Geo-Programming Semester Assignment.
Raster Change Analysis.

This exercise aims to load in and create the Normalized Burn Ratio (NBR) and Differenced Normalized Burn Ratio (dNBR) for the 2017 Thomas Wildfire.

Starting your assignment:

1. Open ArcGIS and create a new project.
2. Navigate to S:\2024_Spring\GEOG_3050\STUDENT\skzebarth\data and copy the data to your student folder, which can be found in GEOG_3050\STUDENT\.
3. In ArcGIS, within the catalog pane, add a folder connection to the student folder to which you just copied the assignment data.
4. From this connected folder, load the following files:
    1. S2_refl_20171128_b5_8a_12.tif
    2. S2_refl_20171228_b5_8a_12.tif
5. Create a new jupyter notebook by selecting the **Insert** tab and clicking **New Notebook.**
6. To begin our spatial analysis, read in the following code:
    1. *Import arcpy*
    2. *from arcpy.sa import **

    The arcpy spatial analyst python module documentation can be found here: https://pro.arcgis.com/en/pro-app/3.1/arcpy/spatial-analyst/what-is-the-spatial-analyst-module.htm
7. Set your working environment to the connected folder. To save time later with saving raster data, create a variable for a shortened name of our working environment:

    1. *folder = "your folder path"*
    2. *Set your environment to the folder*.
8. We should now be ready to begin data manipulation.

Assignment code:

This section aims to give you general guidance on how to proceed with raster calculations in Arcpy. Our goal is to calculate the dNBR, which tells us the magnitude of environmental change from a wildfire. This infers that we understand the health of vegetation from two points in time, the pre-fire and the post-fire state. To move forward, we must calculate a pre-fire and post-fire NBR. Use your teammates to help you get through this assignment!

Pre-fire NBR calculation:

1. arcpy.sa has a built-in function to calculate NBR:
    1. *NBR("your_image", SWIR_Band, NIR_band)*
    2. Notice the function structure; it uses three calls relating to the raster and bands you want to manipulate. We must use Band 12 for the SWIR variable and Band 8a for the NIR variable. However, when you look at the files in the **Contents** pane, it lists three layers: **Red, Green, and Blue**. This means that three bands were put into this image; what bands are present? **Using the file's name, determine which layer belongs to each band.**
2. Input the correct image name for the pre-fire data and use an integer to select the band layer we need. (NOTE: *WHILE PYTHON INDEXING STARTS AT 0, THIS IS NOT TRUE FOR THIS FUNCTION. YOU MUST CHOOSE BEWTEEN 1-3 FOR YOUR INTEGER).* Set the NBR function to a variable; you can name it what you want, but choose something meaningful that you can differentiate from the eventual post-fire NBR:
    1. *your_variable = NBR("your_image", INTEGER, INTEGER)*
3. Name and save your raster with the following code; ensure you have .tif following whatever you choose to name your pre-fire NBR calculation.
    1. *your_variable.save(folder + "name.tif")*
4. Run your code and load in the pre-fire NBR image you created. You can do this by drag and drop from your student folder or right click and refresh your connected folder in the catalogue pane.
5. If you would like to view your newly created NBR with different colormaps, you can choose to modify this in the symbology tab. It's important to understand we are dealing with a diverging dataset, so it would be valuable to choose a diverging colormap. I chose

6. With your team, discuss the general vegetation health prior to the Thomas Fire? Are there any outliers? Are there any spatial trends worth noting? *Answer to the best of your abilities, there is no wrong answer, just give your honest opinion.*

7. Congratulations, you have calculated the NBR index!

Post-fire NBR calculation:

1. From what you have learned from the pre-fire section **calculate the post-fire NBR!**
2. Again, if you would like to view your newly created NBR with different colormaps, you can choose to modify this in the symbology tab. It's important to understand we are dealing with a diverging dataset, so it would be valuable to choose a diverging colormap.
3. Following the creation of the post-fire NBR, compare the imagery with your pre-fire NBR. With your team, discuss the general vegetation health following the Thomas Fire? Are there any outliers? Are there any spatial trends worth noting? *Answer to the best of your abilities, there is no wrong answer, just give your honest opinion.*

The dNBR:

Now that we have both the pre-fire and post-fire imagery, we can calculate the difference. This is easier than you may think, and all you need is to reference the dNBR equation below. *Hint: you created variables for each NBR.*

dNBR = pre-fire - post-fire.

1. There is no function in the arcpy.sa library for this. **With your team, attempt to calculate, save, and load in the dNBR.**

2. Again, if you would like to view your newly created NBR with different colormaps, you can choose to modify this in the symbology tab. It's important to understand we are dealing with a diverging dataset, so it would be valuable to choose a diverging colormap.

3. Discuss the spatial distribution of burn severity with your teammates. Are there any extremes worth noting? Do you think there is much variability in wildfire impacts? How might this information be useful for emergency management groups? *Answer to the best of your abilities, there is no wrong answer, just give your honest opinion.*