

Exercise 21: Raster Functions in ArcGIS Pro

This exercise describes how to use Raster Functions, the Raster Functions Editor, and generate raster analysis workflows in ArcGIS Pro. Raster Functions allow for processing raster data without creating an output dataset. In other words, output is created on-the-fly in RAM as required to fill the current spatial extent and scale of the map display. This can save a lot of time and unnecessary processing. Also, some of the outputs from Raster Functions can be used as input to traditional geoprocessing operations. More information about Raster Function is available at:

<https://pro.arcgis.com/en/pro-app/latest/help/analysis/raster-functions/raster-functions.htm>.

In this lab, you will use a DEM, or digital elevation model, of Monongalia, West Virginia. The DEM was generated from LiDAR data at a 30 m spatial resolution. You will use a Raster Function to generate a hillshade then define a new function using the Raster Function Editor to calculate a slopeshade, which is an alternative means to display a raster grid.

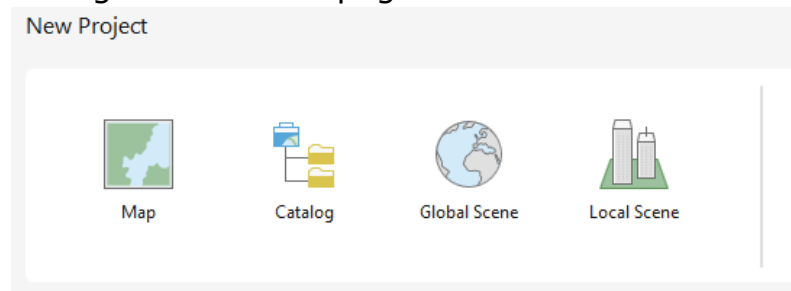
Topics covered in this exercise include:

1. An overview of using Raster Functions
2. How to create and apply Raster Functions
3. How to create your own custom tool that requires multiple steps using the Raster Functions Editor.

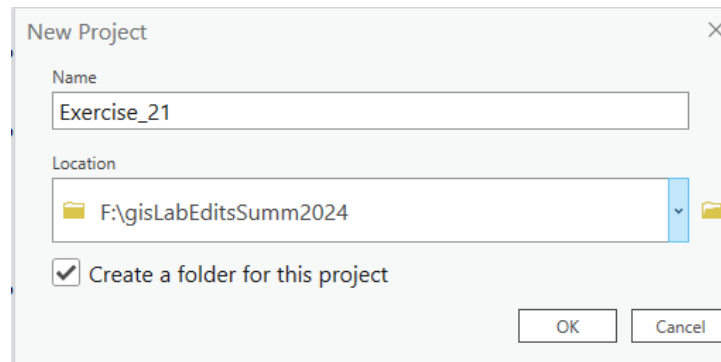
Step 1. Create and Prepare a New Project

You will begin the analysis by creating a new project to work within.

- Open ArcGIS Pro. This can be done by navigating to All Apps followed by the ArcGIS Folder. Within the ArcGIS Folder, select ArcGIS Pro. Note that you can also use a Task Bar or Desktop shortcut if they are available on your machine.
- Once ArcGIS Pro launches, select **Map.aprx** under Create a new project on the right side of the page.

