

GEO 325v Lab 4

Georeferencing, Digitizing, and Creating Metadata

Introduction:

When doing GIS analysis, you may encounter data that does not have a spatial reference. Sometimes this data actually has a projection but ArcMap is not sure exactly what it is. You have already addressed this issue in Lab 2. This time, however, you have been provided with an aerial photograph (of Michigan State's campus) that does not have a projection. You can import most image file formats into ArcMap and geo-rectify these images. The image provided for you in this lab was simply scanned from a hard copy, and does not have coordinates on the Earth. From this photo we want to trace, or "digitize," some of the features from the Michigan State University campus into vector shapefiles so that the data can be more easily used in the GIS. You will populate the attribute tables of the new data you will create, and finally you will be creating metadata to accompany this new data.

Objectives:

At the completion of this lab, you will be able to:

- use the tools in the Georeferencing and Editor toolbars;
- georectify an aerial image or other image/map without a spatial reference;
- create new shapefiles;
- digitize points, lines, and polygons on an data layer;
- populate a spatial database; and
- create metadata for new data layers.

Part 1: Georeferencing Data without a Spatial Reference

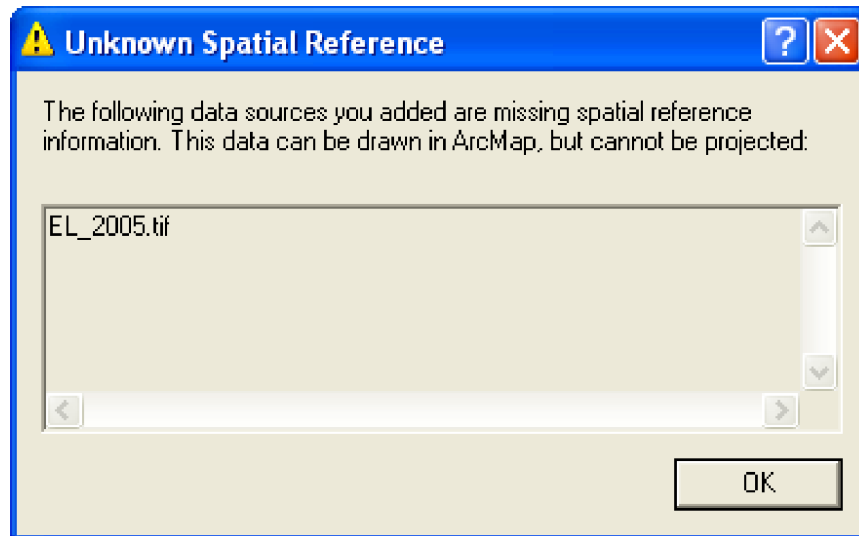
To begin this lab:


1. Log into Geography's remote server (*Desoto*). You should be familiar with this process by now; directions are located in your Lab Exercises and Activities module in D2L.
2. Navigate to the "g325v" > "CourseMaterial" > "LAB4" folder, and copy the two folders in the DATA folder (*roads* and *EL_2005*) to your own "lab4" > "data" folder.
3. Add the ***roads*** data layer and the ***EL_2005uf*** data layer from your personal working data folder to a **new project in ArcMap**. These data layers include an image of Michigan State's campus from 2005 and the campus roads layer.

SAVE YOUR PROJECT to your lab4 > maps folder (lastname_firstname_lab4map).

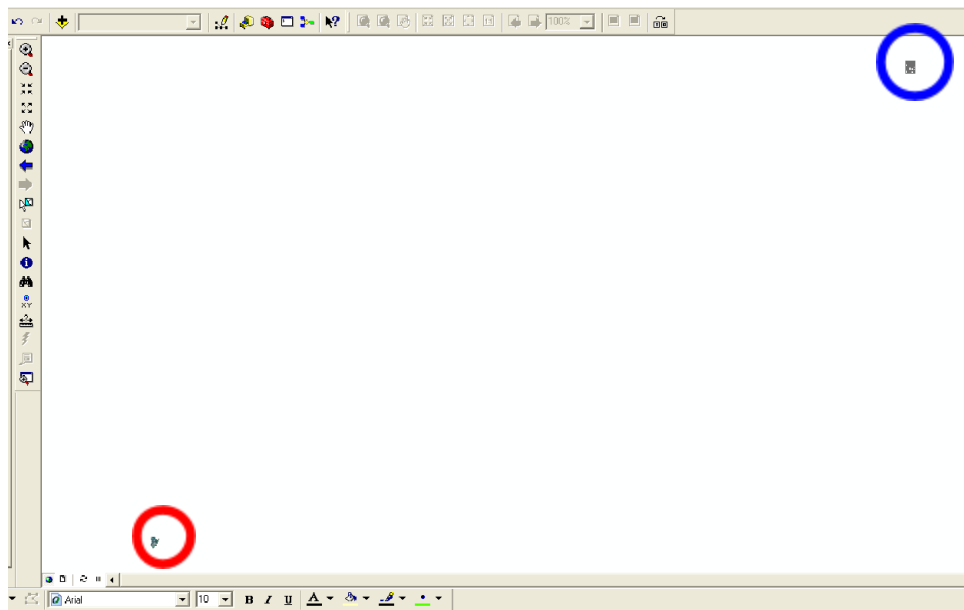
4. You may notice that you do NOT see both of the layers.
 - Right-click on the *EL_2005uf.tif* layer and choose "Zoom to Layer". You will be taken to the aerial image of Michigan State. Using the zoom out tool, zoom out until you can see both layers (they will appear very small).
 - *For future reference*, sometimes when adding an unprojected image or layer, you will see this (below) message appear [you may not see this message for the image layer, that

is okay].



5. Zoom to Full Extent  to see all of the data you have added.

Your map may look something like this (perhaps not exactly, but you should see that the Michigan State image and the roads layers are in very different locations):



The photo is that small feature inside the **red** circle and the roads layer is the feature inside the **blue** circle. Because the Michigan State image is simply a photo, and does not have a projection, you will need to georeference it.

You may be wondering.....


What does the term "georeference" mean?

Answer: By *georeferencing* the image, you are "tying" the image to a location; in this case, you are placing it at the same location as the layer of the Michigan State roads.

Next, open the Georeferencing toolbar.

