GEO/EVS 425/525 Unit 1
The ERDAS Imagine Viewer and File Types

ERDAS Imagine is an extremely powerful Geographic Information Systems program oriented toward the detailed analysis of satellite imagery and other complex raster data sets. There's good reason that it has become an industry standard for raster-based GIS analysis. It is capable of environmental modeling based on input data of several sources with complexity ranging from very simple to extremely complex. The key to using the ERDAS imagine is the viewer. The viewer is the graphic window to whatever image your dealing with. It is opened automatically whenever you learn enter Imagine. You can open as many viewers as you want (within reason), and you'll be able to link viewers to carry out some very interesting sorts of analyses.

ERDAS Imagine is capable of handling a wide range of file types. It is necessary that we distinguish among two different classes of file types: native and importable. To say that a file format is native to Imagine implies that the file can be read directly by the core software. Not only that, if you're saving an image, this is the format in which that image will be saved. There are two native formats. For raster images, the native format is the Imagine format. Image files have a .IMG extension. For vector images, the native format is the arc coverage format used by the industry-standard vector software package ARC/Info. Image components are stored in directories rather than individual files. Each image will have its graphic component stored in a directory with a name corresponding to that of the image in question, and it will have its data stored in a directory named "Info."

As indicated above, you are not limited to those file types that are ERDAS Imagine raster files or ARC/Info Arc coverage vector files. Other files can be read directly by the Viewer, and still others can be imported into Imagine and then read. ERDAS Imagine can import a very large number of different formats – far more than you are ever likely to use in your life. Even so, there are some formats that it cannot import. No remote-sensing software can be all things to all people! Some of the formats you will encounter in this course are very important, however, so you need to be able to use the import and export functions of Imagine. Basically, you *import* files from a non-native form into the native raster or vector format, and you *export* files from the native raster or vector format into whatever format you desire.

In this laboratory, you'll learn the most common activities of the viewer, and you'll learn to deal with both native formats, and you will import a SPOT image. First, however, you need to learn some basic things about ERDAS Imagine.

Opening ERDAS Imagine

To open ERDAS Imagine, click on the icon labeled "ERDAS Imagine" on the desktop of any of the computers in the lab. This will set up the network and call Imagine. When imagine first opens, you'll notice that it takes a while for anything to appear on your desktop. Imagine is a big program, and it takes a while for it to load. Two things appear on your desktop. The first is the main control bar, which appears at the top of the screen. It contains a menu bar with five items: Session, Main, Tools, Utilities, and Help. You should click on all of these and determine what is there. Most of the menus that open up when you click on one of the items in the menu bar won't make very much sense to you right now, but it is important for you to have at least a feeling the what is there. Below the menu bar, there is a series of icons enabling you to do different things. You will not use all of these icons in this course, but you will use most of them.

The second thing that opens up is the viewer. Imagine actually has two types of viewers. The simpler is called the “traditional viewer”; the one we will be using more commonly is the “geospatial light table.” We will refer to both types as “viewer.” The first geospatial light table opens automatically; it is labeled "Viewer #1". However, you can open up as many other viewers as you want to by clicking on the viewer icons in the main control bar. You might try this and open another viewer or two. Alternatively, you can go to the “display” section of the viewer and click on one of the 4 icons. You will notice that other viewer windows open within the single geospatial light table. This can be a very useful feature.

All viewers contain a menu bar with 6 items: File, Utility, View, AOI, Interpreter, and Help (Figure 1).

Figure 1

Beneath the menu bar is in icon bar containing 17 icons (Figure 2), most of which you will need to become quite familiar with.


Figure 2

Note that both the main control bar and the viewer have three buttons in the upper right hand corner


Figure 3

(Figure 3). These are the standard buttons found in this position in most Windows programs. From left to right, the small underline will minimize the object in question. This means that you will no longer see the object on the desktop, but the button corresponding to it will remain on the status bar at the bottom of your screen, so that you can bring it back by pressing this button. Try this with the main Imagine control bar: press the minimize button, and the control bar will disappear for the desktop. Press the button on the status bar at the bottom of the screen labeled IMAGINE, and the control bar reappears. The next button to the right, the Square, maximizes the object in question, so that it takes up the entire desktop. Again, you might wish to try this with a main control bar. You'll notice that when you maximize an object (and this is true of any object), the "maximize" button changes to a different form. Actually, what happens is that it disappears and is replaced by the "Windows" button. Press this, and the object returns to its normal view. You will probably never want to maximize the Imagine control bar. But you're very likely to want to maximize the viewer. The last button on the right, the x, it is the "close" button. When you press it (and don't do it for the main Imagine control bar), the object whose "close" button you have pressed disappears permanently. Try this with the viewer – and then reopen it.

