GEO 450 Exercise IV Tutorial

Raster Analysis Through Map Algebra and Overlays

PREPARING DATA FOR OVERLAY ANALYSIS

1. In this tutorial, you will use the data from the Exercise III tutorial. All of the data that you will need should be in your *'rasteranalysisscratch'* geodatabase. *Naming data so that you know what it is at a later data is critical.

2. Next, open up a new ArcMap document and drag in the GilaAspect raster that you created at the end of the last tutorial.

3. Before you conduct any analysis, it is critical to prepare ArcMap. Open the environments window by placing a right click in the toolbox window.

4. First you will update your workspace. Expand the workspace window and set your scratch workspace to *'rasteranalysisscratch'* geodatabase.

5. Next, you will update the output coordinates to be the same as the GilaAspectLayer. After you have set the output coordinates, expand the 'processing extent' section and change the processing extent from default to 'same as the GilaAspect' layer.

6. After you have changed the processing extent, expand the raster analysis section. Change the cell size from maximum of inputs to 'same as layer GilaAspect.' Once you have set the Raster Analysis properties, click **OK**.

**Always select YES when asked to create pyramids.

ASPECT RECLASSIFICATION

In this next section, you will reclassify your GilaAspect layer in preparation for completing weighted overlay analysis and fuzzy modeling overlay. You have reclassified the GilaSlope layer and all that remains is reclassifying the GilaAspect layer.

7. You will reclassify the Aspect layer so that it reflects the chart below. You can access the Reclassify tool by searching *Reclassify* in your search toolbar or you can access the Reclassify tool in the ArcToolbox under Spatial Analyst Tools/Reclass/Reclassify.

Orientation	Rank
South	5-Purple 160-220
Southeast	4-Yellow 125-160
Southwest	3-Red 220-260
East	2-Green -1-125
West	1-Blue 260 – 340
All Other Directions	NoData

8. Once you have accessed the Reclassify tool, click the Classify button and set the classes to 5 and the classification method to Manual. Click **OK**.

9. After you have set the classification type, the value ranges directly into the old values column (be sure to leave a space between the dash (-) and the values).
10. Next, name the output raster: *GilaAspectReclass*. After you have named your output, check *Change missing values to No Data.* Click **OK**. The resulting raster should resemble the raster pictured below.
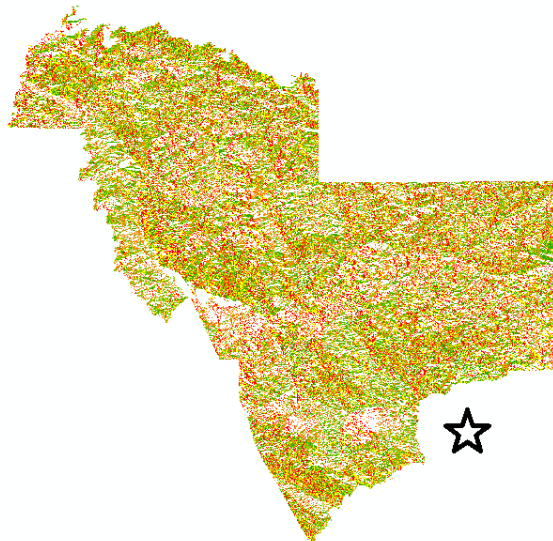
11. The symbology has been changed to the color scheme green to red. You can change the color scheme by accessing the new raster's Properties tab and opening the Symbology tab.

A popular green to red color scheme is 'slope' color scheme. To find the slope color scheme,