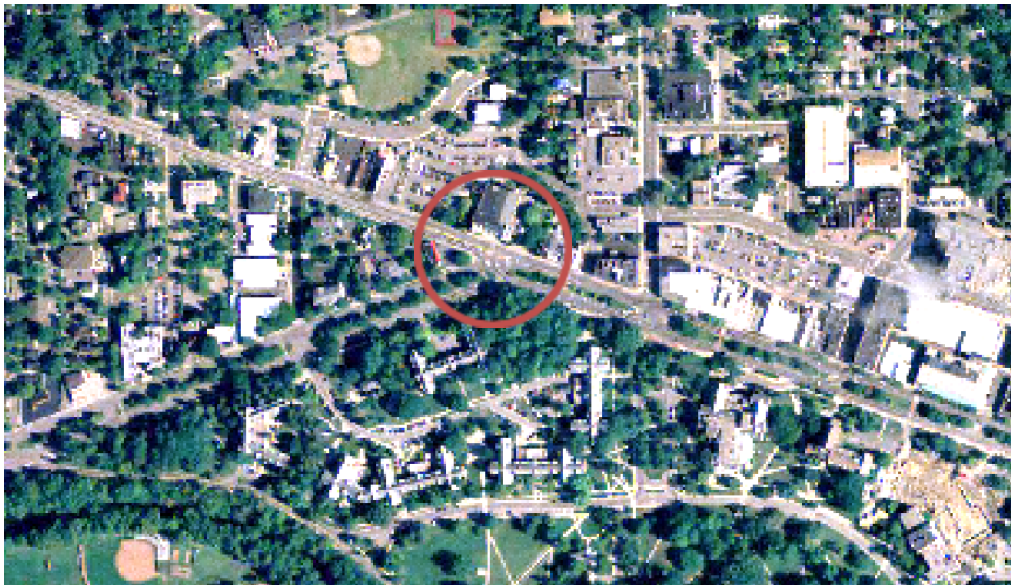
6. Customize > Toolbars > Georeferencing.

"EL_2005uf.tif" should be in the "Layer:" dropdown.


7. Click the Add Control Point button . Your mouse has now turned into a + symbol.

This tool allows you to match points on the photo to those on the roads layer until they match up.

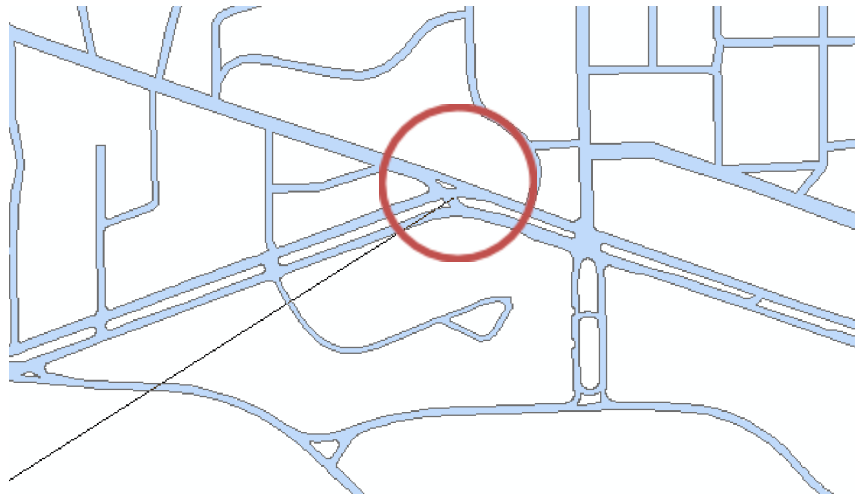
8. Right-click on "EL_2005uf.tif" in the Table Of Contents > Zoom to Layer.
9. Zoom into the image and click on a distinguishable intersection on the aerial photo. An easy one to identify is where Michigan Avenue and Grand River Avenue intersect, circled below.
 - Before you click on the intersection, you should see "crosshairs" when you put your cursor over the intersection. If you do not, go back and click on the Add Control Point button from the toolbar again, then click on the intersection.



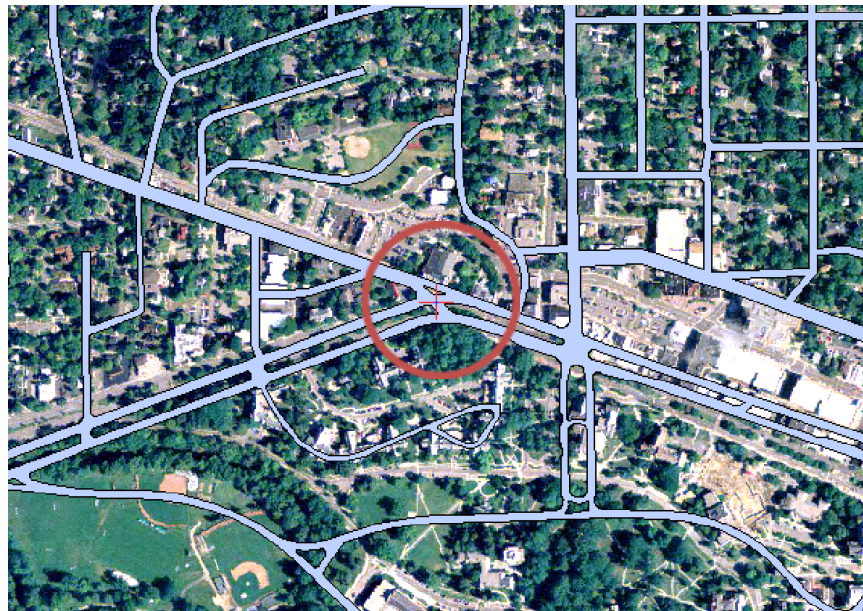
10. If you are not familiar with the Michigan State campus, you may want to open [Google Maps](#)

within the  Satellite View and Show labels option to orient yourself.

11. Right-click on the *roads* layer in the TOC and select "Zoom to Layer".
12. In the *roads* layer, click on the same intersection you found on the aerial photo.




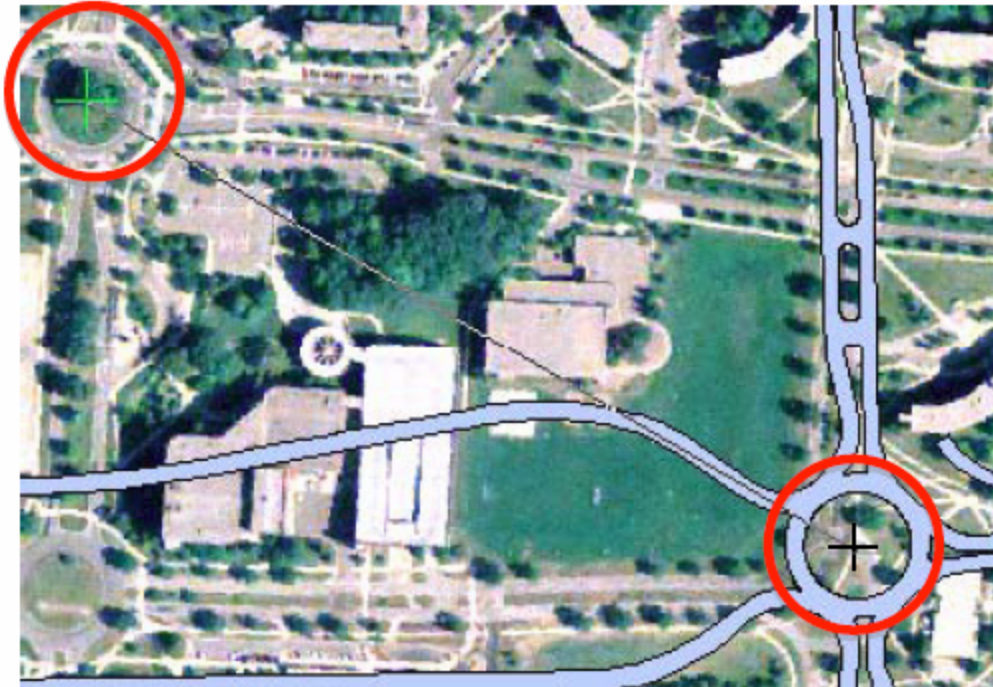
The photo and the roads layer should now be lined up at this intersection, as shown below.