Some Details of Directory Structure

Before you actually open in image, it's useful to get a feeling for how your directories are structured. Click on Session on the menu bar of the main Imagine control bar. From the drop-down menu, choose Preferences. A window opens, indicating a number of preferences which you can change. The highlighted category is User Interface & Session. This is the most important of the "preferences" options, as it specifies the locations of the files you'll actually be working with and a default values of the bands that will be used in the viewer. Scroll down and take a look at the various defaults. Most especially, you should note the default directories and the default bands for Spot and Thematic Mapper images. Shortly, you will see how these defaults actually operate. If you choose to change any of these defaults, you'll be able to customize the Imagine interface somewhat. However, the source directory for images provided by CSU will always be Q:, and your working directory will always be X:. Don't change these – at least not yet. You will not need (or want) to change your working directory from X:. All of the files supplied by CSU which you will need to use in order to carry out the exercises will be in the Q: drive. Later on in the semester, you may wish to change your default source directory to X: – and you will certainly want to change it when you begin to do research in remote sensing, but you should leave Q: as the source directory for the time being.

Opening an image

To open an image, go to the viewer. There are three different ways to open a native-format image, and you need to learn how to use them all. Click on File-Open on the menu bar. You'll notice that you have several choices of file types to open. Of these, the most important are raster and vector. Note that the "raster" and "vector" lines are labeled "Ctl-R" and "Ctl-V", respectively. This means that using the mouse to click on File-Open-Raster is equivalent to using the keyboard by holding down the control key and hitting the R key, and clicking on File-Open-Vector is equivalent to holding down the control key and hitting the V key. Either will open the dialog box for raster and vector images, respectively. If you look at the icon bar, you'll notice that the leftmost icon is a file opening. Clicking on this icon is probably the easiest way to open a file of the sort you have been working with. You should experiment with all of these ways of opening files.

Open a raster file. It doesn't matter which of the three ways you use: mouse-menu, keyboard, or mouse-

icon. They're all the same. The dialog box opens, and you will see what is in the Q: directory. Two sorts of files present themselves. The icon that looks like a file folder indicates a directory. Almost all of these directories have a corresponding fluffy green icon with the same name. These are vector files. You're not interested in these yet. The raster files are indicated by a funny red, gray, and blue icon. Choose the file LNLANDC.IMG. When you single-click on the filename, the filename is highlighted, it appears in the File name window in the dialog box, and a preview image opens in the lower right portion of the dialog box. Note that the dialog box has three tabs. You don't need to worry about the "multiple" tab yet, but the other two are important. You are already looking at the "File" tab. Now click on the "Raster Options" tab. This gives you a certain amount of information about the file you're about to examine. You are told, for example, that its default display format is Pseudo Color. This means that it will appear as a color image. If you click on the drop-down button to at the writer this window, you'll see that there are other options. You should try them all. Do they all work? You are also told that the image contains one layer. You also have a choice of three check boxes in pseudo-color mode: Clear Display, Fit to Frame, and Set View Extent. See what happens when you check or uncheck these different check boxes. Most commonly, you will want the Clear Display and the Fit to Frame boxes checked. Click on OK, and the image will appear in the viewer. This is a land classification file for the Gainesville quadrangle in Georgia. The dark item in the middle of the image is Lake Lanier; the red objects are vegetation, and the gray objects represent urban development of various sorts, mostly in the city of Gainesville. Compare the image with the map of Gainesville, which is posted in the laboratory

Obtaining Information About the Image

Run the mouse over the image, and look at the status bar at the bottom of the viewer. You'll notice that the UTM coordinates of the mouse's location are shown, and you are also told that the projection is UTM using the Clarke, 1866 spheroid.