right click on the Color Scheme color bar and uncheck Graphic View. Instead of color bars being displayed, it will include a text description of the color scheme. Select Slope. It should look like the below:
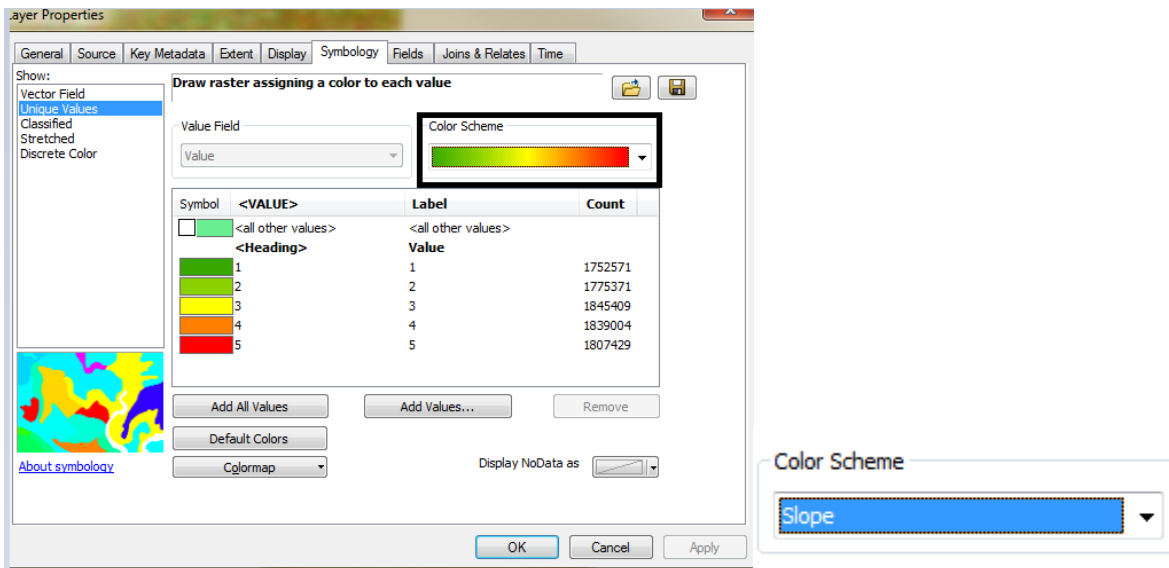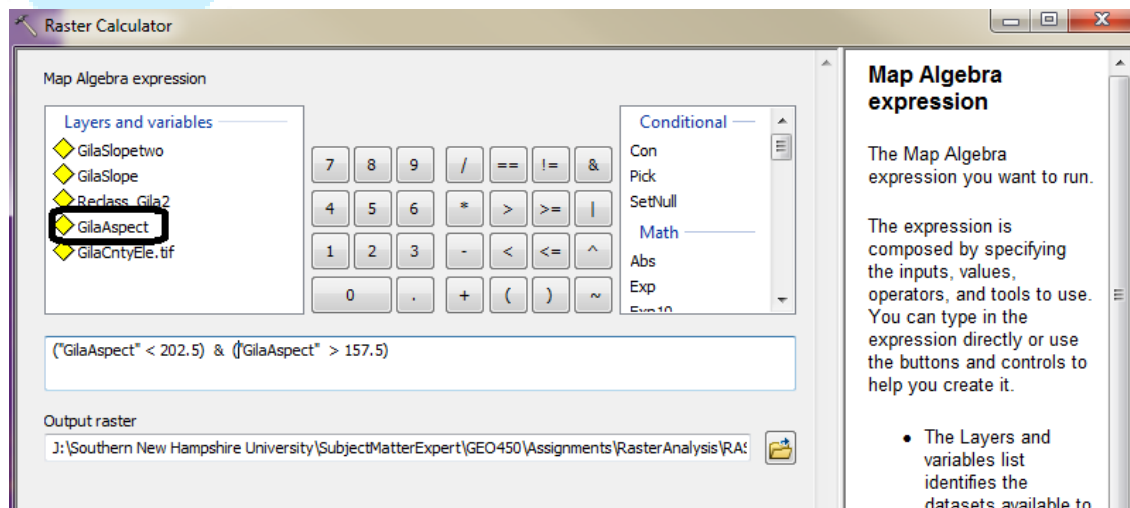
BINARY RASTER ANALYSIS:

A binary overlay analysis asks the question: Does the cell meet the specified requirements? If the answer is YES, the cell receives a value of 1. If the answer is NO, the cell receives a value of 0. You will use map algebra to complete a binary overlay analysis with the GilaAspect and GilaSlope layer.

12. Drag in the GilaSlope layer that was created in the previous tutorial assignment.

13. The primary map algebra tool is called the raster calculator. You can find the raster calculator by searching *Raster Calculator* within your search toolbar or it can be found within ArcToolbox/SpatialAnalystTools/MapAlgebra/RasterCalculator. Double-click the Raster Calculator tool to open.

14. The ideal slope has been described as a slope less than 2 degrees. Using the raster calculator, we will develop a new raster that shows values that will isolate all values with a slope of less than or equal to 2 degrees.

15. Within the raster calculator, double-click on the GilaSlope raster to add it to the raster calculator expression. By adding GilaSlope to the expression, we are telling the raster calculator to perform the operation on the identified raster layer.

16. After GilaSlope has been added to the raster calculation field, we will use our relational statements to complete the expression. The raster calculator should read "GilaSlope" <= 3. This expression is asking the raster calculator to identify all cell values with a slope of 2 or less and assign them a value of 1. The values that are greater than two will not meet the requirements of the expression and be assigned a value of zero.

17. Name the output raster as *GilaSlopeRasCalc2* and save it within the rasteranalysisscratch geodatabase. Click **OK**. The raster should look something like the image below. Notice in the table of contents that the value is 1 or zero. Take a **screenshot** of the resulting layer and add it to the submission document. Label the image *Slope Raster Calculator.*

18. In this region, a south-oriented section of land will generally receive more sunlight than any other orientation. For this analysis, you will use the raster calculator to identify all of the cells within the GilaAspect that have a south orientation. Open up the raster calculator and double-click on GilaAspect.

19. According to the aspect analysis, south falls between the degrees 157.5-202.5. In order to identify all cell values that are oriented south, the raster calculator needs to call on all values within this range. To do this, we will tell the GilaAspect layer to identify cell values greater than 157.5 **AND** call on cell values less than 202.5. Be sure to input the expression as in the screenshot below.

20. After you have completed the expression, name the output raster as GilaAspectRasCalcSouth and save it in your *rasteranalysisscratch* geodatabase.