However, the photo is only correctly placed at *that* control point (the Michigan Ave/Grand River intersection). You now will need to add several more of these control points to line the image up exactly with the roads layer. An important note for future reference: you must have *at least 4* control points every time you *georectify* an image. It also works best if the control points are placed evenly across the map.

13. Find another intersection or point you can identify on both the roads layer and the photo. (Use the pan tool - it looks like a hand) to move the photo around.

Another easily identifiable point is the circle at the corner of Shaw Lane and Bogue Street near the Business College. Use the Add Control Point Tool  again to first click on the photo, and then the roads layer. You should see the layers adjust slightly to be more "lined up" with each other. Do not worry if your map does not look exactly like the image below; just continue with the process of lining up the points.



14. Now add at least two more points of your own. You can find them by zooming out and seeing where the two layers do not seem to correspond.

- *Be aware that there are several traffic circles that are shown on this 2005 image that have been removed and are not shown in the Roads layer.*

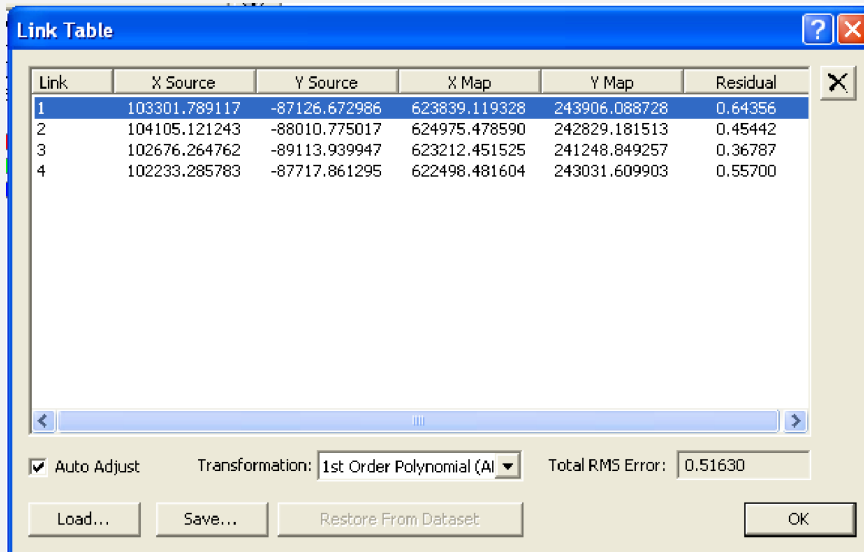
You can see the control points I made in the screen-shot below. Make sure to spread the points out the way it appears in the screen-shot. If they are too close together, the image will not match with the road data completely.



Troubleshooting: Incorrectly Placed Control Point

If your image does not completely match because one control point is off:

- o Open the Link Table (The  icon on the Georeferencing Toolbar)
- o Select the point you think is incorrect

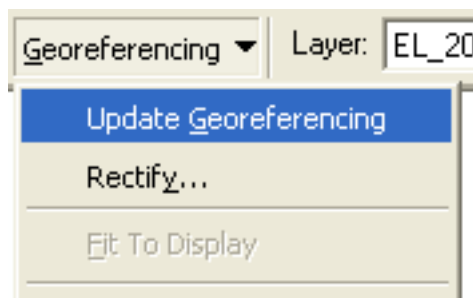


Link	X Source	Y Source	X Map	Y Map	Residual
1	103301.789117	-87126.672986	623839.119328	243906.088728	0.64356
2	104105.121243	-88010.775017	624975.478590	242829.181513	0.45442
3	102676.264762	-89113.939947	623212.451525	241248.849257	0.36787
4	102233.285783	-87717.861295	622498.481604	243031.609903	0.55700

- o Click on the Delete Link button (top left of the pop-up window you're working in).
- o Now add a new control point to replace the one you just deleted.

Once the image is correctly geo-referenced with **at least FOUR points**, you need to update the geo-referencing and make it permanent. This way in the future if you use the photo as data in another ArcMap project, it will already be correctly georeferenced.

15. On the Geo-referencing Toolbar dropdown, select "Update Georeferencing".




Congratulations! You have georeferenced an aerial photograph - that is an important skill if you go on to do more GIS analysis.

