DS 2500: Intermediate Programming with Data
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The Challenger Accident

Problem Description:

On January 28th, 1986, the space shuttle Challenger exploded approximately seventy seconds after lift-off, killing all seven astronauts on board. The accident was caused by the unusually cold temperatures reducing the resiliency of the rubber O-ring seals connecting each section of the solid rocket boosters. The loss of resiliency led to a gas leak at one of the O-ring joints and the eventual explosion. Let's investigate the weather on that fateful day.

There are two parts to this assignment.

Part A. How cold was it at Cape Canaveral on January 28th, 1986?

Analyze temperature data for weather stations within 100 km of the NASA facility. Do your analysis using Python Pandas to the extent possible. The basic approach is as follows:

1. Read the weather station and temperature data for the year 1986. The station data identifies the station and its GPS location. The temperature data records the temperature at a particular station on a particular day.

2. Filter and clean up the data: Some temperatures are missing, some stations identifiers may be null (missing), and some GPS coordinates (e.g., 0.0 / 0.0) are clearly invalid. You can ignore the WBAN identifier and just focus on the STATION identifier.

3. Identify all weather stations within 100 km of Cape Canaveral. Calculate the distance using the *Haversine* distance function which takes into account the curvature of the Earth. (Note: not all of the stations necessarily recorded a temperature on any given day.)

Cape Canaveral, Florida, USA
Geographic Information

Country	United States
Latitude	28.396837
Longitude	-80.605659
DMS Lat	28° 23' 48.6132" N
DMS Long	80° 36' 20.3724" W

4. Use inverse distance weighting (https://gisgeography.com/inverse-distance-weighting-idw-interpolation/) with *p=1* to estimate the temperature at Cape Canaveral on January 28, 1986. The idea here is that in estimating the temperature at Cape Canaveral, we want to give more weight to temperature readings from stations that are closer to the site of the shuttle launch.

5. Plot the temperature at Cape Canaveral for every day in January 1986.

Part B. How cold was it on January 28th, 1986 across the continental United States?

Visualize the temperatures for January 28th across the continental United States. Although there are visualization libraries that could help us with this, let's try doing it using NumPy arrays to create a crude image-plot as shown in class.

1. Map GPS locations to (x, y) coordinates in a 2D image array. I found that mapping a latitude range of +25.0 to +50.0 and a longitude range of -125.0 to -65.0 to a 100x150 NumPy array produces pretty good results.

2. Map a temperature to a 3-valued RGB color array. I recommend bucketing temperatures into 10-degree intervals. This website might be helpful: https://www.rapidtables.com/web/color/RGB_Color.html

3. Plot the NumPy array as an image plot. Repeat for both January 28th, 1986 and February 1st, 1986. Note how the temperatures in Florida had warmed up considerably after just four days.

What to submit:

1. Your code in the form of a python file (.py) or a Jupyter notebook file (.ipynb). You can do Part A and Part B as two separate programs or notebooks if you prefer.

2. A single page .pdf containing your day-by-day temperature plot from part A and your US temperature visualizations from part B, unless these are already embedded inside your Jupyter notebook. Be sure to document any internet resources you used to help you address this assignment. It's always a good policy to cite your sources!