21. Click **OK** and take a **screenshot** of the resulting layer and add it to the submission document. Title the screenshot *Aspect Raster Calculator*. You have created a new raster layer that

highlights cells that are oriented south. To only see 1 values, you can assign the 0 symbology to hollow.
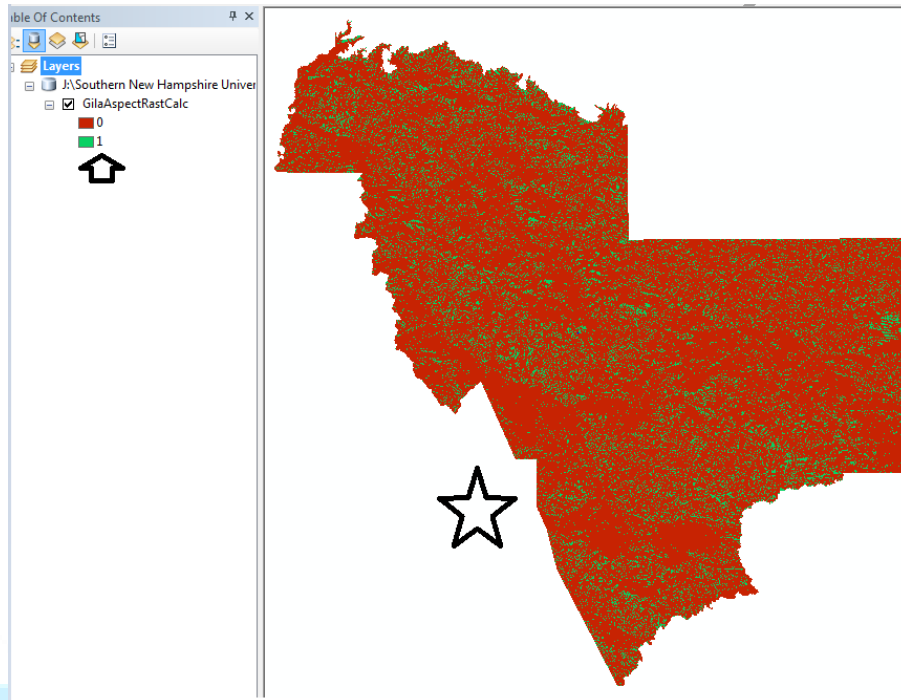
RASTER CALCULATOR BINARY OVERLAY

You will now create a raster of Gila County that features cell values that have both a slope of less than or equal to 2 degrees and face south.

22. For this analysis, you will use the GilaAspectRasCalcSouth and the GilaSlopeRasCalc2 rasters. Double-click on GilaAspectRasCalcSouth to add it to the expression. Because you have already identified all of the south-oriented cells, you know that if the cell value equals 1, then the cell faces south. Use the expression ("GilaAspectRasCalcSouth" == 1) to identify all cells that equal south.

23. Because the cell must meet both conditions it is necessary to use *and* (&) to connect the next part of the expression. Since GilaSlopeRasCalc2 rasters have already been refined to identify a slope of less than or equal to 2 degrees, we can use the statement ("GilaSlopeRasCalc2" == 1) to identify all cells that meet that requirement.

24. To find cells that meet both requirements, our expression should read: (GilaAspectRasCalcSouth == 1) & ("GilaSlopeRasCalc2" == 1). Name the Output Raster: GilaIdealSlopeAspect. Click **OK**.
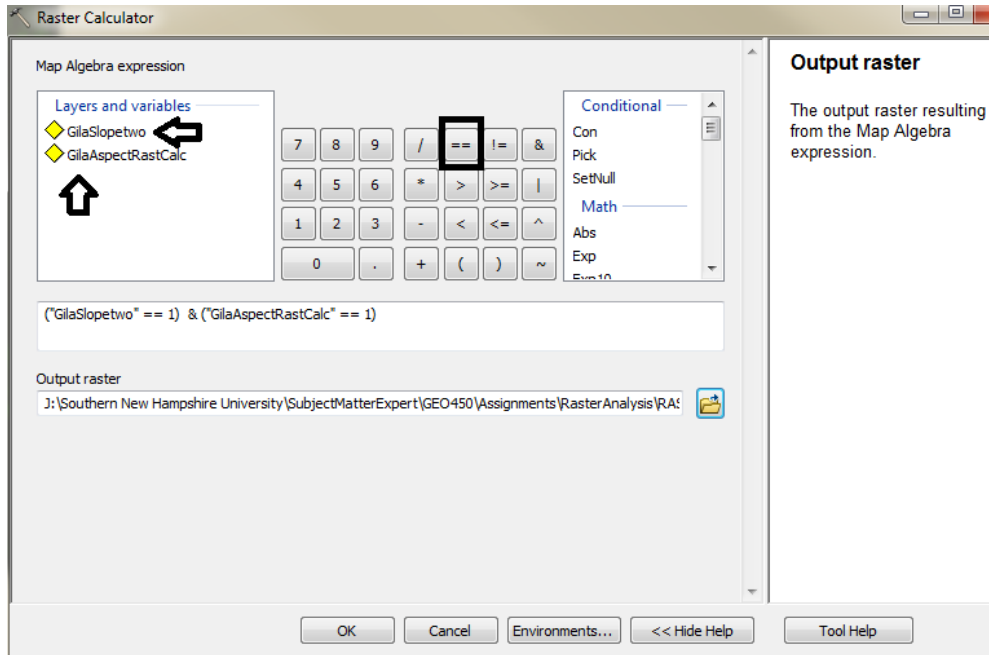
25. The resultant layer should only identify cells that meet both criteria. Take a **screenshot** of the new raster and add it to your submission document. Label it *Binary Overlay*.
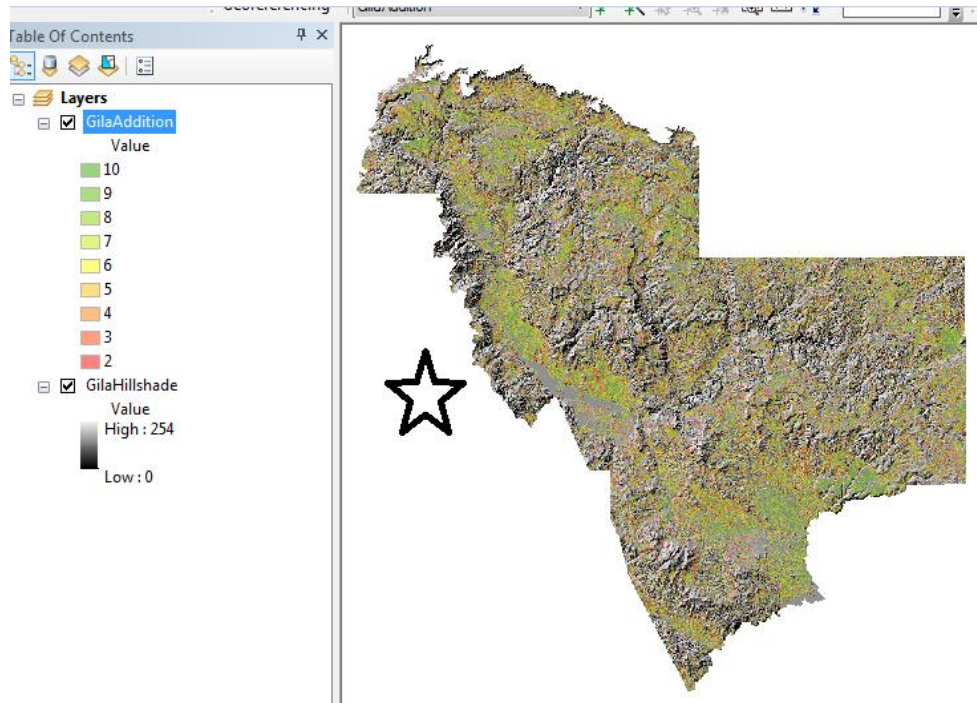
RASTER ADDITION