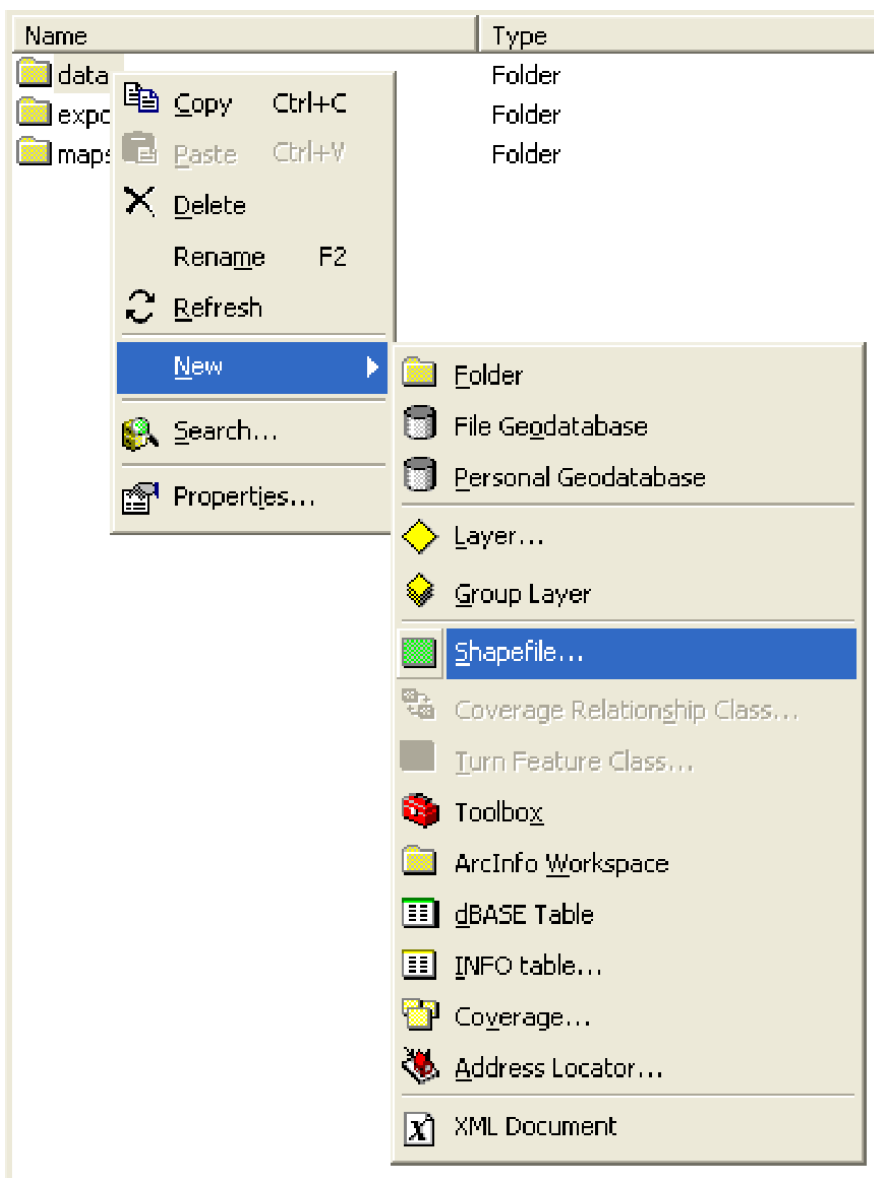
SAVE YOUR PROJECT (again) to **your** lab4 > maps folder (lastname_firstname_lab4map).

Part 2: Creating New Shapefiles

Often the data you need for a project does not exist, so you must draw new points, lines, and polygons from other data. Today we will be digitizing several different features on the Michigan State University campus: the Sparty Statue (point), the Red Cedar River (line), and five buildings (polygons).

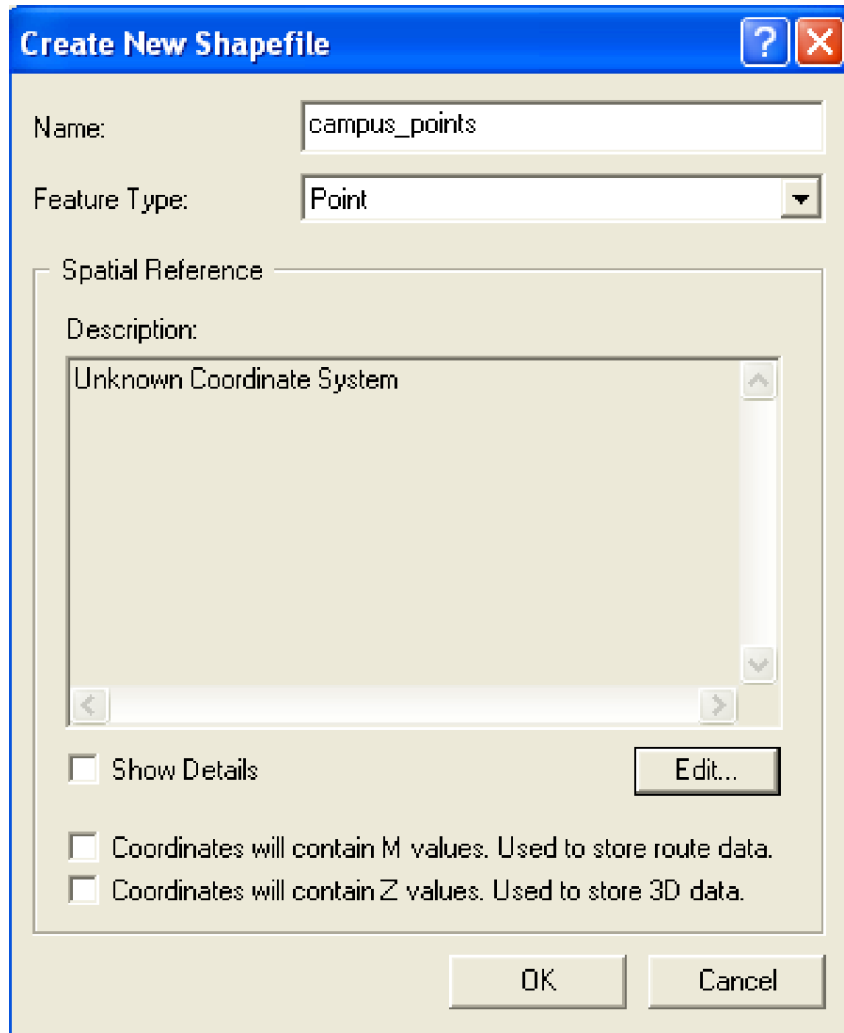
First we need to create blank shapefiles for each of the different data types.

16. Start ArcCatalog  on the Standard Toolbar.
17. Navigate to *your* "lab4" > "data" folder.
18. Right-click on *your* data folder > New > Shapefile.



This will open the Create New Shapefile dialog box. This first shapefile you will create will be a point feature type.

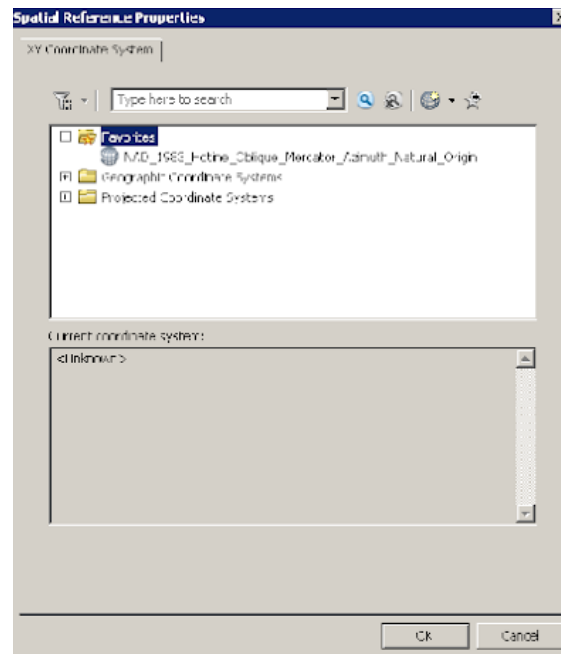
19. Give the new shapefile a name, something like *campus_points* might work.
20. The feature type is "Point".



