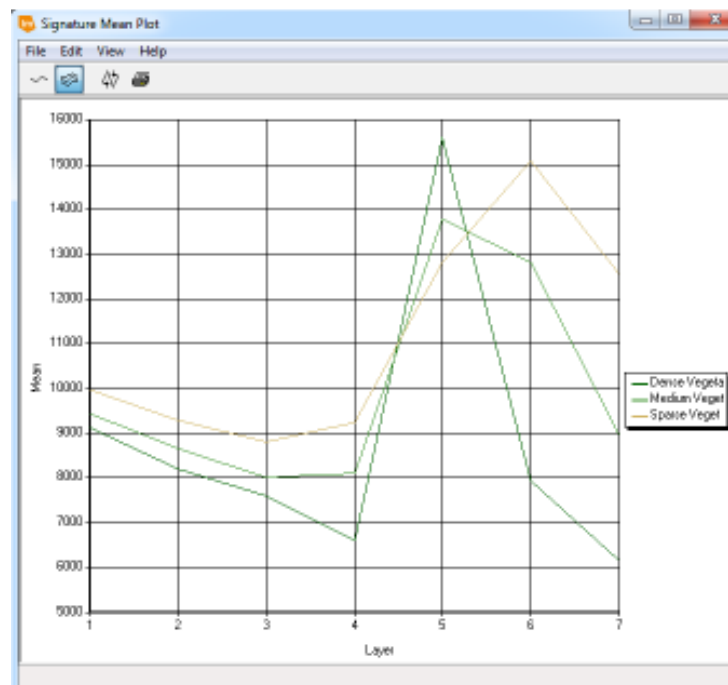
5. Click the General Tab and Change Plot Background to **White**

6. Click the Y Axis tab and adjust the Max value to **16000**



7. Click **Apply** and **Close**

For each signature, you should be able to view its mean value for each band of data



8. Move the cursor onto the Mean Plot. In the Status field below, you will see the layer and mean values have been updated with the position of the cursor

9. From the Signature Mean Plot menu, select File > **Close**



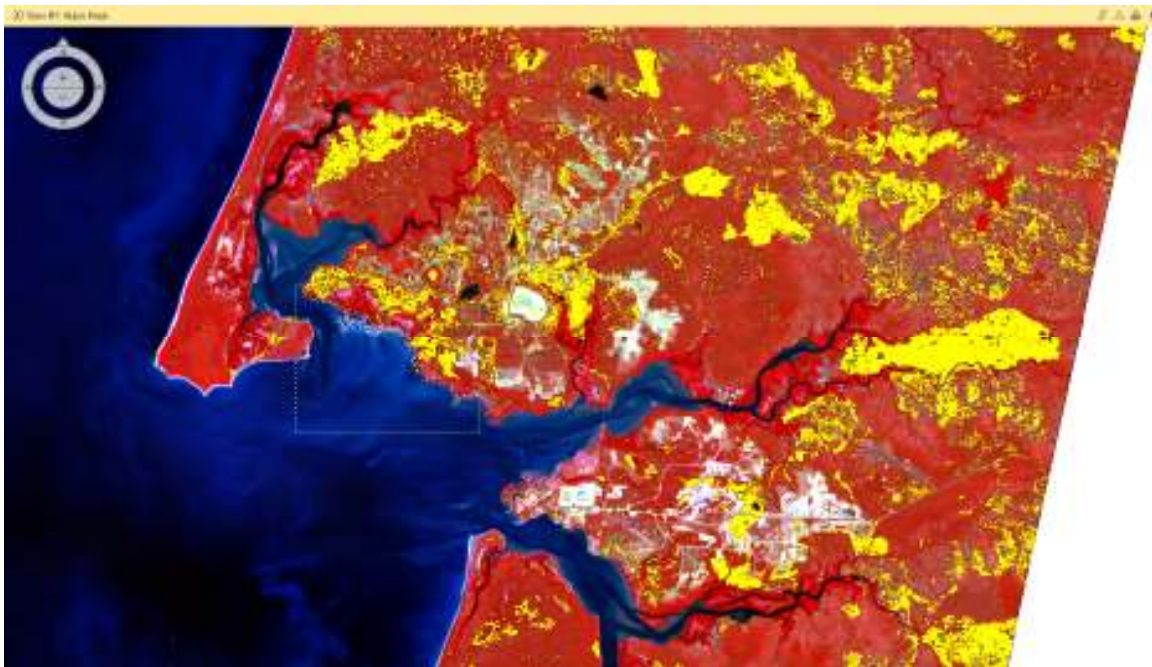
## Task 6: Image Alarms

Image Alarm performs a rapid classification using one or more signatures. Next, you will use Image Alarm to evaluate your signatures.