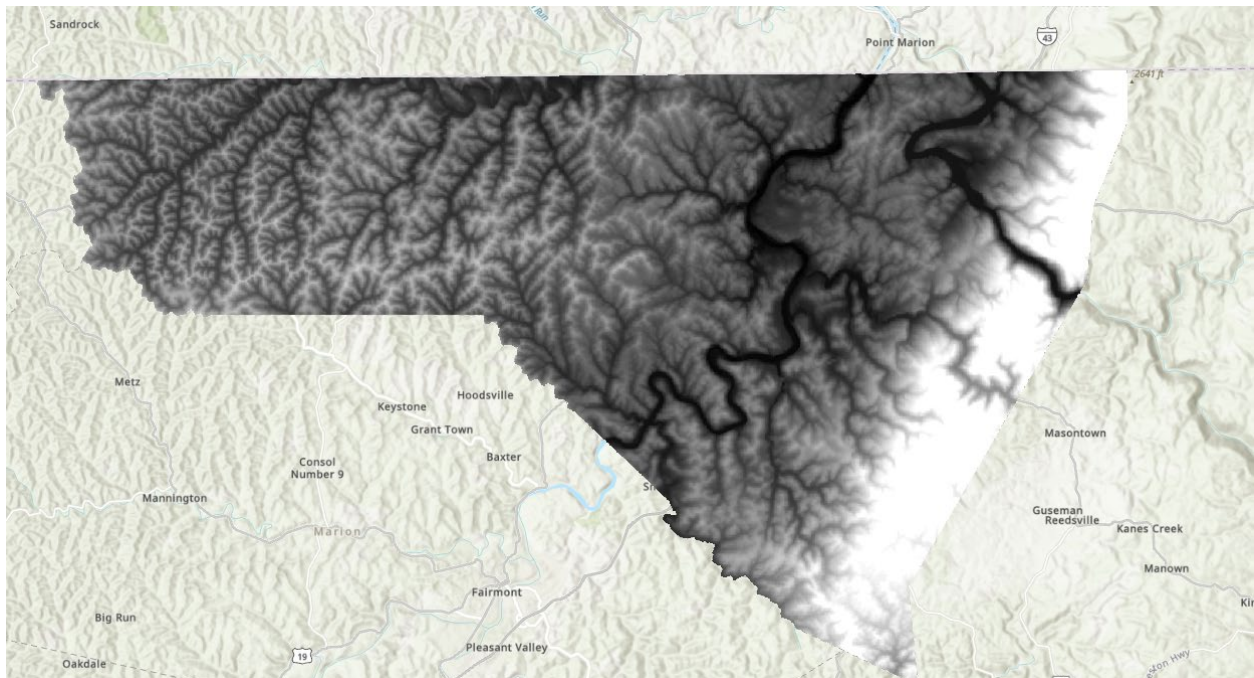


- In the Create a New Project Dialog Box, name your new project **Exercise_21** and save it to your personal folder. You can leave the “Create a new folder for this project” option selected.



You have now created a new project. Since you used the **Map.aprx** template, a map has already been added to the project. You will now need to add data to the map. You will need to download the required data from the GIScience class page on the West Virginia View website by clicking on the Lab 21 button followed by Data. You will need to uncompress the folder.

- Click on the Add Data Button. Navigate to your copy of the lab data. Navigate to the downloaded **Data** folder. Add the **monongalia_dem.tif**.



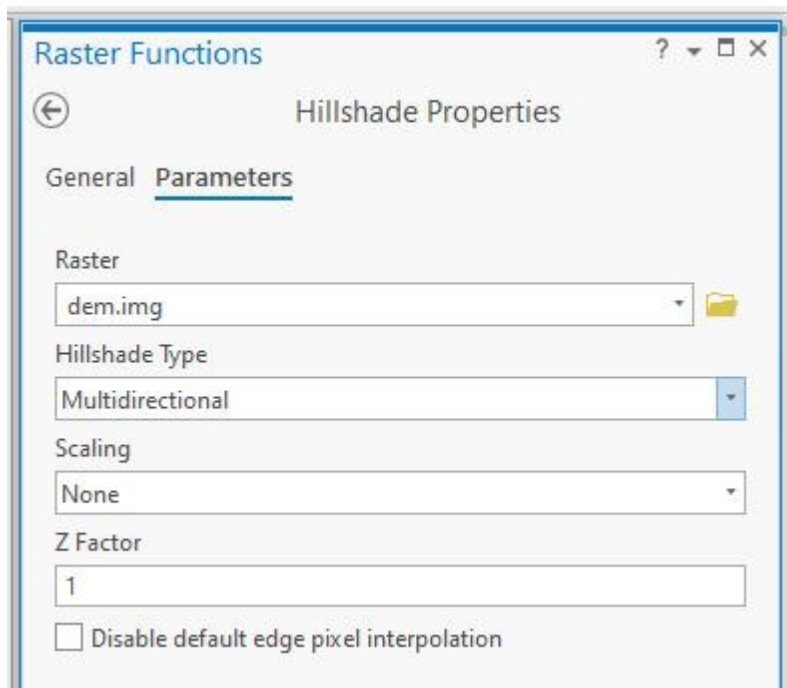
Step 2. Create a Hill-Shade

In this section, you will create a hillshade using a Raster Function as opposed to the traditional geoprocessing tool available through the Spatial Analyst Extension. This can be accomplished using the **Surface Tool**.