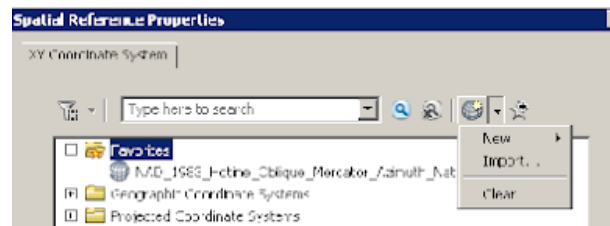
Finally we need to give the new shapefile a coordinate system. We learned this in Lab 2, but we can take a shortcut here. Because we already know that the roads layer we have been using is in a coordinate system, we can *import* the coordinate system from the roads layer.

21. Click "Edit".

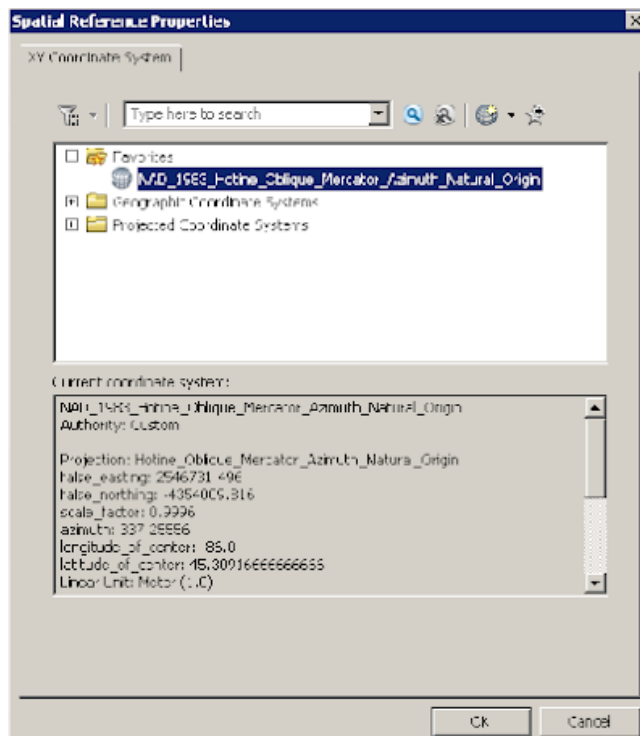
This opens the Spatial Reference Properties dialog box.



22. Since we want to import the spatial information from an existing dataset, select "Import" (see below) and in the Browse for Dataset dialog box navigate to your roads dataset in *your* "lab4" > "data" folder.



It should now look like this:

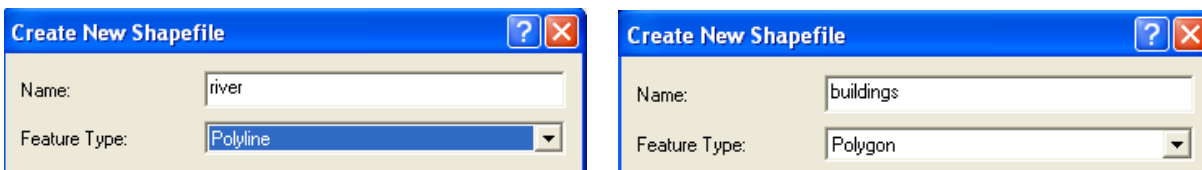


23. Hit OK **twice**.




You should now see your *campus_points* with the two other layers from Part 1 of this lab.



24. Now we want to create two more shapefiles just like this, one for the river ("polyline") and another for buildings (polygon). Follow the same process for creating the points as in Steps 16-21, just change the feature type. They should all have the same spatial reference as the *roads* layer.



25. Your three new layers should look like this along with the other layers in your "lab4" > "data" folder:

Name	Type
 buildings.shp	Shapefile
 campus_points.shp	Shapefile
 river.shp	Shapefile

You now need to add these new shapefiles to your ArcMap document. They should be automatically added to the Table Of Contents. If they are not, use the Add Data button in ArcMap to add the new data, the same way we have in this lab and previous labs.

Part 3: Adding a Field to an Attribute Table

We now need to add a field to the attribute tables of each of the new layers we just created.

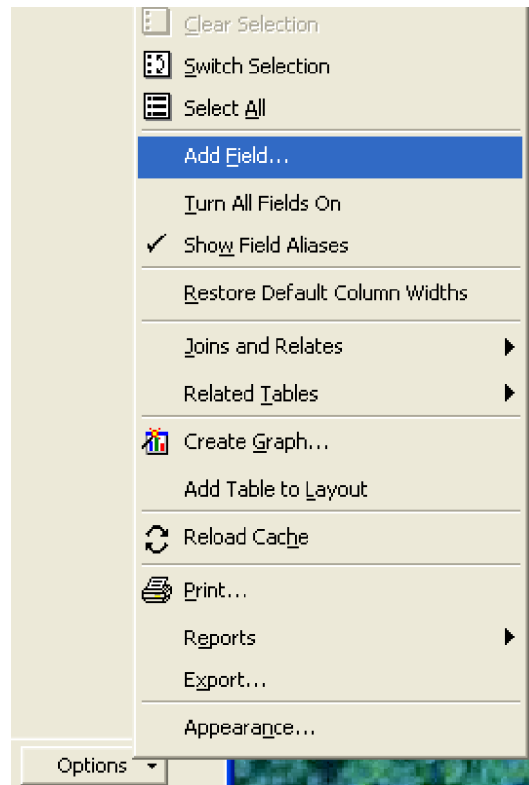
26. View the attribute tables of each of the layers (Right-click > Open Attribute Table)

Each of the attribute tables includes three fields: FID, Shape, and ID, and you will notice there are no values or features in these fields.

FID	Shape *	Id
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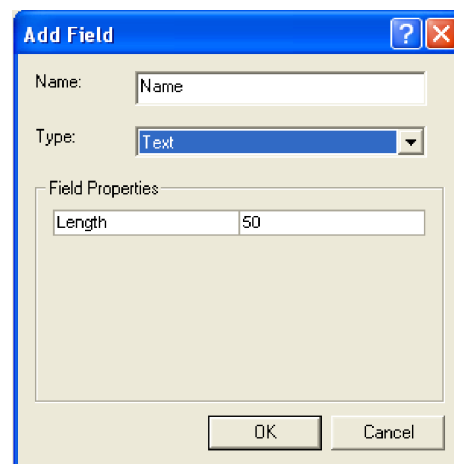
First, you need to add a Name field.

27. Let us start with the Points layer. Open the attribute table, and choose the far-left icon for "Table Options". From the pull-down menu, choose "Add Field".



This opens the Add Field dialog box.