Click on the third icon in the icon bar. This is the one that looks like a sheet of paper with an "I" on it. Note that when you put the mouse over this icon, an explanation of what it does appears in the status bar at the bottom of the viewer. The ImageInfo window appears. Note that it has four tabs. Examine the information on all four tabs, by clicking on each of the four tabs and examining the information that appears. Does this information makes sense to you? Concentrate especially on the General tab. The File Info section is fairly straightforward. The Layer Info section is very important, although the information it contains is not intuitively obvious. The Width and Height are the number of columns and rows, respectively, comprising the image. The Type refers to the type of the image in the viewer. This one is a thematic image. That means that the data included in the image are of themes. In this case, the themes are land-use types. You can ignore the Block Width and Block Height. The Data Type refers to the way that information is stored. Unsigned 8-bit indicates that the data are stored as integers, each 8 bits (one byte) in length. The Statistics Info section is fairly straightforward. The Map Info section is equally important, and it is fairly obvious, as it documents the details of the UTM coordinate system. The Projection Info section is also straightforward. Look over all of the information on this tab, and then look at the information presented on the other tabs. Do you understand all of the information that you have about this image? At this point, you might check the discussion group to see if your interpretation is the same as that your colleagues -- or if you understand more (or less) than others in the class.

Going back to the icon bar, look at the fourth icon, which looks like a floppy disk. This will allow you to save the image if you choose to. Don't bother at this point, but remember that the icon will save your image if you need to do so. It's a useful icon. The next icon looks like a printer; it will allow you to print the image. Again, don't bother. The next icon lets you save your image as an HTML image – that is as an image that you can export to the WorldWide Web. The next icon in the bar is really important. It clears the viewer. It is a stylized eraser like one might use on a blackboard. You don't want to take clear the viewer yet, but this will be one of your more important icons.

Six of the icons on the icon bar deal with zoom. These are the ninth through twelfth icons and the 19th and 20th icons. Icon 9 (a miniature sure magnifying glass in a red circle with a red slash through it) cancels any zoom, so that each pixel in the image corresponds to one pixel on the monitor. Icons 10 - 12 are extremely useful. Click on them to see what they do. Icon 10 (four arrows facing into the center) lets

you zoom in on an image; icon 11 (four arrows facing out from the center) lets you zoom out from an image; icon 12 (4 arrows pointing to a blue boundary) zooms the image to the size of the viewer window. Now look at icons 19 and 20 (the two magnifying glasses with a + and -, respectively). If you click on them, you'll notice that they don't do anything immediately. However, if you click on icon 19 (+ magnifier), move the cursor changes to magnifying glass, and when you click on the image itself, it has the effect of zooming in on the image, just as icon 10 did. In the same way, clicking on icon 20 and then on the image has the same effect as icon 11. You might wonder why you have two icons that appear to do basically the same thing. The answer, not surprisingly, is that they're really quite different. When you click on icon 19 or 20, the cursor changes into a magnifying glass. You can then pick out a feature on the image and hold down the left mouse button to draw a box around that feature. The portion of the image that your chosen now fills the viewer. To go back to where you started, click on icon 9 (the crossed-out magnifier).

Now look at icons 22 - 24. These all control the in-view magnifier. They are best understood by trying them. Icon 22 turns in the magnifier; icon 23 controls its characteristics; icon 24 turns the cursor into a magnifier. Note that you have to turn on the in-view magnifier with icon 22 before icons 23 or 24 have any effect.

Three other icons on the bar are of interest at this point. Icon 18 (the hand) allows you to move the image around within the viewer. Try it, especially on an image that you have zoomed in onto. The 14th icon (the arrow) returns the cursor to an arrow. Note that you will generally want to have the curser in its "arrow" form. It can be somewhat frustrating if the cursor is a magnifying glass, and you constantly change the image magnification when you want to deal with an image. The last icon on the bar, icon 25, is a very useful one. Click on it. See what it does.

The icon (the hammer) opens the tools palette. You'll have reason to use a number of palettes, but probably not too much in the simple viewer.

Let's look at the other tool-oriented icons. The gray area in into the middle of the image is Gainesville. You might want to know how far it is from one end of the town to the other, or what is the area occupied by the town. You can find out using the 13th icon (the ruler). Be sure that the cursor is an arrow. Then click on the ruler icon. A window of labeled "Measurement Tool for Viewer #1" opens. It has some icons of its own. Click on the wavy line. This lets you measured the length of lines. Note that the cursor changes from an arrow to a cross-hair. Place the cursor at the beginning of the town and click. Then move the cursor to the other end of the town and double-click. The length of the line you have just indicated and its azimuth appear in the Measurement Tool window. Now click on the icon just to the right of the wavy line (the polygon icon). Again, the cursor has changed to a cross-hair. Click the edges of the town until you have made a polygon that includes all of Gainesville. At the last point you wish to indicate, double-click. The perimeter and the area appear in the Measurement Tool window.

