**Project 2 Assignment**

MSYM 492/892, Spring 2022

**Objective:**

Complete a working Python script for processing time-series drone images collected in season, extract vegetation indices for each plot, and investigate the correlations between manual measurements and extracted vegetation indices, and the effect of nitrogen and water treatments.

**Data Provided:**

- Subfolder "UAV_images" – field maps of seven dates of an experiment field. The maps were orthomosaicked from drone-based five-band multispectral images collected at South Central Ag Lab in Clay Center, NE. As we discussed in the class, there are five spectral bands: blue, green, red, red edge, and near infrared for each map. Time series data were collected over the corn growing season on June 4$^{th}$, June 14$^{th}$, June 21$^{st}$, June 30$^{th}$, July 12$^{th}$, August 2$^{nd}$, and August 16 in 2021. Each map was name by "date_spectral band.tif", for example, "0630_red.tif".
- Field treatments "Treatment.jpg".
- Subfolder "Shapefile" contain the shapefile of plots. In Python, you may only need the "Treatment.shp" file.
- An file "ManualMeasurements_and_Outputs.xlsx" contains growth stages, data collection dates, plot IDs, nitrogen rates, irrigation rates, and manually measured leaf area index (LAI) and Soil Plant Analysis Development (SPAD) chlorophyll readings. This will also be the file you will add your outputs into.

**Part 1 – extract vegetation indices (VIs) of each plot for a day (30 points)**

- Write a Python script to calculate three VIs for each plot, i.e., NDVI, NDRE, and GNDVI, use data collected on June 4$^{th}$.
    - There are different ways to do this. You can first prepare the cropped map for a plot using the plot shapefile, then calculate the VIs for that plot. Or you can first calculate a VI for the entire field, then calculate the VI for each plot.
    - Recall the for loop we had practiced.

**Part 2 – extract the VIs of each plot for all seven days and output to the spreadsheet (30 points)**

- Automate this process using for loop rather than repeating code blocks for each date.
- Plot a figure (Figure 1) for time-series change of the VIs for two different plots that you select. You can select use line plotting for each VI each plot. Use the dates for x axis, and VI values for y axis. Use proper labels to show treatment information of the two plots you selected.

**Part 3 – investigate the correlations between each VI and manually measured plant traits (LAI and SPAD readings) over the season (30 points)**

- Plot three figures (Figures 2-4) for the three VIs vs. LAI including the seven days' data. Perform regression analysis and plot the equation of the fitted model you selected and the corresponding correlation coefficient on each figure.
- Plot three figures (Figures 5-7) for the three VIs vs. SPAD including the seven days' data. Perform regression analysis and plot the equation of the fitted model you selected and corresponding correlation coefficient on each figure.
- Insert a paragraph of discussion in the Jupyter Notebook about your finding from the plots. You could discuss, for example, what can we get from these plots with model fitting? Why some of them have higher correlations, some of them do not? You may search for some literature/resources for LAI, SPAD and VIs.

**Part 4 (bonus) – investigate the treatment effects (30 points)**

With the three nitrogen treatments and three irrigation treatments, there were nine combinations of treatments in total. Each treatment had three replications.

- Select a VI. Write a Python script to automatically calculate the mean VI value of the three replications for each plot over the growing season.
- Plot the mean VI for each of the nine treatments over the growing season in a figure. Use dates for the x axis, and mean VI (specify the specific VI you selected here) for the y axis. Use line plots with markers to show individual means. Use proper legend to indicate the treatment information, e.g., "0 lb N/ac, 50% ET" for one line in the figure.
- Insert a paragraph of discussion in the Jupyter Notebook about your finding from the plots.

**Due Date:**

5 PM, Monday, March 28th in Canvas

**Submission Package:**

- Jupyter Notebook file .ipynb. Name it as "[Your First Name]_[Your Last Name]_Project2.ipynb".
- Make sure you do extensive comments for your code to explain your thinking process. We also use the comments as part of the information to check the originality of your work. This accounts for 10% (10 points) of the total points.
- ManualMeasurements_and_Outputs.xlsx with your outputs as added columns.
- Zip them as "[Your First Name]_[Your Last Name]_Project2.zip", and submit the zip file in Canvas.