CS1112 Fall 2010 Project 5 Part 1 due Thursday, Nov 11, at 11pm

(Part 2 will appear in a separate document. Both parts have the same submission deadline.)

You must work either on your own or with one partner. You may discuss background issues and general solution strategies with others, but the project you submit must be the work of just you (and your partner). If you work with a partner, you and your partner must first register as a group in CMS and then submit your work as a group.

Objectives

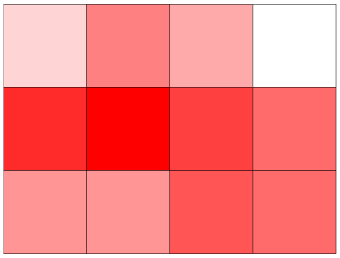
Completing this project will solidify your understanding of numeric arrays, character arrays, cell arrays, structures, and structure arrays. You will also work with text data files. Part 1 covers simple numeric and cell arrays, graphics, and linear interpolation (again!). In Part 2 you will work with the other array types and text data files.

1 Visualizing 2-dimensional data

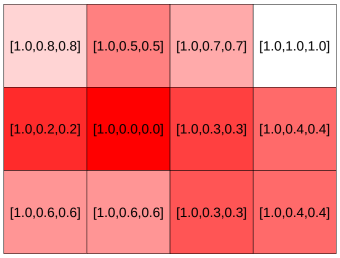
In Chapter 7 of *Insight* you saw that one could store the values of a function of two variables in a matrix over some "x" and "y" ranges. Furthermore, one could visualize the data using a contour plot. In Project 5 Part 1 you will develop a graphic that we call a color map to visualize 2-d data. Let's see an example:

0	4	2	−2
8	10	7	5
3	3	6	5

matrix



color map



[1.0,0.8,0.8]	[1.0,0.5,0.5]	[1.0,0.7,0.7]	[1.0,1.0,1.0]
[1.0,0.2,0.2]	[1.0,0.0,0.0]	[1.0,0.3,0.3]	[1.0,0.4,0.4]
[1.0,0.6,0.6]	[1.0,0.6,0.6]	[1.0,0.3,0.3]	[1.0,0.4,0.4]

color map with rgb values

The values of the 3 × 4 matrix on the left above is visualized in the "color map" in the middle. The largest value in the matrix—10, in component (2,2)—corresponds to the deepest red in the color map, in tile (2,2). The smallest value in the matrix— −2, in component (1,4)—corresponds to white in the color map, in tile (1,4). The other values in the matrix correspond to colors that are *linearly interpolated* between red and white. The color vector, i.e., the rgb values, of each tile is shown on the diagram on the right.

Implement the following function:

```
function colr = show2dData(M,maxColr)
% Show values in matrix M as a color map and return the color data as a cell array.
% M is a matrix of numeric values; M is not empty.
% maxColr is an rgb vector representing a color.
% colr is a 2-d cell array such that colr{r,c} is an rgb vector that
% represents the value in M(r,c), where r and c are valid row and column
% indices of matrix M.  The maximum value in M corresponds to the color
% maxColr.  The minimum value in M corresponds to the color white.  Other
% values in M have colors that are linearly interpolated between maxColr
% and white.
```

Recall that MATLAB rgb values are real numbers in the range [0,1]; white has the rgb values `[1 1 1]`. Here are additional specifications for the figure that your function produces:

- Each tile is one unit by one unit
- Write your own code using built-in function `fill` to draw each tile. Do not use the function `DrawRect` from *Insight*. Do not write subfunctions.

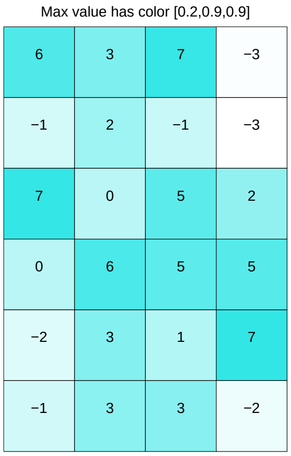
- Display the value of `maxColr` in the title of the figure.
- Let n_r and n_c be the numbers of rows and columns, respectively, of matrix `M`.
  - If $n_r \leq 6$ and $n_c \leq 6$, display the value `M(r,c)` in tile (r,c). The displayed text should be near the middle of the tile.
  - If $n_r \leq 4$ and $n_c \leq 4$, in addition to the value `M(r,c)` display the color of (r,c), i.e., the rgb vector, in tile (r,c). The displayed text should be near the middle of the tile.
  - Otherwise only draw the tiles—no text.

  See example output figures below. *See Appendix A.4 in Insight for the commands to use in order to place and align text in a figure.* Recall that you can build a string out of variable values by using the function `sprintf`. In the diagrams below the values in `M` are displayed with zero decimal places—in your calculations do not assume that `M` stores integers.

- Look at the commands you used in Project 4 for setting up a figure window. Do something similar here. In the future, you can learn more about formatting and controlling MATLAB figures using Appendix A in *Insight*.

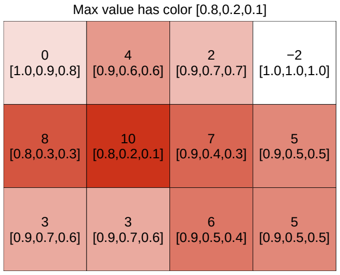
For Part 1, submit your file `show2dData.m` on CMS.

Example output



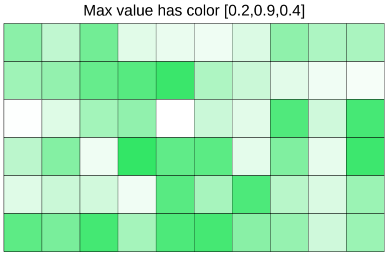
Max value has color [0.2,0.9,0.9]

6	3	7	−3
−1	2	−1	−3
7	0	5	2
0	6	5	5
−2	3	1	7
−1	3	3	−2



Max value has color [0.8,0.2,0.1]

0 [1.0,0.9,0.8]	4 [0.9,0.6,0.6]	2 [0.9,0.7,0.7]	−2 [1.0,1.0,1.0]
8 [0.8,0.3,0.3]	10 [0.8,0.2,0.1]	7 [0.9,0.4,0.3]	5 [0.9,0.5,0.5]
3 [0.9,0.7,0.6]	3 [0.9,0.7,0.6]	6 [0.9,0.5,0.4]	5 [0.9,0.5,0.5]



Max value has color [0.2,0.9,0.4]