Now click on the 14th icon (the cross). This is one of the most powerful and useful tools in the viewer. A window opens which will give you a great deal of information about the point under the cross-hair. Again, the projection is given as UTM using the Clarke, 1866 spheroid. The X and Y coordinates are the UTM coordinates in meters. Note that the window in the upper left-hand corner of this window says "Map." This indicates that the X and Y units are those of the map's current projection. Click on the drop-down button at this window. You will note that you have several other choices. Try them. What happens to the X and Y values? Does the changes make sense? Lower down in this window you'll notice another window giving the pixel value and the color values of the pixel in question. The pixel value indicates the actual value of the pixel in question. The red, green, and blue columns indicate the intensity of red, green, and blue colors used to depict this pixel on the image. Use the scroll bar at the bottom of this window to move to the right. What other information is to be found here? Be sure the cursor is the arrow. Point the arrow at the cross-hair on the image. Holding down the left mouse button, move the cross-hair around the image. Look at the information that appears in the information window. This tool gives you access to a tremendous amount of information about every point in the image.

Finally, click on the 16th icon (the graph). This opens the profile tool. You have three choices. The spectral is not available for a one-layer image, but the other two are. Click on spatial. The spatial profile

window opens. Click on the wavy line icon. Move the cursor back to the image, and create a line with a series of clicks. When you're done with your line, double-click to end it. The profile of land use types appears in the profile window. Click on the profile tool again, and now choose surface. The surface window and opens. Click on the square icon, and hold down the left mouse button to draw a box on the image. Your surface appears in the window. Consider, for the moment that this image is a thematic image, in which the numbers making up the image are indices of land use type. Do the notions of profile and surface make sense here, as they would if this were an image of land surface, where the numbers making up the image referred to elevation? What do you think?

Another Raster Image

Open another image. Since this will also be a raster image, you can use the file open icon if you choose. Otherwise, you can use File-Open-Raster or Control-R. The name of the file that you should choose it is LNSOILS.IMG. Be sure that the raster options you choose include Clear Display. If you are asked if you wish to save your information from the previous image, click on "no." This is a soils map of the same area that you looked at in the previous image. The first thing you'll notice is that the color distribution is very different. Each soil type is represented by a notably different color.

How the think you would find the most useful information about the data included in this image? Consider the tools you had for the previous image, and them out here. For example, use the ImageInfo tool (icon 3 on the viewer icon bar). What differences are there between this file and the last? Although the information presented here is quite different from that presented by ImageInfo for the land classification image, the basic structure of the information box is almost identical, isn't it? Another tool you might use is the inquire cursor tool (the 14th icon on the icon bar). Again, the information shown is soils rather than land-use types, but the basic structure of the information is very similar.

Is there a relationship between land-use types and soil types? How would you address this question? One way might be to display both images together and to switch back and forth between them. Let's try this! In your viewer which now contains LNSOILS.IMG, open up LNLANDC.IMG, but be sure that the raster option to clear the display is unchecked (check on the “raster options” tab)! Your viewer in now contains both images, although you can only see the top image. To verify that both images are there, click on View-Arrange Layers. The Arrange Layer is window opens, showing both images to be there. Because LNLANDC.IMG is on top, it is the one you see. To change this, point your mouse cursor at the LNLANDC.IMG panel in the Arrange Layers window, and drag it to the bottom (or just click on it), so that LNSOILS.IMG is on top. Click on Apply. You'll see the land-use map appear and then be covered by the soils map, which should not surprise you, since the soils map is now on top.

To see other two images fit together, click on Utility-Swipe from the viewer’s menu bar. A part of both images appears in the viewer. Now check Auto Mode, and the swipe tool will move back and forth across the image showing first one and then the other. You can see how the two fit.

Digital Elevation Model

Clear the viewer using the eraser tool (icon 8). Now open the digital elevation model, LNDEM.IMG. The digital elevation model, or DEM, is an image of elevation. The pixel values are actually the elevation of the land surface. Unlike the previous images that you have look that, this is a gray-scale image. You have any idea why this would be gray and the previous images would be in color? How to get the information that you need? Again, you might try the ImageInfo and the Inquire Cursor tools. What differences do you see? For example, is this a thematic image? Why or why not? Try using the profile tools on this image. What you actually seeing here? Don't you wish you had been able to do this when you were drawing your profile in unit 1 of the maps course using the Pine Grove quadrangle?

