Assignment for "Supervised Learning" - Curtis Baker

I. single-layer classifier - use provided code for gradient descent binary classifer ("*demo_classifier_gradDesc*"). Experiment with different values of learning rate. What are the consequences of it being too small or too large ? What is the largest value that usually works well ?

II. single-layer classifier with regularization - use provided code ("*demo_classifier_reg*"), which incorporates a penalty on the sum-squared weights (see MacKay, section 39.4, Figure 39.5). Modify the code to graph all three weights vs the iteration number. Experiment with different values of the hyperparameter, and illustrate its effect for different values. Note that for each value, you should try several times to get an idea of the effect; for illustration in Figures, you can show typical results, but where relevant please graph MSE (or VAF) as average +/- SD, as a function of what is being varied (e.g., learning rate, regularization parameter, amount of data).

III. receptive field (RF) estimation using regression - use provided code to do this for a simple model system ("*demo_1d_RF_sysIdent*"). Note that here, we evaluate performance by the ability of the estimated RF to predict a holdback dataset - the quality of RF estimation is quantifed as "variance accounted for" (VAF). Test the effect of using an initial weight vector estimate of all-zeros, vs random values, and discuss the results. Test the effect of differing amounts of data (value of nMeasEst), for all-zeros vs random initial weights, and discuss the results. Illustrate the results as above (II).

R-squared

III. estimation of RFs using regression with regularization - use provided code, which has holdback datasets for regularization (with ridge regression) and prediction ("*demo_1d_RF_sysIdent_ridge*"). Explore and comment on the effect of different values of the regularization parameter (alpha), both on the estimated kernel and the prediction vs measured output. Modify the code to loop across values of alpha (see "$$" locations in the code, for suggestions). Show an example graph of prediction VAF vs. alpha, and discuss the results. Repeat this for different amounts of estimation data (i.e., measurements), and discuss the results.

Assignment guidelines:

The above exercises should be done in standard Matlab. You must provide a written report, as a Microsoft Word or PDF file, which describes what you find, and what it means or illustrates. The text of the report should be a maximum of 8 pages (including Figures), and easy to read (font size=12, margins = 1"). You should illustrate key results such as graphs or plots with Figures, which may be in Word or as PDF file(s). Label axes of each Figure, and give it a short figure "legend", describing what it shows and indicating which of your Matlab scripts produced it. For each part of the Assignment, describe in the text what you found, and discuss why (i.e., "what it means") - it is not sufficient to simply show Matlab Figures, with little or no explanatory text.

Also please provide the Matlab code in a form which I can run (i.e., include any custom functions), so I can see what you have done and provide feedback. The Matlab code must be provided *in addition to* the above written report; comments in the M-files are very welcome, but they do not substitute for the report.

All of this should be packaged in a single archive file (.zip or .hqx). Please include your last name, as part of the file name - e.g. Smith_603_Assign.zip