You can perform any type of Map algebra within the Raster Calculator tool. However, there are simplified versions of raster calculator functions within the math toolset. In this section, you will complete an additional overlay on the reclassified GilaSlope and GilaAspect layers.

26. You can find the Plus tool by searching *Plus* in the search window or by accessing the ArcToolbox/SpatialAnalystTools/Math/Plus. Open the Plus toolset.

27. For the first input raster, you will add the Gila County slope raster that you have reclassified (GilaSlopeReclass). The second input raster will be the reclassified Aspect raster of Gila County (GilaAspectReclass). Name the Output raster *GilaSlopeApsectPlus*. Click **OK**.

28. This tool will simply add the values of each cell and assign the new values to a new raster. In this case, the higher the number, the better fit the location will be. Take a **screenshot** of the layer and add it to your submission document. Label the image *Slope Aspect Plus*.
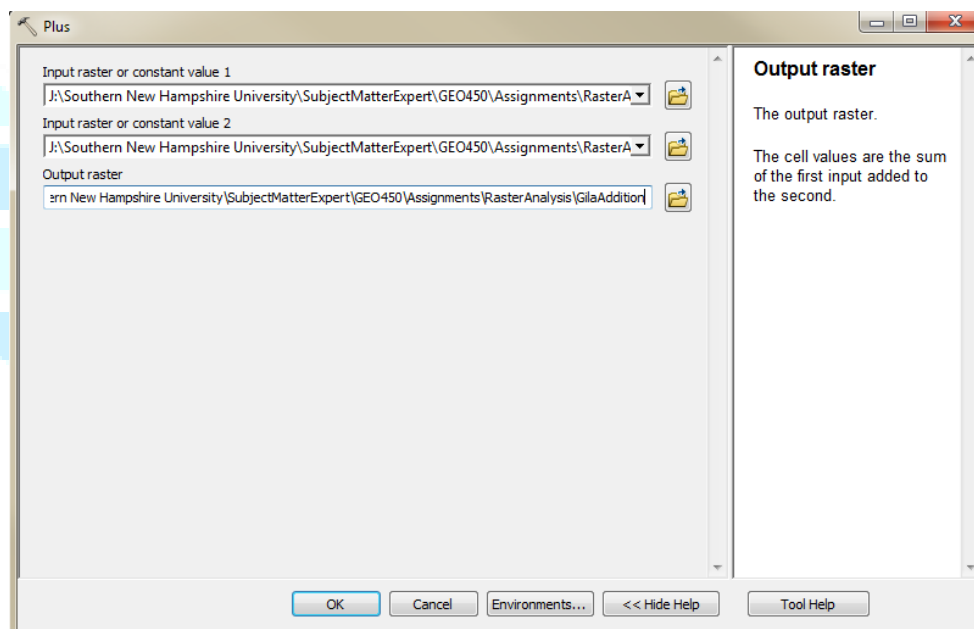

In the image below, the *slope* classification color scheme has been assigned to show green to red. The transparency of the GilaSlopeAspectPlus raster was also reduced to 50% and a gilahillshade raster that was created in the last tutorial was added.