Image Drape

The digital elevation model represents actual elevations. We can use this rather effectively. Click on

Utility-Image Drape. A rather strange image opens, which you may recognize as the elevations of this area. Click on the file open icon in the Image Drape window. Choose LNLANDC.IMG as the file you wish to drape you'll notice that the Image Drape window now shows the land-use map draped over the elevation model. The viewer shows the eye position and the target position (i.e. the point in the image that the eye is looking at). These can be moved, and as you move them, the appearance of the image drape will change substantially. You may wish to try drape in other images over the DEM. Is this a useful way of visualizing how to data expressed in the images are actually distributed in the real world?

There is another way to drape an image. On the main Image icon bar (not the viewer's icon bar), click on "Virtual GIS," then click on "Virtual GIS viewer." The viewer that opens is essentially the traditional Imagine viewer, meaning that it is a simpler version of the geospatial light table. Open the DEM first, and then drape another raster image over it. Change the vertical exaggeration to about 4 to see what it looks like. Which image drape do you prefer?

Thematic Mapper Image

Clear the viewer using the eraser icon. Now open a new file called LANIER.IMG. Check the raster options and note that this will be displayed as True Color, not Pseudo Color. Note also that the layers are assigned to colors: different layers are assigned to the red, green, and blue color guns of the monitor. Note also that you have some more options with this image then you head with previous images. For the moment, check only the Clear Display and Fit to Frame options, and click on OK. One of the first things that you'll notice is that this image looks very much like LNLANDC.IMG. This is not a coincidence, but you'll need to make some more progress in this course before it is clear why. Again, you should use the tools that you have become accustomed with to view this image and understand the ways in which it differs from the other images you have look that so far.

The most significant difference between this image and the other images that you have seen it is that it is a satellite image. It is made up of seven different bands representing different portions of the electromagnetic spectrum, of which bands 4 (near infrared), 3 (red), and 2 (green) actually appear in the image. You can assign different bands to different colors. You are not limited to bands 2-4. You can use band 1 (blue), bands 5 and 7 (mid-infrared) or band 6 (thermal infrared). You can adjust the bands appearing in the image in two ways. The more cumbersome is to use the open-file icon to reopen the image, changing the colors on the "raster options" tab to see the impact of assigning different bands to red, green, and blue. This is the way you would adjust colors if you were opening an image, and you knew from the beginning that you did not want to use the standard colors. Try this for a different color combination. What differences to you see? You might also experiment with turning "No Stretch" on and off. Can you imagine what stretch might actually represent?

There is an easier way to adjust the image. Look at the "spectral" portion of the geospatial light table (in the part of the GLT viewer that you turn on and off with icon 25, Figure 4). Note that there are numbers in the R, G, and B boxes. Try changing these. Also, try changing the options in the word-boxes in this section. What happens? Do you like any combinations better than others? Are some combinations easier to understand that others? Look at the wheels and icons in the "enhance" and "zoom/rotate" sections of the GLT viewer. Use your mouse to try them out. Experiment with the icons next to the wheels. We can discuss what they do in class. Be prepared to come with questions!

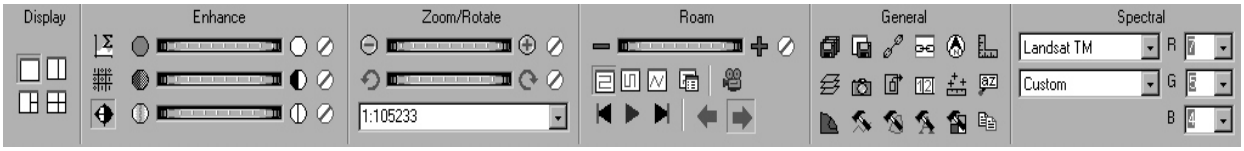

Figure 4

Don't feel bad if some of the things raised so far seem complex. They are! We'll have plenty of time to talk about them in greater detail throughout this course and even more in the "Advanced Topics in Remote Sensing and GIS" course. You'll have adequate time to get used to the portions of the program you need.

SPOT Image

SPOT is the acronym for Système Probatoire pour l'Observation de la Terre. This is the French multispectral satellite, whose imagery has finer resolution than that of Thematic Mapper, but has only three bands. You will import two SPOT images at look at them both in a single viewer.

