CS 100: Programming Assignment P6

Due: Friday, April 16, 5pm, Carpenter Lab (or in lecture)

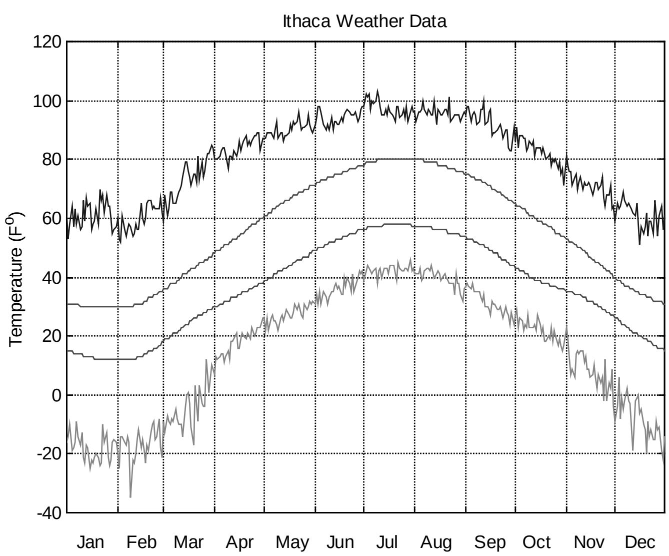
You may work in pairs. Do not submit your assignment for grading unless you have read and understand the CS100 webpage on Academic Integrity. Follow the course rules for the submission of assignments or lose points.

Background

The Matlab script

```
% Script File: P6Demo.
% Plots Ithaca temperature data over the span of a year. Displayed are the record high, the average
% high, the average low, and the record low.
D = ithacaData;
mStr = '      Jan    Feb   Mar    Apr    May   Jun    Jul    Aug    Sep   Oct    Nov    Dec';
m = [1 32 60 91 121 152 182 213 244 274 305 335 366];
close all                            % Closes all open figure window—a good habit
plot(D')
axis([1 365 -40 120])                % Horizontal range from 1 to 365 and vertical range –40 to 120
title('Ithaca Weather Data')         % Put a title on top.
ylabel('Temperature (F^{o})')        % Label the y-axis
set(gca,'Xtick',m,'XtickLabel',[])   % Put tick marks at the xvalues named by m but don't label
text(-10,-50,mStr)                   % Display the string mStr along the bottom edge
grid on                              % Show the grid lines
```

produces the following plot:



This script and the functions

```
  function D = ithacaData
% Yields a 4-by-365 matrix D. For i=1:365,
%    D(1,i) record high temperature for day i.
%    D(2,i) average high temperature for day i.
%    D(3,i) average low temperature for day i.
%    D(4,i) reord low temperatture for day i.
% Days are indexed from 1 (= Jan 1) to 365 (= December 31)

  function D = D98
% Yields a 2-by-365 matrix D. For i=1:365,
%    D(1,i) the high temperature for day i in 1998
%    D(2,i) the low  temperature for day i in 1998.
% Days are indexed from 1 (= Jan 1) to 365 (= December 31)
```

are available on the website. In this assignment you graphically depict various aspects of the Ithaca weather scene using these two functions to generate the necessary data. Matlab is available in all public labs. Use the course ID `CS100` (case insensitive) and the password `Code4` (case sensitive) to gain access. Create files `P6Demo`, `ithacaData`, and `D98` from the Matlab editor and copy into them the corresponding source codes available on the website.

Part A. (5 correctness points and 2 style points)

We say that a day is *hot* if the high temperature is closer to the record high for that day than to the average high for that day. Thus, if today's high is 70 and the record high is 80 and the average high is 50, then today is hot because 80-70<70-50. Likewise, a day is *cold* if the lowest temperature during the day is closer to the record low than to the average low. Write a script that "adds" the hot and cold days of 1998 to the plot shown above. Proceed by copying `P6Demo` into a new file `P6A` and then augment it as follows

- Get the 1998 data on tap via the statement `LastYear = D98`. As a result, `LastYear` be a 2-by-365 array whose first row has all the 1998 daily highs and whose second row contains all the 1998 daily lows.
- Compute a vector `hotDays` of hot day indices and a vector `coldDays` of cold day indices. Thus, if days 22, 100, and 254 are hot days and days 150 and 200 are cold days, then `hotDays` should be [22 100 254] and `coldDays` should be [150 200]. Use `find` to help generate these arrays.
- Designate the hot days with a red circle and the cold days with a blue circle via the sequence

```
hold on
plot(hotDays,LastYear(1,hotDays),'or',coldDays,LastYear(2,coldDays),'ob')
hold off
```

Style points deducted if your solution uses loops and/or lacks comments. Submit a listing of `P6A` and the plot.

Part B. (4 correctness points and 2 style points)

The following functions can be used to approximate the average high and average low:

```
High(t) =  55.8301 - 25.1551*sin((t +  70.0800)*(2*pi/365))
Low(t)  =  36.3452 + 21.7682*sin((t – 115.4738)*(2*pi/365))
```

Implement each of these as Matlab functions and write a script `P6B` that graphically displays the error for each in separate windows. In particular,

- As in `P6Demo`, get the necessary data on hand via the command `D = ithacaData`.
- Compute a vector `errHigh` where `errHigh(i)=D(2,i)-high(i)` for `i=1:365`, then execute `plot(err)`. Make the plot informative as we did in `P6Demo` with appropriate `axis`, `title`, `ylabel`, `grid`, `set`, and `text` commands.
- Generate another figure window with `figure` and place in it the corresponding error plot for the `Low(t)` function.

Style points deducted if your Part B solution requires a loop and/or lacks comments. Submit a listing of `P6B` and the plots.

Part C. (5 correctness points and 2 style points)

For each month define the average monthly high as the average of all the average daily highs. Likewise, define the average monthly low as the average of all the average daily lows. If these values are stored in vectors `highs` and `lows` (each length 12) then the sequence

```
bar(highs,'r')
hold on
bar(lows,'b')
hold off
```

produces a nice bar graph that simultaneously depicts the monthly highs and lows. Write a script `P6C` that does this. (The vector `m` in `P6Demo` defines some useful day indices for this purpose. More example, if `D = ithacaData` then `D(1,m(1):m(2)-1)` is a vector that consists of the average daily highs for February.) Adjust the axis range to make things look nice, include a title, and label the vertical axis. For bar graphs the string labeling of the horizontal axis is best done with `set(gca,'XtickLabel','Jan|Feb|Mar|Apr|May|Jun|Jul|Aug|Sep|Oct|Nov|Dec').`

Submit a listing of `P6C` and the bar graph. Style points deducted if nested loops used and/or inadequate comments.