28. In the Name field type "Name".
29. In the Type field change it to Text.



30. Click OK.

There will now be a new empty field called Name in the attribute table.

31. Make sure to add this same field to each of the new layers you just created: campus_points, river, and the buildings.

Part 4: Digitizing and Populating Spatial Databases

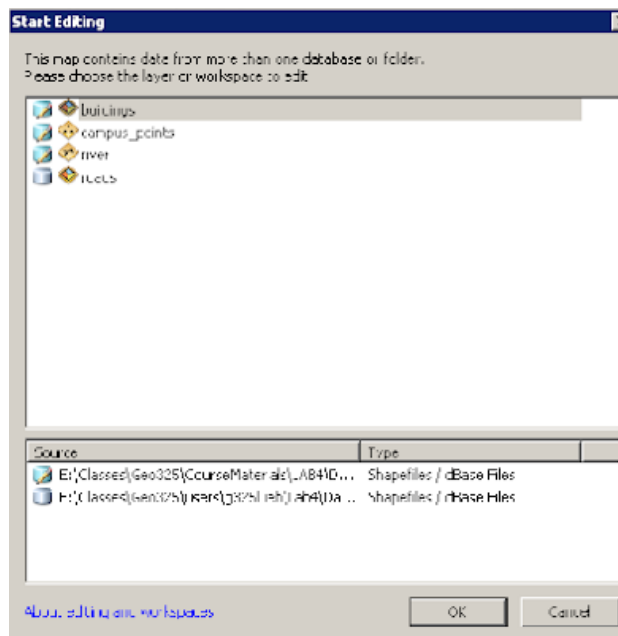
You have probably noticed that the attribute table for each of the new shapefiles is empty; this should make sense as they are new shapefiles that we created and have no data. We will now "populate" the database with information.

32. Turn on the editor toolbar, Customize > Toolbars > Editor or  on the Standard Toolbar.

33. Click the editor dropdown > Start Editing.

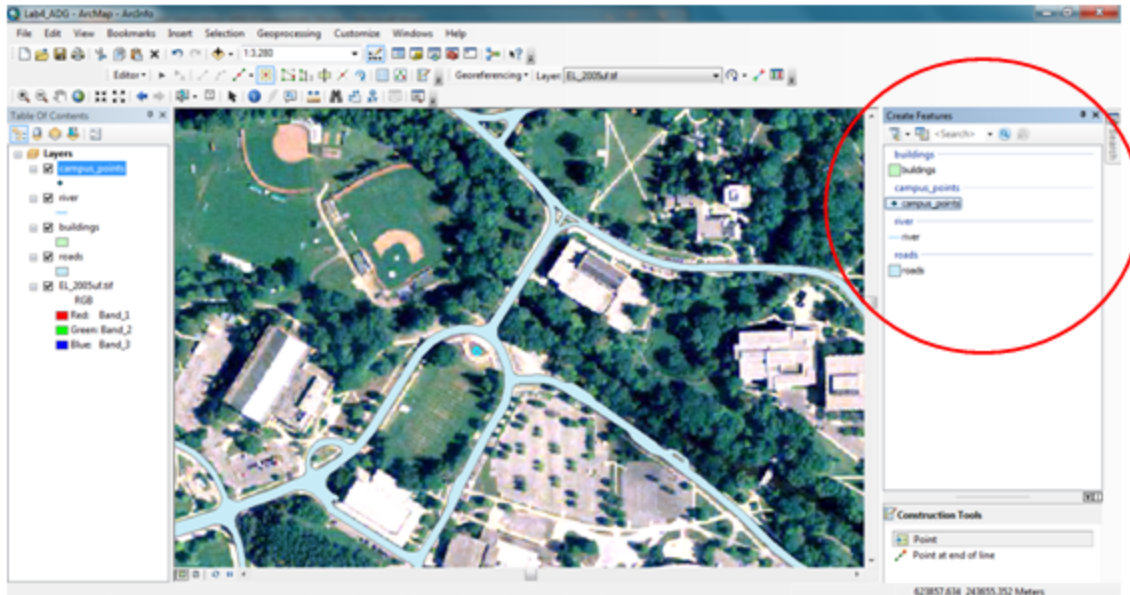


You will see a box entitled "Start Editing" prompting you to "choose the layer or workspace to edit. Select the *campus-points* layer and then click "OK".

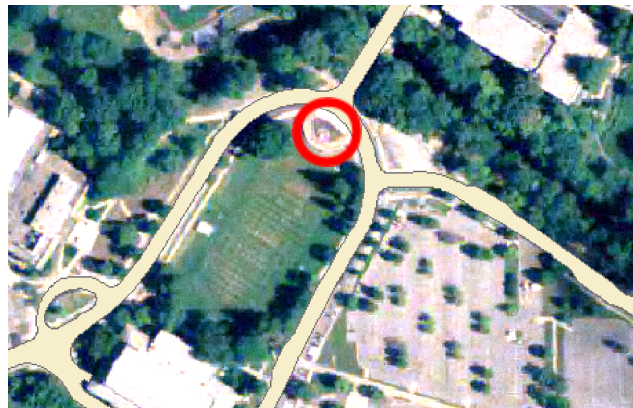


You will see a box entitled "Create Features" on the right-hand side of ArcMap. It lists the layers currently in your project, including the campus points, buildings, and river layer you recently created.

34. We will start with the points layer first. Click on your points layer name in the "Create Features" box.



35. Pan to the location of the Sparty Statue on the aerial photo, shown above. Find the Sparty Statue on the aerial photo, shown below in the screenshot (If you are not familiar with the Michigan State campus, use [GoogleMaps](#) to find the Sparty Statue).



35. Click on Point, under "Construction Tool" in the Create Features box. On the aerial photo, click on the location of the Sparty Statue.

Where you just clicked there will now be a cyan-colored dot.



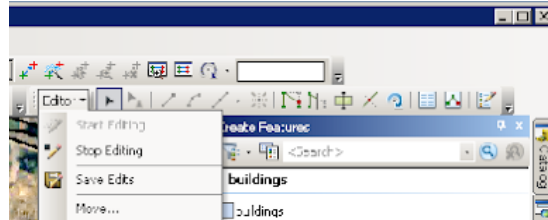
Now let us edit the attribute table to reflect the new point we just added.

36. Right-click on the *campus_points* layer in the Table Of Contents > Open Attribute Table.

37. You will see the row highlighted in blue. Double click in the empty name cell and type "Sparty Statue", then close the attribute table.

Name
Sparty Statue

Make sure to **save your edits** by selecting "Save Edits" from the editor drop down menu, shown below (*if you are editing a lot, you should do this often, simply saving your ArcMap document does not save the edits to the data*).