Click on the Import icon on the main Imagine control panel to bring up the Import/Export dialog box. Click on the “Type” pop-up list and select “SPOT”. From the “Media” pop-up list, choose “File.” From the Input File list, choose first the Q: directory. You'll notice that there is a file named CD_DIR.FIL. Choose in this file. Give a suitable name to your output file. Imagine will put “CD_DIR.FIL” as a default output name, but you should change it to something more meaningful to you. Click on OK. The Import SPOT dialog opens. You will notice that the first line of this dialog says “Image # 1 of 10.” There are, in fact, 10 different SPOT images available to you. You want to import Images Nos. 3 and 4. Click on the “Next Image” button until the Image # says 3 of 10. Check the “Calibrate the Image” box, and click OK. Imagine will extract the SPOT image. Use exactly the same procedure to input Image No. 4. Be sure, when starting the Import SPOT dialog, that you give a different output file name to the file; otherwise it will overwrite the first file.

In the viewer, open the first of these two files. You note that the image is not square. Indeed, it is quite diamond-shaped because of the way that satellites travel across the Earth's surface. We will talk about this later on in the semester. You'll note that the image includes an "image" portion and a "background" portion. Now open a second file within the same viewer. Be sure that you uncheck the "Clear Display" check box. Consider the nature of the background. If you click on OK now, what you think will happen? Do you want to check the "Fit to Frame" box? Do you want to check and the "Background Transparent" box? What you think will be the results of any of these options? Try various combinations to see what gives you the best results. Do you recognize where this area is? To be absolutely sure, how do you find the specific information that would tell you where this is? When you are satisfied that the two images fit together as well as they possibly can, consider what would make the composite a better image of this particular area. What changes would like to make?

What level of resolution does this image actually have? If you can see the whole image in the viewer, it is considerably compressed. Look at the ImageInfo window to see how many rows and columns are actually included in each image. Remember that your total desktop has 1024 columns and 768 rows. The viewer as you open it up contains many fewer than that. Pick an area that might be of some interest to you, and zoom in on it. How much can you actually see, under the best of conditions?

Mixing Raster and Vector Images

Open the raster image entitled SHAKERHEIGHTS.IMG. This is a Thematic Mapper image of the Shaker Heights topographic quadrangle. You should recognize many of the features in this satellite image. Now open the vector image entitled SHRIVERS. You should remember that you can open images in three different ways: File-Open-Vector, Control-V, and by using the file-open icon on the viewer's icon bar. If you use this last method, you'll notice that the images presented to you are all rasters. In the bottom of the Select Layer To Add dialog box, there is a window labeled “Files of Type.” Open the pop-up menu for this window, and choose Arc Coverage as the file type you wish to access. Then choose SHRIVERS. You notice that the rivers and streams found in the Shaker Heights quadrangle are now superimposed over the satellite image.

The rivers, however, are not particularly easy to see. Let's change this. From the viewer's menu bar, choose Vector-Viewing Properties. A window opens up. It contains a number of options, which you can turn on and off through check boxes. You do not need to worry about most of these. You do, however, need to have Arcs turned on, since rivers are represented by lines (known as Arcs in the jargon of GIS). Note that arcs are represented by a thin black line. Click on the icon button just to the right of this black line. A small window opens, which will enable you to change the way that arcs are represented in the image. Go down to "Other", and click on it. Click on Solid black, and then click on the icon button just to the right of the black blob labeled Outer Color. This will open up a color palette, from which you can choose the color you wish to use. Since this image deals with rivers, you might choose blue. When you

have made your choice, click on OK. Then move up to the Width box, and change the 1 to 2. Again click OK. You note that the designation of the arcs is now a blue line thicker than the original black line. Click on apply. The streams should now stand out quite nicely.

Questions to Consider

Normally, this section of a laboratory handout will include a series of questions to consider. This unit, because it is most students' first contact with ERDAS Imagine, has more questions than usual, and the questions have been distributed throughout the detailed instructions. You should each take a minimum of 6 of the questions raised in the text and think seriously about them. To share your observations with others in the class, you can access the discussion forum by using any web browser to go to the address http://www.bges.csuohio.edu/geo425/dg.htm and clicking on "Enter the discussion forum."

Portfolio

Normally, a unit will have two or more images to be included in your portfolio. Again, because this is most students' first contact with ERDAS Imagine, you haven't really *done* anything to the images you are dealing with, so you do not need to turn in hard copy for any images. Your grade for this unit will be based on the discussion in the recitation and the effectiveness of your dealing with the questions raised in this handout. However, you should remember where all of these images are, in case you need to access them again, and you certainly need to remember how to do everything introduced in this unit.