ELEC 1520 – Final Project

Due 12/9/2022

Objective: The objective of the final project is to develop a C++ program that can process daily weather data over the span of years and perform various analyses on the data such as average temperature or precipitation over periods of time (perhaps, days, months, or years). The results of the analysis are to be exported to a data file that can be read in by utilities such as Matlab. The second objective is to write Matlab scripts that can read in these data files and plot the data analyzed in a meaningful way.

Description:

Data: You are given a large data set for analysis. For this term's project, the data set is daily weather for Denver Colorado during the period of June 1908 through early November 2022. The data is included in the link for this project. The first line of the file contains the number of rows in the data set (41178 lines). The data set has 9 columns. The columns are:

Month, Day, Year, precipitation(inches), snow(inches), snow depth(inches), max temp, min temp, Obs temp

The month, day and year are integer values. The remaining values are floating point numbers. The temperatures are in degrees Fahrenheit. The observed temperature is the temperature measured at 12 noon of that day.

Your code can expect these 9 columns of data from any weather station, but an arbitrary number of rows.

Analysis: Your code should be able to perform the following analyses.

1) Find the total precipitation per a given period of time – that is the total amount of rain that fell during that period of time
2) Find the total snowfall per a given period of time.
3) Find the maximum and/or minimum temperature over a given period of time
4) Find the average maximum and/or minimum temperature per given period of time
5) Find the average temperature at mid-day per given period of time.

The period of time can be per week, month, or year. Your code should also be able to output, or tabulate, these averages for a broader period of time. For example, finding the average maximum monthly temperature over the period of 1908 to 2022. The table would then contain three columns: month, year and maximum average temperature. Another example would be to find the total rainfall per year over the period of 1908 to 2022.

Procedure:

1) Function design: List all the functions that you need for your code. Then, design each function using the same process that we have been using in class. That is, identify the input data and types needed. Identify the output data and types needed and determine how the data will be returned to the user.

From this write your function declaration. Finally, identify what is needed in the body of the program and how it will be laid out. Then, write your function definition.

2) Top-level design: Create a top-level design for your code that describes the overall process. Write your main program so that it reads like your top-level design. Note that a single C++ code should be used for all of your analyses.
3) MATLAB: Create Matlab scripts to read in and plot your data. Plots should be self-descriptive.
4) Testing: Validate your code by running several tests. The following tests are mandatory:
    a. The average maximum recorded temperature per month over the period of 1909-2022 (1908 is not a complete year in the data set).
    b. Total annual rainfall per year over the period 1909 to 2022.
    c. The minimum recorded temperature per month over the period of 1910-1915.
    d. The average temperature in July over the period of 1908-2022.
5) Your own analysis: Come up with 3 different analysis studies that you think would be interesting using the data set. Perform the analysis with your code, and plot out the results in meaningful way using Matlab.

Reporting:

For this project, you are to complete a formal report using a word processor, such as Microsoft Word. The first page of your report should be a cover page with a report title (e.g., ELEC 1520 final project), your name, and date. There should be 5 sections in the report corresponding to the 6 bullet points in the procedure. It is recommended that you actually write the report as you conduct each step. For example, as you design your functions, design them in your report document, and then write the replit code function. Your report should contain a replit link to your program. Your report should also have an appendix that includes all Matlab scripts (.m) used in your project. The first line of your script should be a comment line that describes what test case the script is performing. Your testing study (sections 4 and 6) should reference which Matlab script that you used and where it is found in the appendix. For section 6, briefly state your motivation and objective of the case studies that you did. Plots generated by Matlab should be self descriptive in terms of labels, legends and titles. You can be creative in your presentation of data as well. Your report will be turned in to Canvas as part of this project. Make sure that your replit link(s) is working.

Honor Code:

In this project, you are welcome to discuss the project with your classmates. However, all work performed, including your replit and Matlab codes, report, and case studies, must be your own work.