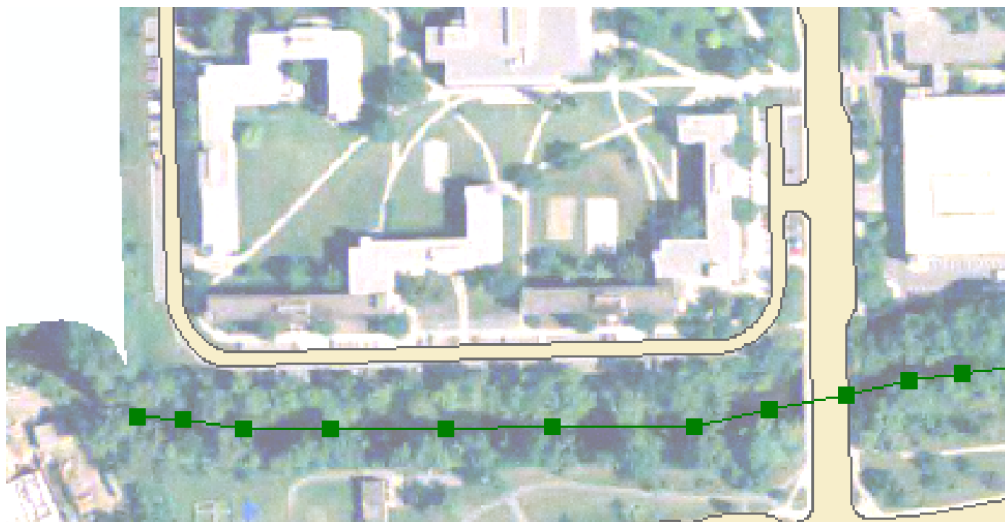
Now let us add in the Red Cedar River.

38. Pan your map to where the Red Cedar River is south of the Brody Complex on the western end of campus.

39. Click on River in the Create Features box, then Line under "Construction Tools".

40. Start clicking to create a line where the river is located (this aerial photo was taken during leaf-on, making the river difficult to identify, however, try to do your best to find it and create a line at the river center line).

- If you need to move the image, just pan (using the hand symbol) to a different part of campus, then click Line and resume tracing the river where you left off.



The new line is shown in green above. Note: Image is grayed out to show the new line.

41. Continue following the river until you reach Hagadorn Road. Double Click to end the line.

The line will turn a cyan color once you double-click to end it.

42. Edit the name field in the attribute table so that this line is named "Red Cedar River"; close the attribute table when you are finished. **Save edits!**

Name
Red Cedar River

Think about this for a moment....

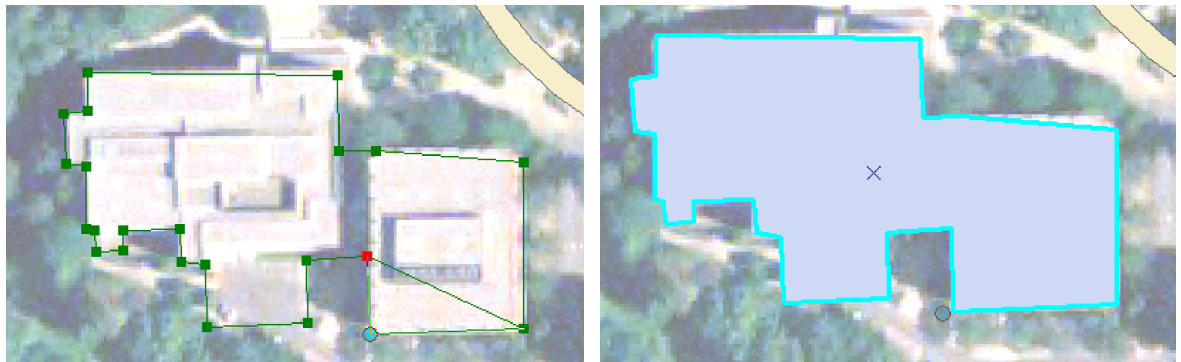
Now that you have added information to the attribute tables of two shapefiles, what might be other information (feature attributes) you could add to these attribute tables? Perhaps the age of the Sparty Statue? The average depth of the river? You could add this information as new fields in the attribute table, as you did earlier in the lab.

Note: For the purposes of this lab, it is not necessary but just *consider* it for a moment.

Now, we will add the buildings.

43. You must draw polygons of the following structures on campus. Add their names to the Buildings attribute table when you are done with each.

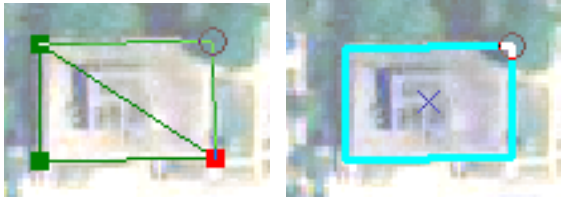
- o The Main Library



- o The International Center



- o One building of your choice. (I chose the Geography Building.)



44. Double-clicking will close each of the polygons.

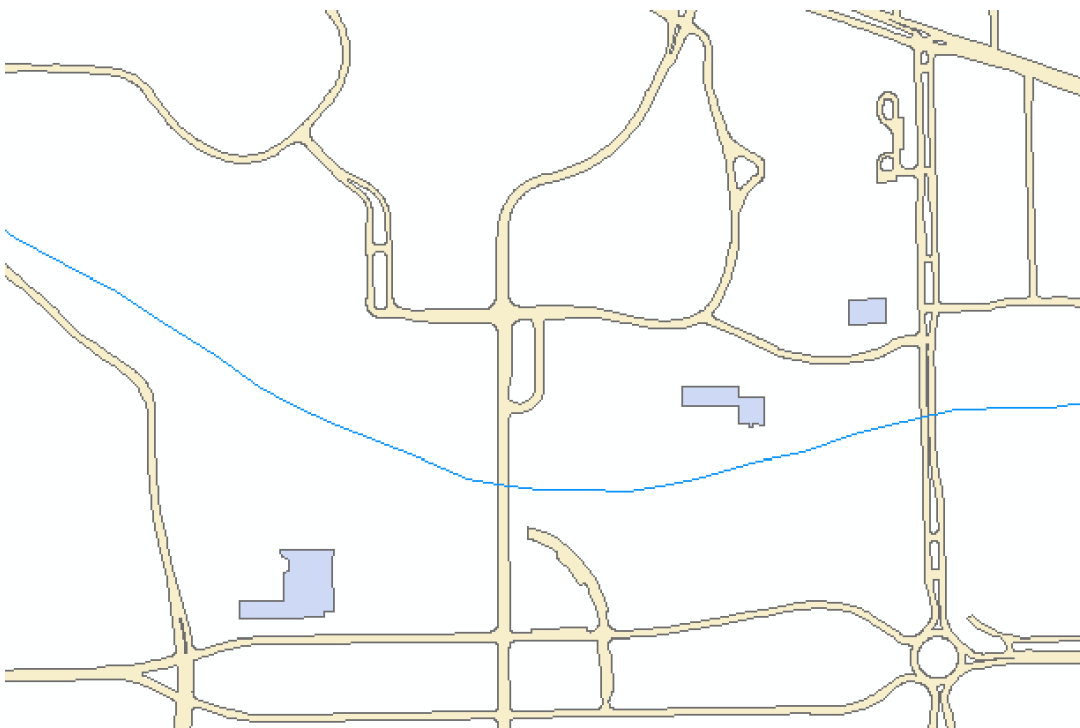
45. Be sure you have entered each of the building names into the attribute table.