1. In the Signature Editor, select the **Fire Scar** signature and place the caret in the first column
2. Click on the Color block and select **Yellow**

Class #	>	Signature Name	Color
1		Clearing	Yellow
2		Dense Vegetation	Brown
3	▶	Fire Scar	Yellow
4		Medium Vegetation	Brown
5		Sparse Vegetation	Brown
6		Water	Teal

3. From the View menu, select **Image Alarm**
4. In the Signature Alarm dialog, click OK
5. Uncheck the **landsat8.img** image in the Contents Panel to only display the Image Alarm in viewer
6. When the process has finished, you will notice yellow pixels on the screen that represent the areas that will most likely be classified as Wetland 1.



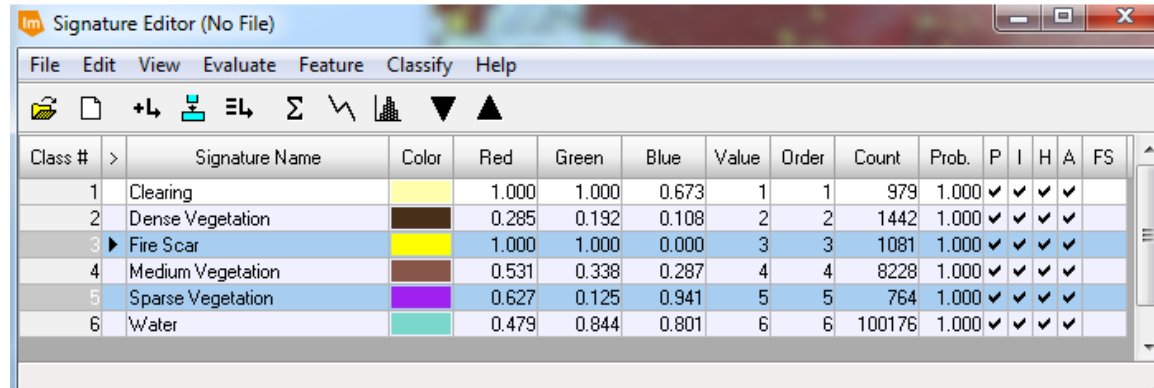
You should notice a larger area is classified by Image Alarm for the Class: Fire Scar than ideal. This highlights how you can further improve upon Supervised Classification using Rapid Classification Image Alarm.

7. Zoom and Roam to see which pixels will probably fall in the Sparse Vegetation class.

If you experience trouble locating this use the following location sing the Inquire Box: **621852, -1383652**

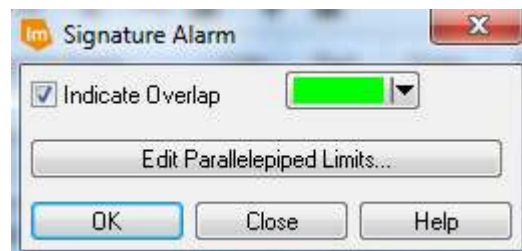
By selecting multiple signature when using the Image Alarm, you will find signatures that will most likely be confused or overlap one another

8. In the Signature Editor, select the **Sparse Vegetation** class, and change its color to **Purple**, then Shift+LMB click to re-select the **Fire Scar** class also



Class #	>	Signature Name	Color	Red	Green	Blue	Value	Order	Count	Prob.	P	I	H	A	FS
1		Clearing		1.000	1.000	0.673	1	1	979	1.000	✓	✓	✓	✓	
2		Dense Vegetation		0.285	0.192	0.108	2	2	1442	1.000	✓	✓	✓	✓	
3	▶	Fire Scar		1.000	1.000	0.000	3	3	1081	1.000	✓	✓	✓	✓	
4		Medium Vegetation		0.531	0.338	0.287	4	4	8228	1.000	✓	✓	✓	✓	
5		Sparse Vegetation		0.627	0.125	0.941	5	5	764	1.000	✓	✓	✓	✓	
6		Water		0.479	0.844	0.801	6	6	100176	1.000	✓	✓	✓	✓	