WEIGHTED OVERLAY ANALYSIS

The raster addition tool did provide some "next best" site locations. However, what if one of our layers is more important to the analysis than the other? This is where weighted overlay analysis becomes an excellent tool. In this scenario, we would like to find areas in Gila County with a low slope and that generally face south; however, the slope is more important to our analysis than the direction.

29. You will now open the Weighted Overlay analysis tool. You can find this tool by searching Weighted Overlay in the search window or by accessing ArcToolbox/Spatial Analyst Tools/Overlay/Weighted Overlay. Open the Weighted Overlay tool.

30. Within the weighted overlay window, use the + button on the right to add the GilaSlopeReclass and the GilaAspectReclass layers. After you have added the layers, change the evaluation scale in the bottom left corner to '1 to 5 by 1.' You have built the reclassified rasters on this scale.
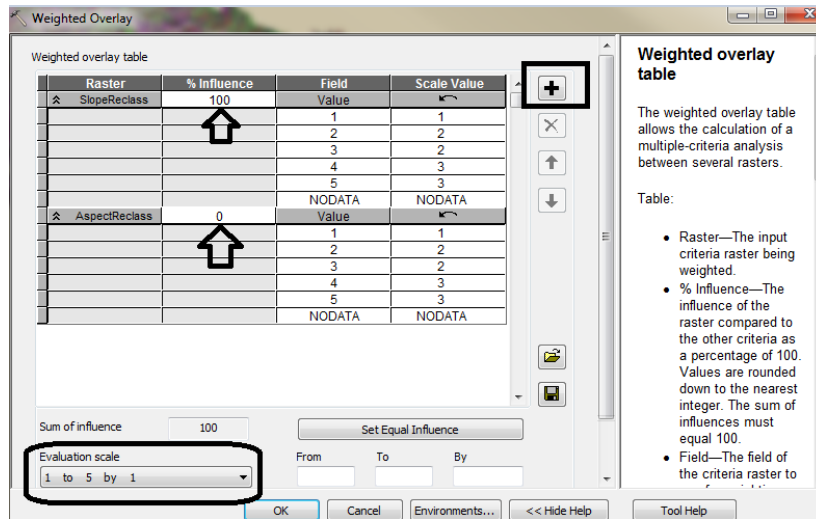
31. Next, change the GilaSlopeRelcass rasters influence to 70%. If you receive an error, this will go away as soon as the influence adds up to 100%. Change the GilaAspectReclass to 30%. Make sure that the scale value matches the scale values in the image below. **NOTE**: The Weighted Overlay can accommodate as many raster layers as needed as long as the 'Sum of Influence' adds up to 100.

32. Name the new raster *GilaSlopeAspectWeighted*. Click *OK*.
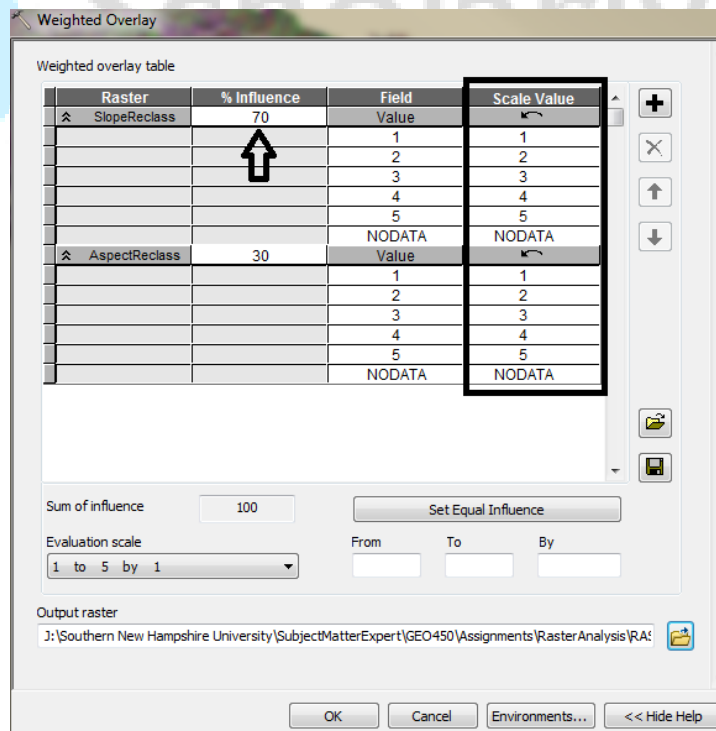
33. The raster that you have created uses both the GilaAspect and GilaSlope rasters to evaluate the suitability of a location. However, the slope raster has a greater influence on the suitability. Take