- On the Analysis tab, click **Raster Tool**.

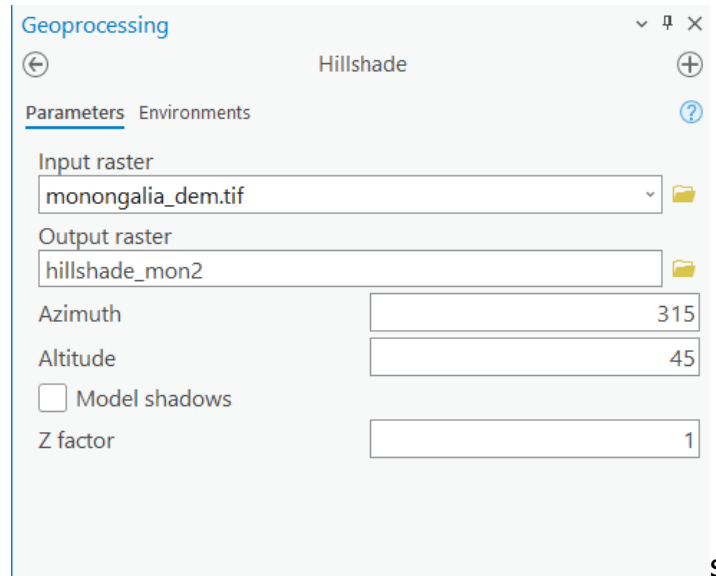


- Under **Surface**, click on **Hillshade**.
- In the pop-up window, use the **monongalia_dem.img** layer for Raster.
- Leave all other settings as the default.
- Click Create new layer to execute the tool.



Now, you will create a hillshade using geoprocessing tool. Go to geoprocessing pane, search for **Hillshade** tool.

- In the pop-up window, use the **monongalia_dem.img** layer for Raster.
- Name the output "hillshade_mon2"
- Leave all other settings as the default.
- Click Create new layer to execute the tool.



Now you have 2 hillshade layers. Right-click on each layer and click properties. Dive into the properties of each layer and answer questions below.

Question 1. How are raster functions different from traditional geoprocessing functions? (4 Points)

Question 2. Explain the difference between a traditional hillshade and a multidirectional hillshade. (4 Points)

Step 3. Create a Custom Tool

The implementations of Raster Functions are not that different from geoprocessing functions in ArcGIS Pro in regards to the user interface even though the underlying computational methods being used are different. Similar to ModelBuilder, which allows for sequencing multiple geoprocessing operations to create a more complex task, Raster Functions can be chained using the Raster Function Editor. In the second part of the lab, you will create a custom tool using the Raster Function Editor to calculate a slopeshade.

The equation for a slopeshade is provided below.

$$\text{Slopeshade} = (1 - (\frac{\text{Slope in Degrees}}{90})) \times 255$$

A slopeshade can be created by:

1. Calculating slope from a DEM.
2. Dividing the slope value at each cell by 90.
3. Subtracting the result from 1.
4. Multiplying the result to rescale the values from 0 to 1 to 0 to 255.
Although not implemented here, the 0 to 255 result can be saved as an 8-bit integer data type as opposed to a float data type.

In a slopeshade, low values indicate steeper terrain whereas high values indicate flatter terrain. As a result, if a standard black-to-white color ramp is applied, darker shades will indicate steeper slopes and brighter shades will indicate flatter slopes. This offers an alternative means to a hillshade to visualize a terrain surface. Let's now design a process using raster functions to calculate a slopeshade.

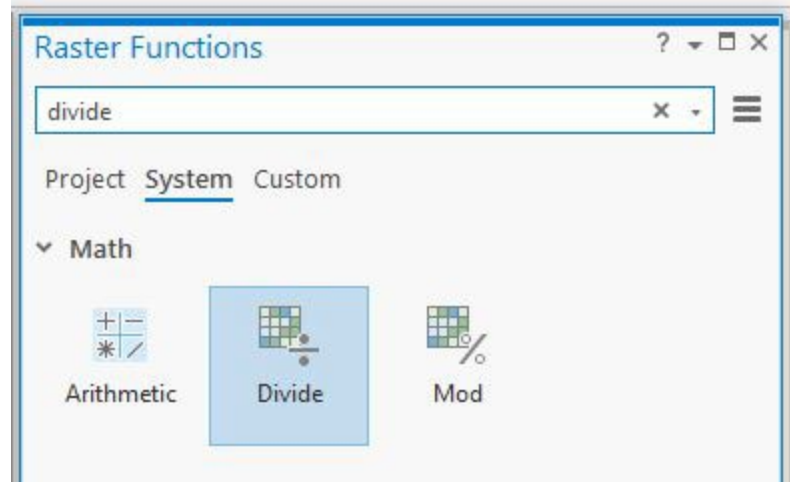
- On the Analysis tab, click **Raster Editor Tool**.