Name
Main Library
Geography
International Center

When you are finished, save your edits and stop your edit session.

46. Editor > Stop Editing.

47. You can view your new map by turning off the aerial photo.



SAVE YOUR PROJECT (again) to ***your*** lab4 > maps folder (lastname_firstname_lab4map).

Part 5: Creating and Updating Metadata

You have learned about Metadata in Geo 221, the ESRI Tutorial, and in this class. To review, metadata is data about the layers in your GIS project, and it is very important to create metadata when you create your own data layers.

[Here is more information](#) about metadata that you can review.

48. Go back to ArcCatalog.

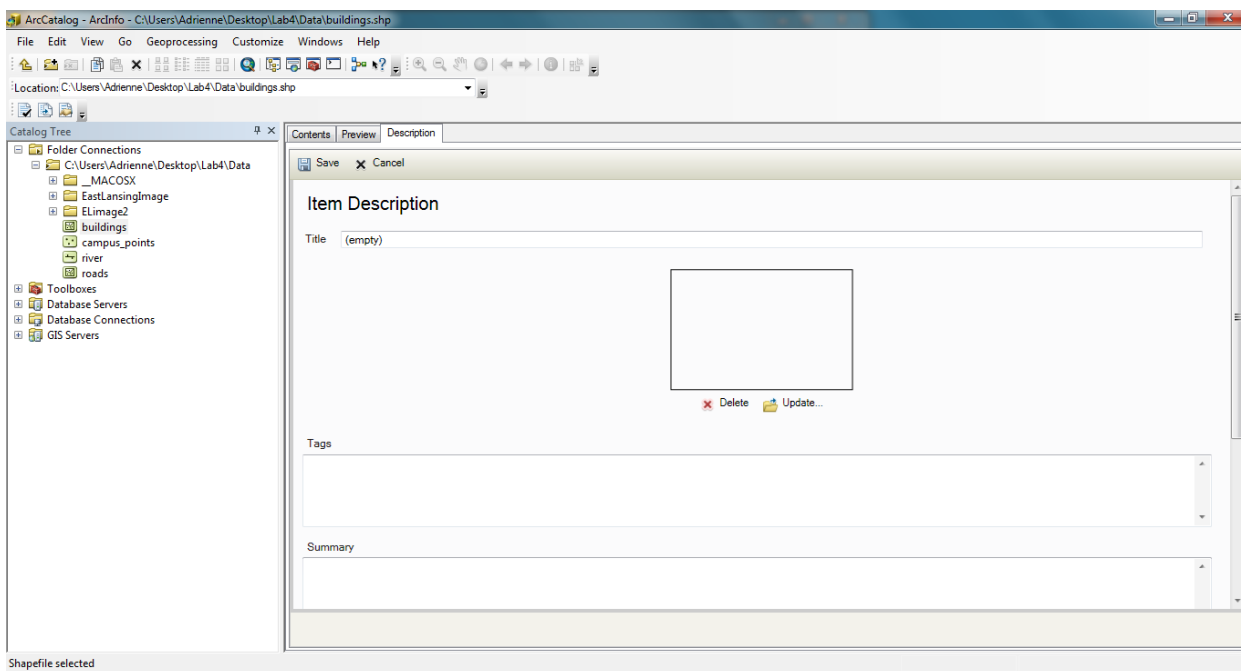
49. Click on the Buildings layer and notice that there are three tabs in ArcCatalog: Contents, Preview, and Description.

50. Click through each of the tabs to see what each contains.

51. Click on the Description tab. Notice that there is little information here; *you will need to add the metadata so it is current and useful to other potential users of the layers you have created.*

52. Click on the Edit button  (located just underneath the Description tab).

This will open the Edit Metadata dialog box, shown below:



Notice that there are many fields in this dialog box: Title, Summary, Description, et cetera.

For this lab you will be required to fill out only some of the fields.

53. You need to add a Title and Description for **each** of the three new shapefiles (*buildings*, *campus_points*, and *river*, or however you named those shapefiles). What you write in these fields is up to you, but remember that metadata is designed so that others can use your data without actually talking to you, so make sure it makes sense! Basically, think about why it

would be useful to create a new shapefile of the buildings on campus.

- Feel free to add information in the other fields as well if you would like, such as Summary and Tags.

54. Notice your cursor may not appear in the editing box, simply click within the editing box and begin typing. Once you have written your Title and Description for one shapefile, click Save. Repeat the process for the other shapefiles.

You are all finished! Your instructor will view your maps and metadata in your folder on the remote server.

Conclusion

After completing this lab exercise you should be comfortable georectifying an image, creating new shapefiles, adding fields to an attribute table, editing an attribute table, and creating metadata.

Deliverables

1. The Lab 4 .mxd you created (located in your lab4 > maps folder on the GEO remote server) to the Lab 4 Dropbox (Lab Exercises and Activities > LAB 4 module) in D2L. [25 points total]

You will be graded on the following tasks:

- a. If your aerial photo is correctly aligned with the roads layer, Part 1. (4 points)
 - b. If you have successfully created a shapefile and populated their respective attribute tables for the Sparty Statue, the Red Cedar River, and the campus buildings, Parts 2-4. (4 points each; 12 points total)
 - c. If you successfully created metadata for each layer, and wrote clear and concise descriptions of each shapefile, Part 5. (3 points each; 9 points total)
2. **Question 1 (short essay).** [5 points]

Consider what you have learned about GIS in class so far, and the tasks that you learned how to do in this lab. Describe a situation when you might use these skills. For example, can you think of an application of when a GIS analyst would need to upload a new or historic aerial image and add new features (like we did with the points, lines, and polygons) to a map?

[You will enter your response to this question in the Lab 4 Assignment (Lab Exercises and Activities > LAB 4 module) in D2L.]

Total: 30 points

This lab was written by Carolyn Fish (MSU-Geography); edited by Dr. Grant Gunn, Dr. Mike Luehmann, Adrienne D. Goldsberry, and Beth Weisenborn; and proofed by your Instructor.