a **screenshot** of the created layer and add it to your submission document. Name the screenshot *Weighted Overlay.*
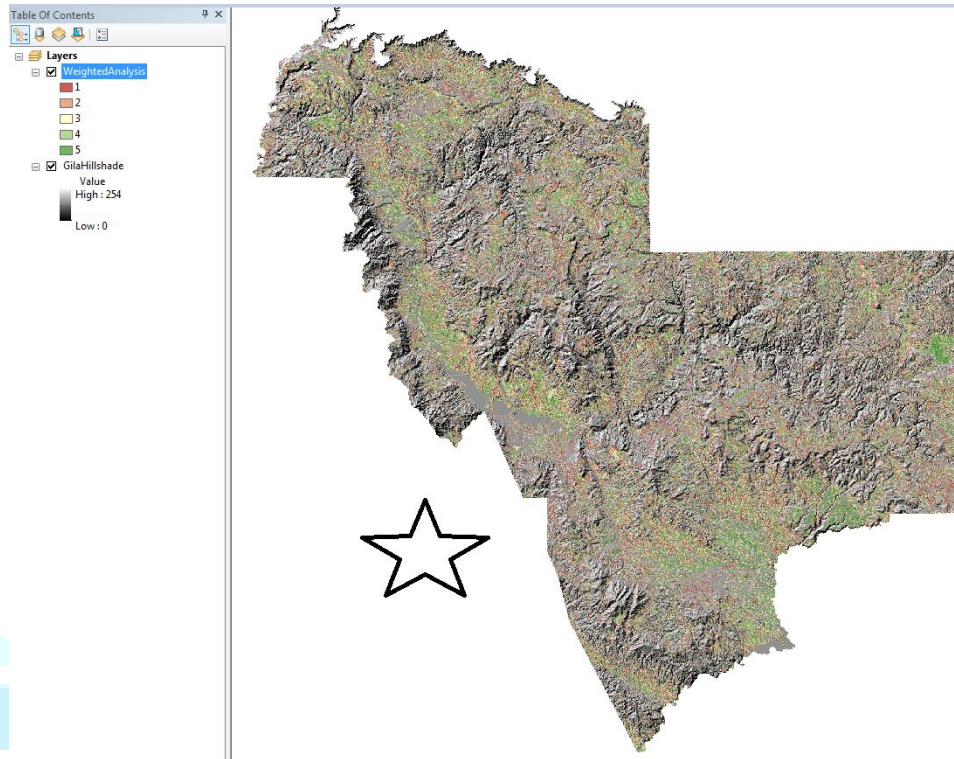
FUZZY MEMBERSHIP

The use of the Fuzzy Model Overlay is saved for analyzing phenomena that does not strictly adhere to discrete data analysis. In this case, we are searching for the burgundy-topped mushroom, which is most likely to be found in an area that receives indirect sunlight (east or west orientation) and a land slope between 4–10 degrees.

34. Before we can use the fuzzy overlay tool, it is necessary to assign a fuzzy membership to each of the layers that will be utilized in the Fuzzy overlay. To access the fuzzy membership, search *Fuzzy Membership* within the search window or access ArcToolbox/SpatialAnalystTools/Overlay/Fuzzy Membership. Open the Fuzzy Membership tool.

35. For the input raster, select the GilaAspectReclass raster. For the output raster, name it GilaAspectFuzzy. Set the membership type to 'small' because the smaller values in our reclassified raster represent east and west orientation. East and west should receive a higher membership value than other values. Leave the remaining default values and click **OK**.
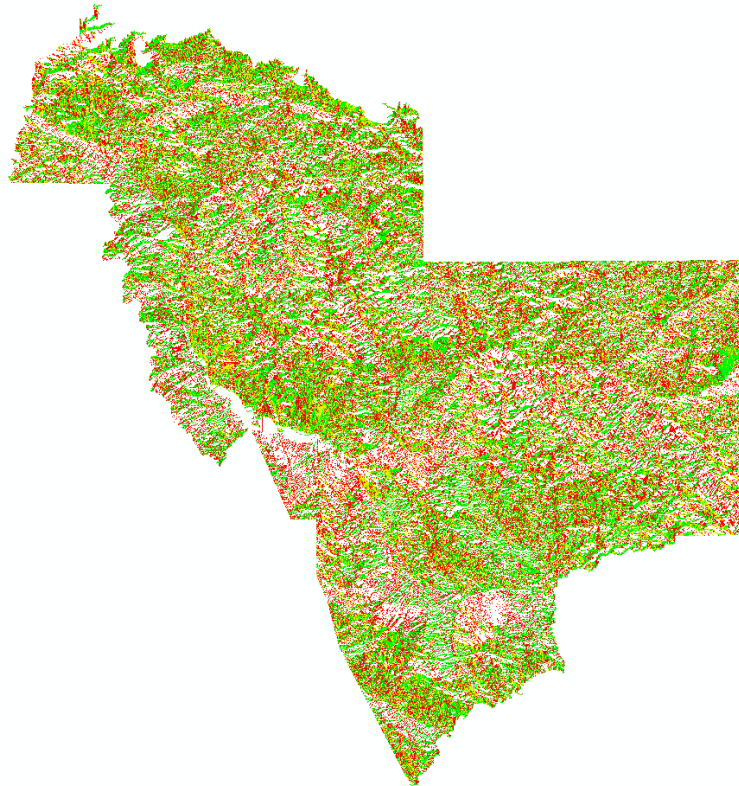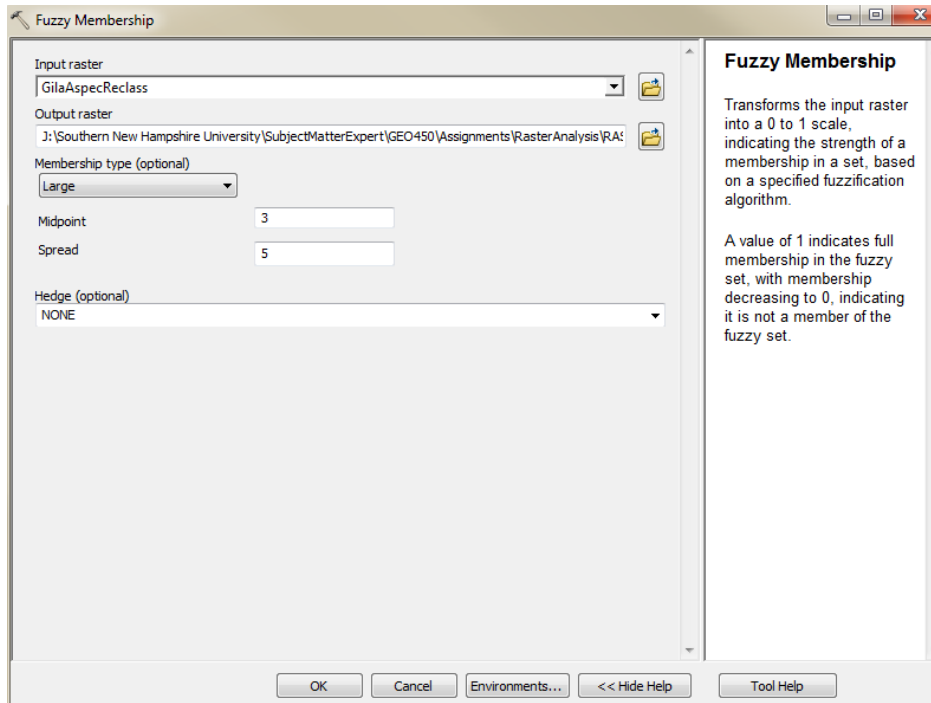
FUZZY SLOPE