- The first variable you need is the DEM.
- To add the DEM, click on **monongalia_dem.tif** in the Content Pane and drag it to the Raster Function Editor window.

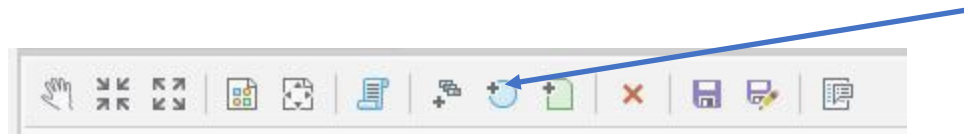
Now, you will need to add additional Raster Functions and variables to complete the tool.

- In the search bar of the Raster Functions Pane, type "divide". Right-click on the Divide tool and click on Add to add it to the Function Editor.

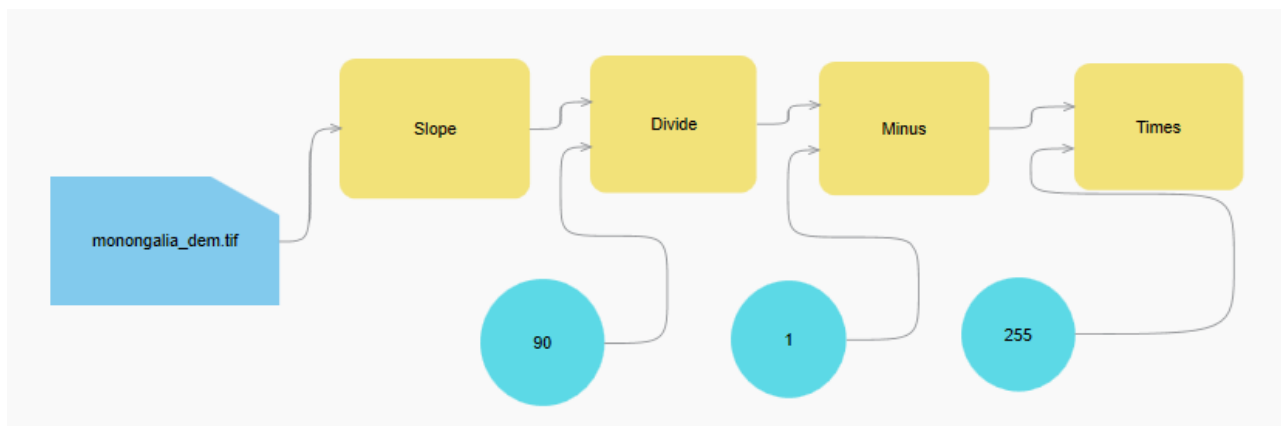


- Repeat the process to add Slope, Minus and Times Raster Functions.