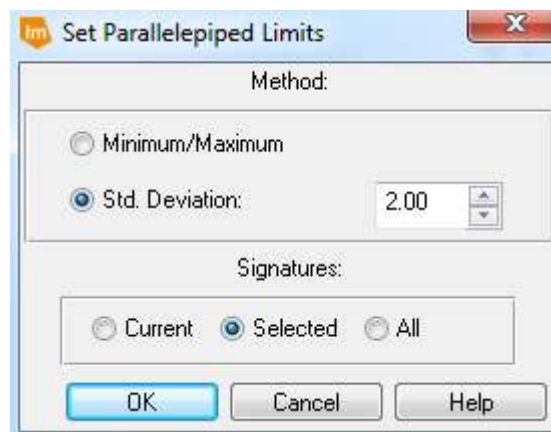
9. From the open Signature Alarm dialog, enable the Indicate Overlap checkbox and change the color to Green, then click OK



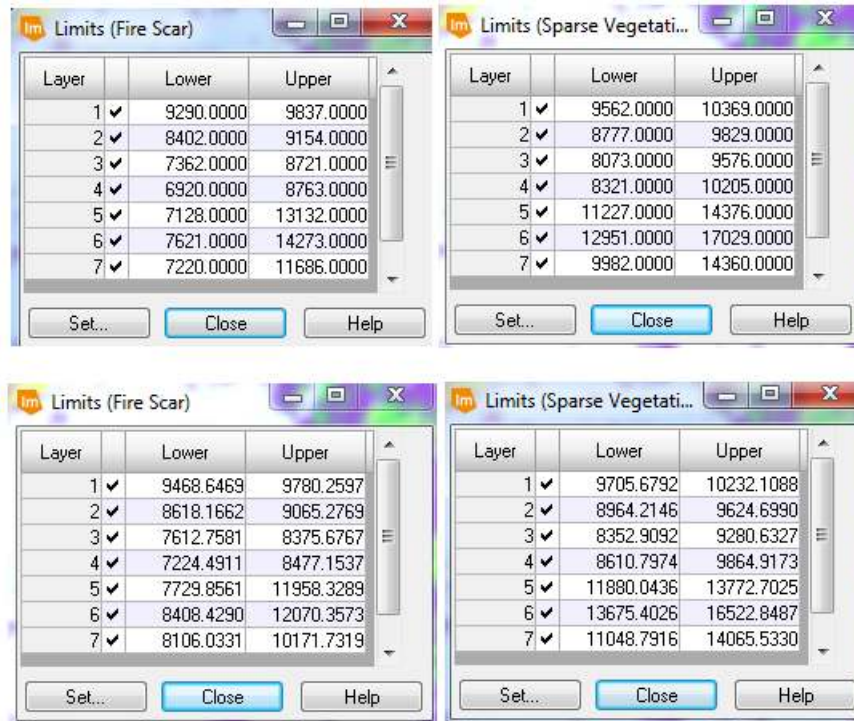
10. Zoom and Roam in the image to determine what areas may have spectral confusion
11. Use the roam and zoom tools again, to look at the area in the north-east corner of the image. You will notice areas of overlap
12. In the Signature Alarm dialog, click the Edit Parallelepiped Limits button. The Limits dialog displays. Using this tool, we will eliminate some of the overlap.
13. Click the Set button



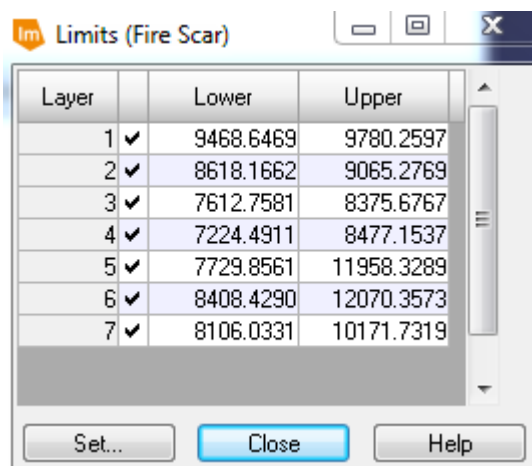
14. In the Set Parallelepiped Limits dialog, enable the **Std. Deviation radio** button and set its value to **2.00**
15. From the Signature group, click the radio button for **Selected**, then click **OK**