36. Open the fuzzy membership tool. For the input raster, select GilaSlopeReclass. The output raster should be named GilaSlopeFuzzy. Because the preferred values are in the middle of our values,

we will select the near membership type. The values in the middle of our raster will receive a higher membership number than numbers that are high or low. Leave the remainder of the options to their default settings. Click **OK**.
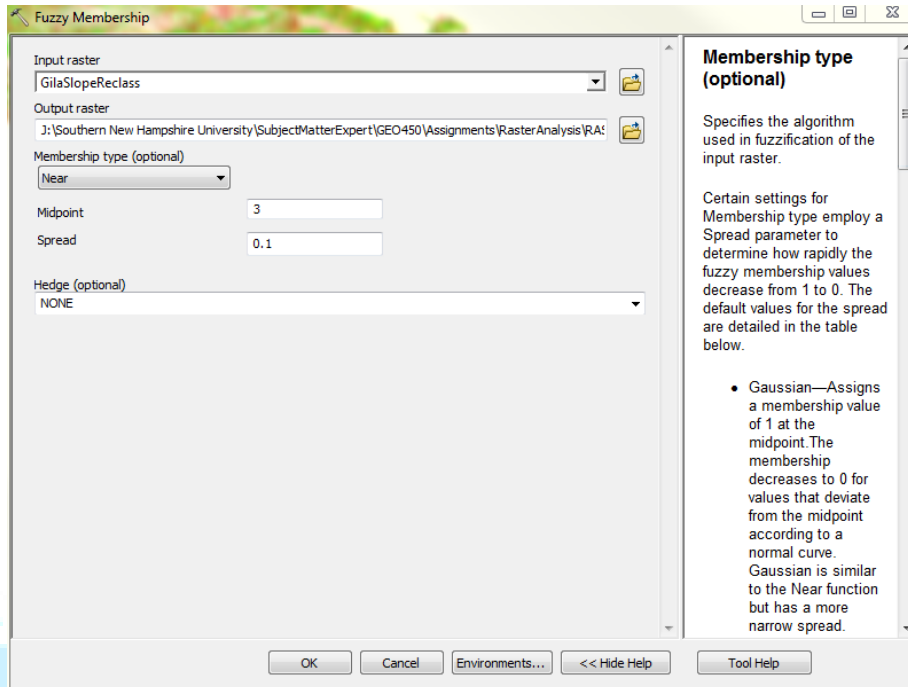

37. Take a **screenshot** of the new layer and add it to your submission document. Label the screenshot *Fuzzy Membership: Slope.*
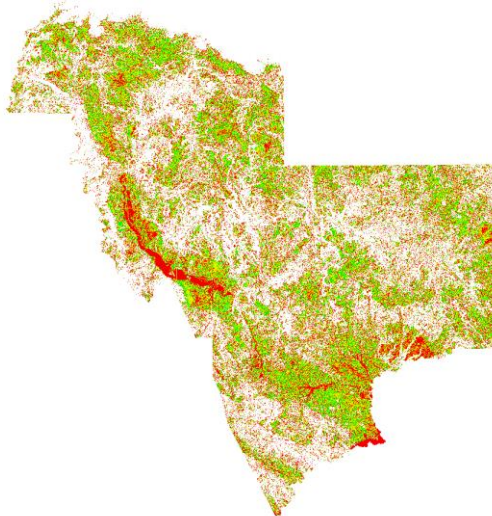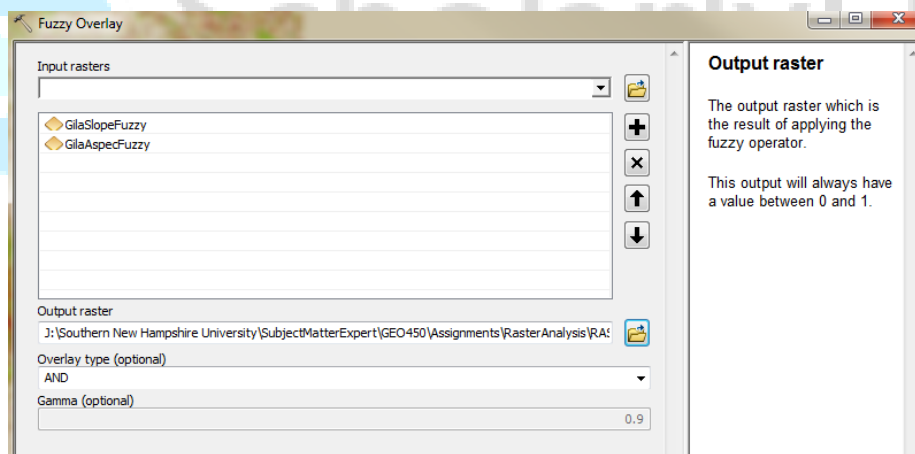