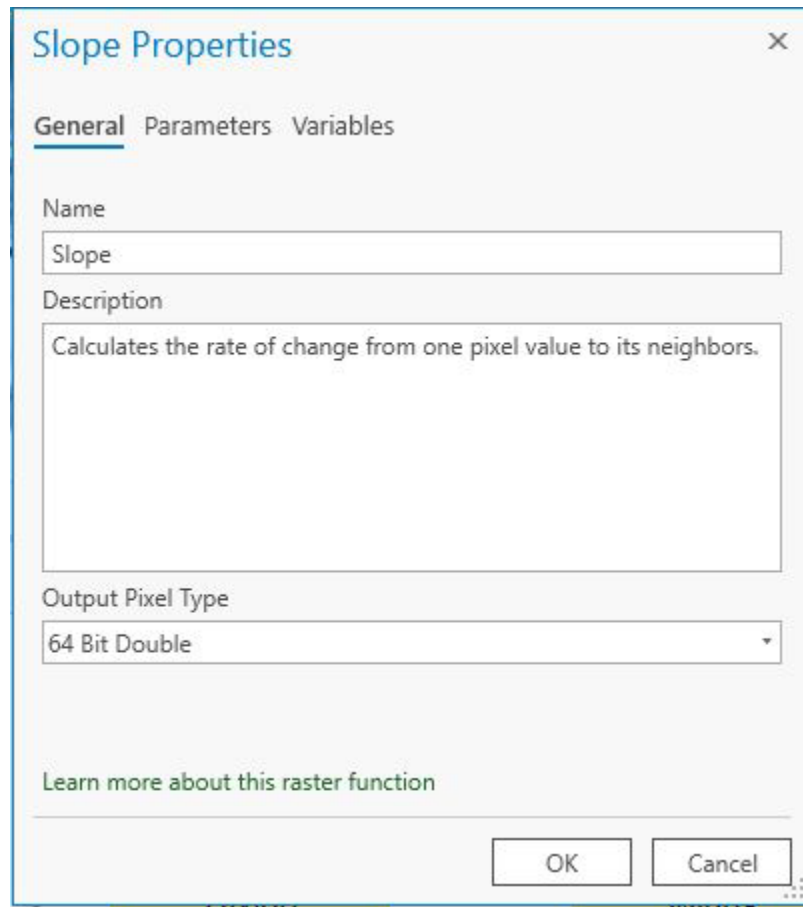
You now need to add a couple of other constant variables, which can be added from the same Raster Function Editor window. You will need three constant variables.



- The constant values should be 90, 1, and 255. Right-click on the constant and click on Set Value to change each value.
- Once you have all the variables and constants, you need to connect them to form the processing chain. You can do so by dragging lines from the variables to the associated tool or operation.
- Once you are done, the model will look like the image below.



- Now, you must assign the raster data type for all your variables. You can do so by right-clicking on the tool and clicking on properties. Go to the General Tab and under Output Pixel Type choose 64-bit Double. Do this for the Slope, Divide, Minus, and Times Raster Functions.



Question 3. Why was the output type defined as 64-bit double as opposed to another data type? (4 Points)

Question 4. What is the difference between 64-bit double and 8-bit unsigned? (4 Points)

- Once you are done, save the model. If there are no issues with your model, there will be no problems while saving. If you are not able to save, then this may indicate that there is some issue with your model. If an error is raised, double-check your model and associated settings.