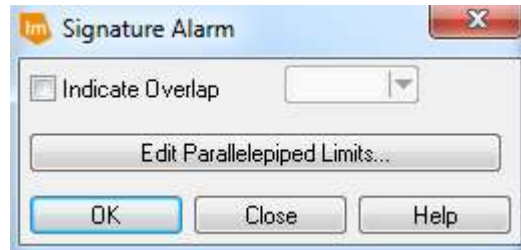
16. Notice that the upper and lower limits changed for the selected classes; Fire Scar and Sparse Vegetation. You can see the Parallelepiped Limits of other classes by moving the caret the Signature Editor



17. Click **Close** in the Limits dialog



18. Click **OK** on the Signature Alarm window to run the process again with the updated limits. The results will be an Image Alarm that contains fewer areas of overlap then click **Close**

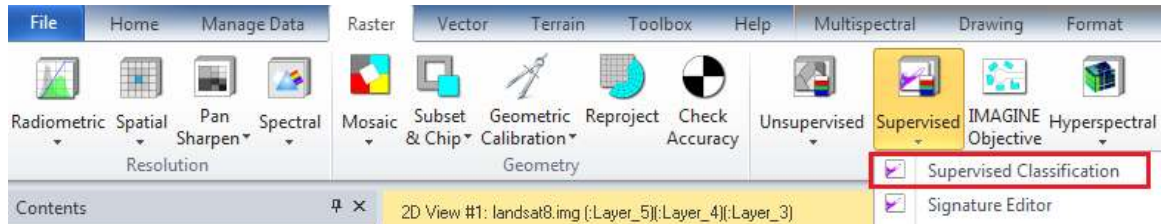


19. Click **Close** in the Signature Alarm dialog
20. From the Contents Panel, right-click on the Alarm Mask layer and select **Remove Layer**
21. Select **NO** when asked to save changes  
Now that you have seen some of the ways that signatures can be evaluated, return to your Signature Editor and use those tools to ensure that they are all separate, and represent different land cover
22. When you are finished, right-click below the Class # column heading, and click Select None
23. **Save** your signatures

## Task 7: Supervised Classification

Now you fully understand Image Classes, Signatures and how to change or evaluate these to further improve your classification – you can now run Supervised Classification using an input image and signature file

1. From the Raster Tab | Supervised Pulldown select **Supervised Classification**



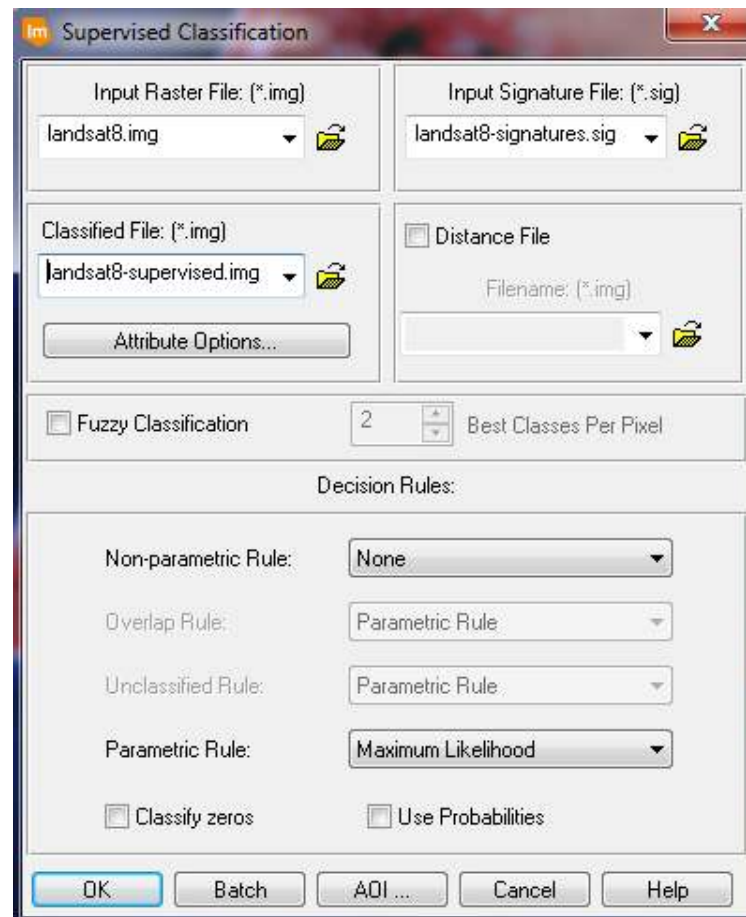
2. Specify the following parameters:

Input Raster File: **landsat8.img**

Input Signature File: **landsat-signatures.sig**

Classified File Output Folder\**Landsat8-Supervised.img**

Then click **OK**



If you have the Signature Editor already open you can also run this process directly from the Signature Editor Dialog

If there are any signatures selected in the Signature Editor when you run your classification, your output will be based only on that selection

Some notes on classification methods:

### **Parametric Rule**

Based on the statistics of a signature set.

For the Parametric Rule, ensure that Maximum Likelihood is selected.

### **Minimum Distance**

Calculates the distance in multispectral space of each pixel from the mean of each signature. The pixel is classified based on the mean to which it is closest

### **Mahalanobis Distance**

The Mahalanobis equation is a parametric classification algorithm. It relies on a normal distribution of data in each band for each class. Usually, it gives more discriminate results than the minimum distance option because it also considers the variance of the data

### **Maximum Likelihood**

Rule based on the probability that a pixel belongs to a particular class. The equation calculates the statistical probability of a pixel belonging to a specific signature

3. Open the original and supervised images in a viewer.
4. Visualize results with viewer tools then **Clear View**



## Task 8: Calculate Total Area of a Classified Land Cover

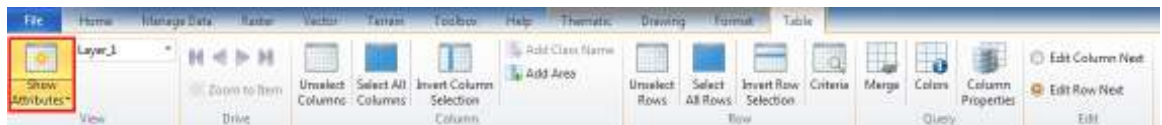
1. In a new Clear 2D View Right Click | Open Raster Layer



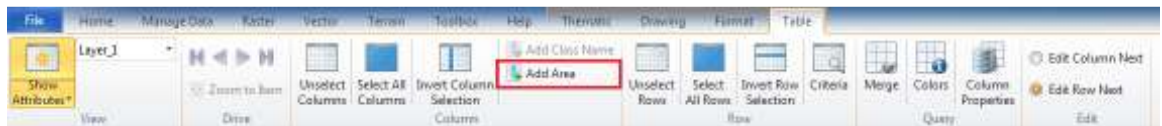
2. Navigate to your Output Folder and Open **Landsat8-Supervised.img**

If you have not yet generated this image, a copy is also available to you under the Example Output Folder

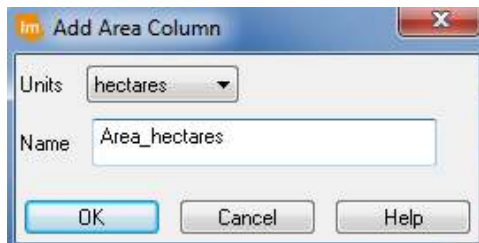
3. Raster Contextual Tab | Table | **Show Attributes**



4. Table | Column Group | **Add Area**



5. Select Unit as **hectares** and define Name as **"Area\_hectares"** Click **OK**



The total area in hectares will now be added to each class table of attributes

landsat8-supervised.img								
Row	Histogram	Color	Red	Green	Blue	Opacity	Class_Names	Area_hectares
0	376020		0	0	0	0	Unclassified	33841.8
1	244925		0.753	1	1	1	Clearing	22043.3
2	193597		0.776	0.286	0.192		Dense Vegetation	17423.7
3	521370		0.427	0.49	0.333		Fire Scar	46923.3
4	1011673		0.667	0.529	0.337		Medium Vegetation	91050.6
5	689640		0.608	0.718	0.627		Sparse Vegetation	62067.6
6	1601411		0.204	0.478	0.843		Water	144127

6. **Close** the table of attributes
7. When prompted, click **Yes** to Verify Save on Close
8. **Clear View**



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## *Class Notes*

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