Remote Sensing Data Display and Python

Remote Sensing

The remote sensing portion of the course will explore how satellites observe the environment in both the visible and thermal spectrum. The main project will be to devise an algorithm that will detect clouds both in day and night, and will classify the remaining surface into vegetated, urban, and water. Python programming will be used to read, analyze and display the satellite data.

Python

Python is a powerful and popular programming language that provides students with the tools needed for numerical computations, data analysis of experiments and sensor measurements, and graphical displays of spatial and temporal data. The material covered in this portion of the course will be blended with the concepts of remote sensing; introducing students to the programming techniques needed to read, display and eventually analyze satellite data.

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Scoring

Quizzes and/or classwork will occur each day. The session will conclude with a computer project done in class.

Quizzes*:* 5pts/twice weekly
Classwork: 5pts/twice weekly
Project: 10pts/one per section

Thursday July 7 – *Introduction to Remote Sensing*
- Intensity, reflectivity, transmission, absorption and scattering
- Descriptive optical depth
- Pixels and images
- Satellites and other sensors
- Using Python in Interactive mode

Classwork: radiation physics

Friday July 8 – Field Trip to Carry Institute (no class)

Monday July 11 – *Making images using visible light*
- Reflectivity and Color
- Images and arrays
- Array mathematics in Python: numpy
- Reading a text file with Python

Quiz: radiation physics

Tuesday July 12 – *Working with Images*

- Making an image in Python
- Writing functions in Python: reading a file, displaying an image
- Decision structures: If and Boolean algebra
- Loops: FOR and WHILE
- Contrast

Classwork: script to open and display multiple files in succession

Thursday July 14 – *Thermal radiation and clouds*

- Thermal Radiation
- Creating a thermal radiation function
- Histograms
- Thermal cloud selection and cloud fraction

Classwork: function to calculate brightness temperature from radiation
Quiz: arrays and color

Friday July 15 – Trip to National Weather Service (no class)

Monday July 18 – *Calculating Optical Depth*

- Optical Depth and Math
- Calculating Optical Depth of Clouds
- Scatter plots of cloud properties

Quiz: thermal radiation
Begin Project (see below)

Tuesday July 19 – *Project Day*

You will be placed in groups to help each other develop a script using your previously developed functions to do the following:

1. Loop through the landsat archive by date and for each one:
    a. Open the thermal radiation file and convert to temperature.
    b. Make a histogram of temperature, and let the user input where to place the temperature to select cloud, or indicate if there is no cloud present. If clouds are present, do the following:
        - Pick out the pixels that have clouds, calculate cloud fraction.
        - Calculate the optical depth of each cloudy pixel
        - Append the optical depths and temperatures for each pixel to their respective arrays
        - Make a scatter plot of cloud top temperature versus optical depth, and save it with the date and cloud fraction in the file name.
2. Based on the plots you have, write a brief analysis of how cloud optical depth and cloud top temperature are related.

EVERY member of the team will turn in their own script and module containing the functions that go with it. However, the team may divide up jobs to let different members investigate each component of the project and explain to the rest how to do it.