Name
Terrain Vs

Description
Slope form DEM

Help

Type
Mosaic

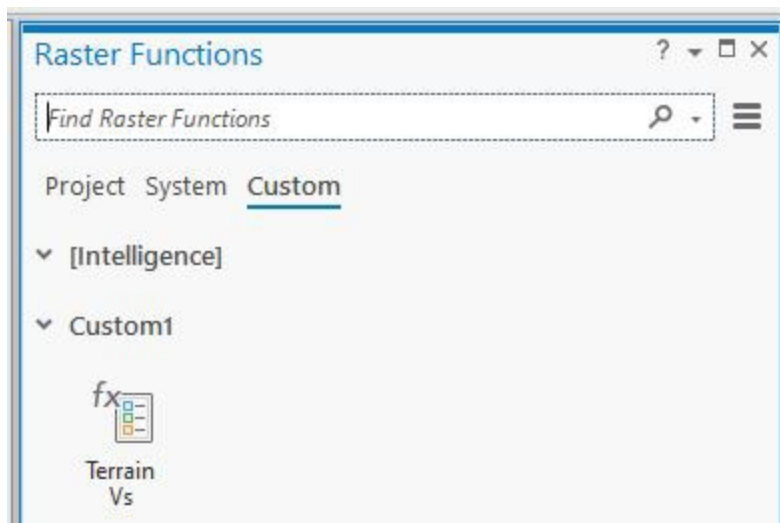
Definition Query

Multidimensional Rules Match Variables Union Dimensions

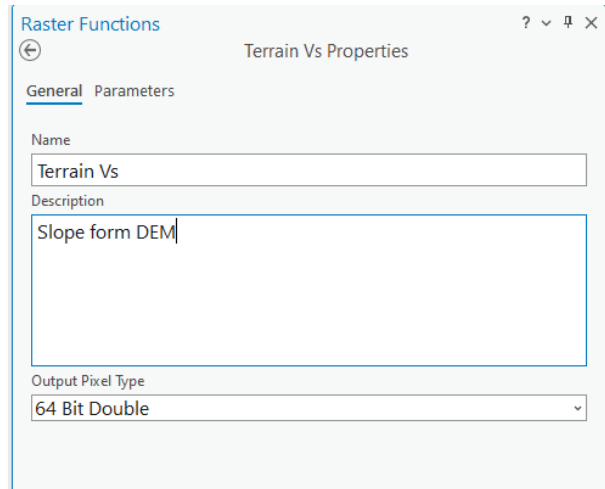
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OK Cancel

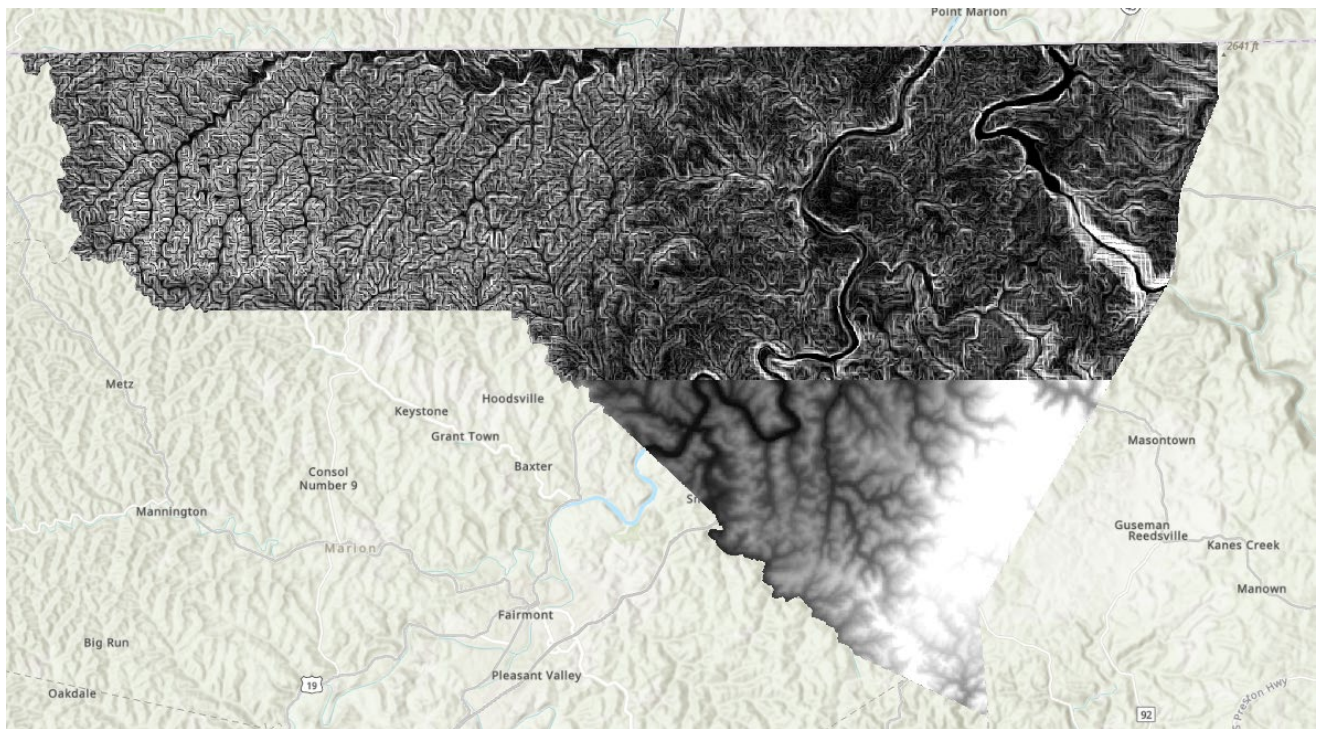
- Give the model a name of your choosing.
- Provide a description for the tool.
- Leave all other settings as the default.
- Click OK to save the tool.
- Now clear the search bar for the Raster Functions Pane.
- Click on the Custom Tab. Your tool will appear there as pictured below.



- Now click on Create new layer.



- The final product will look something like this.



END OF EXERCISE