ATM350 Homework 3, Spring 2025
Due: Tuesday, April 8, start of class

Reminders: *Think and plan* before tackling each problem! Also, please *follow the naming conventions for required files/directories* ***precisely!*** Linux is *case-sensitive,* so be sure you are also when naming your files/directories!

Preparation: In your **/spare11/atm350/<username>** directory, create a directory named **hw3** and set its permissions such that it is *readable, writable*, and *executable* only by you (*note:* ***1-point penalty*** *if permissions are not set properly!*). All of your notebooks, and output, for this assignment should be placed in your **hw3** directory.

All of your notebooks should be well-documented with Markdown cells, as follows:

- Introductory cell with the name of the notebook and its main goal (e.g., for #1, something like **q1.ipynb: Analyze annual diurnal range with Pandas**)
- Documentation cells that precede significant parts of the notebook (e.g., for #1, something like **Calculate daily temperature difference**).

Consider the look of your finished graphics. Part of the score for each item will come from the overall aesthetics and readability of your plot … including titles, axis labels, and legends when appropriate that clearly describe what you have plotted. Make sure your figures are large enough (you can set the figure dimensions via the *figsize* parameter). View each plot as you work through the assignment and put yourself in the position of someone who happens to look at the plot … would they be able to understand what the graphic is attempting to present?

For documentation on matplotlib line colors and styles, see:
Line styles: https://matplotlib.org/stable/gallery/lines_bars_and_markers/linestyles.html
Line colors: https://matplotlib.org/stable/gallery/color/named_colors.html

Be sure you select the *Python 3 Jan. 2025 Environment* for each new notebook you create!

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1. (3 points) Within your **hw3** folder, create the **q1** directory and **cd** into it. Create a notebook, **q1.ipynb** that analyzes and visualizes Albany climate data from 2024, using the same file used in class during the Pandas lectures. In your notebook, do the following:
    a. After reading in minimum and maximum daily temperature, create a new object defined as the daily *temperature difference*, or diurnal range. Include a cell that prints out the maximum diurnal range, minimum diurnal range, and mean diurnal range for the year 2024.
    b. On one figure, plot the daily diurnal range over the entire year. Save this figure to your **q1** directory as **albDiurnalRange2024.png**.

c. On a separate figure, plot the 15-day and 60-day rolling means of diurnal range, named **albDiurnalRange2024_15d.png** and **albDiurnalRange2024_60d.png**, respectively.
d. Analyze the 60-day rolling means plot you have created (**albDiurnalRange2024_60d.png**). In your **q1** directory, create a new text file named **q1d.txt**, and answer the following questions:
    i. Which months (or seasons) in 2024 featured the *minima* and *maxima* diurnal range?
    ii. Given your understanding of Albany's climate, do you have a hypothesis as to why these minima and maxima occurred in these seasons? *Note: We are more interested in your thought process, and ability to analyze the plot and think scientifically about the reason for the minima/maxima, than coming up with a correct answer.*

2. (5 points) Create a **q2** directory in your **hw3** folder and `cd` into it. Then follow these steps:

a. Watch this MetPy Monday video, "How to Plot Wind Roses in Python with Windrose".

b. Create a notebook, **windrose_co_2024.ipynb**, and ***reproduce the workflow*** that MetPy Monday host John Leeman demonstrates in the video. ***Note: we have already downloaded the corresponding CSV file to /spare11/atm350/common/hw3/asos.csv*** .

c. Write a **shell script** named ***download_wind.sh***. The script should do the following:
    i. Sets four variables, ***stn1, stn2, stn3, stn4***, corresponding to four ASOS (METAR) sites of your choice from the state we assigned you.
    ii. Set one variable, ***YYYY***, representing a recent year of your choice.
    iii. Uses **wget** to download the corresponding CSV file from Iowa State . Name your CSV file **<state>_<YYYY>_wind.csv** . ***HINT: the format of the URL can be found in `/spare11/atm350/common/hw3/iastate_wind_url.txt`.*** *You will use the same year, which you specified in part (ii) above, for both year1 and year2 in the URL. This may result in your dataset ending on 30 December, instead of a full year, which is fine for the purpose of this problem.*

d. Create a notebook, **windrose_<state>_<year>.ipynb**. Use the state that we have assigned you and select a recent year and four ASOS (METAR) sites that have complete or near-complete wind velocity data for that year. Create a 2x2 plot of wind roses, analogous to 2.b. **Note: your notebook should be well-documented with *Markdown cells* and *comment lines***.

e. Conclude your notebook from 2d. with a Markdown cell that summarizes the main features of the annual wind rose for each site. Compare and contrast the four sites.

**** Reference for the Windrose Python package: ****
https://python-windrose.github.io/windrose/

3. (2 points) The website, xmACIS2, is a great archive for text-based weather data, climatology, records, etc. For this problem, you will be retrieving data relevant to your final project case study.
First, create a **q3** directory and **`cd`** into it.

a. Copy the notebook, `/spare11/atm350/common/hw3/Xmacis.ipynb` into this directory.
b. Modify the notebook as guided by the four Tasks. Choose a site and a time period (at least one week, no greater than one month) to retrieve data relevant for your case study.
c. Run the notebook to its completion.
d. Create a *new notebook*, **q3.ipynb** that uses Pandas to create the following time-series plots:
    1. Max and min temps (deg. C)
    2. Daily precip (units of mm) (or, if relevant for your case, daily snowfall)