FUZZY OVERLAY

You will now use the Fuzzy Overlay tool to identify likely areas of the burgundy-topped mushroom. However, since collectors of the burgundy topped will have to walk to sites to collect the mushrooms, they are only interested in areas that are within a mile of a road.

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38. Access the Fuzzy Overlay tool. This can be done by searching Fuzzy Overlay within your search window or by accessing ArcToolbox/SpatialAnalyst/Overlay/FuzzyOverlay. Open the Fuzzy Overlay tool.

39. Within the Fuzzy Overlay tool, click on the Environments button. Scroll down to the raster analysis and expand the section. For the mask option, select the roads1milebuff shapefile from the *ExerciseIIIandIVData* folder. Click **OK**. You will return to the Fuzzy Overlay window. This mask will create a raster that only depicts areas within the *roads1milebuff* boundaries.
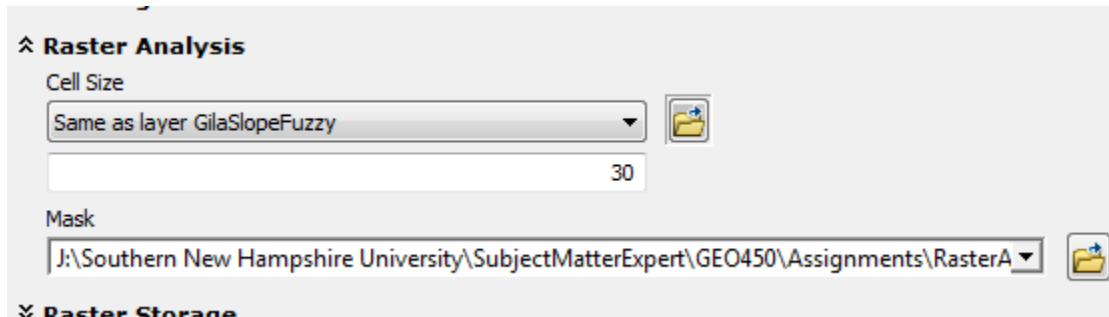
40. Within Fuzzy Overlay, input both the GilaSlopeFuzzy and GilaAspectFuzzy layers. Leave the overlay type as AND. Your Output Raster should be GilaFuzzyOverlay. Click **OK**.

41. Change the color scheme to 'slope.' Take a **screenshot** of the raster and add it to your submission document. Name the screenshot *Fuzzy overlay with 1 mile road buffer*. Included is a sample of what the overlay would have looked like without the mask.

42. Add the GilaHillshade Layer and set the fuzzy overlay to a 50% transparency. Use the Zoom tool to explore your data.

AND
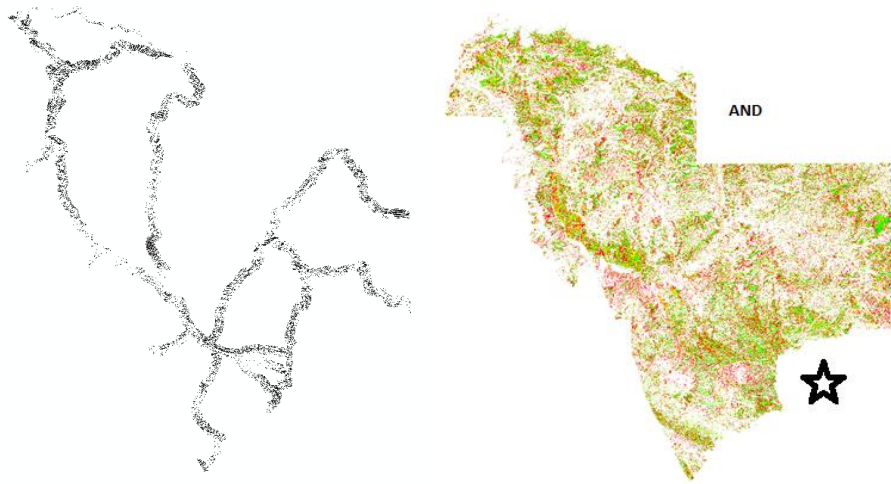
This completes the Exercise IV Tutorial. Continue to the Exercise IV Assessment. See the *Exercise IV Guidelines and Rubric* document for details.