HW 1; EPSS 171 Winter 2019

Advanced Computing for Geoscience Types
6 Total Course Points

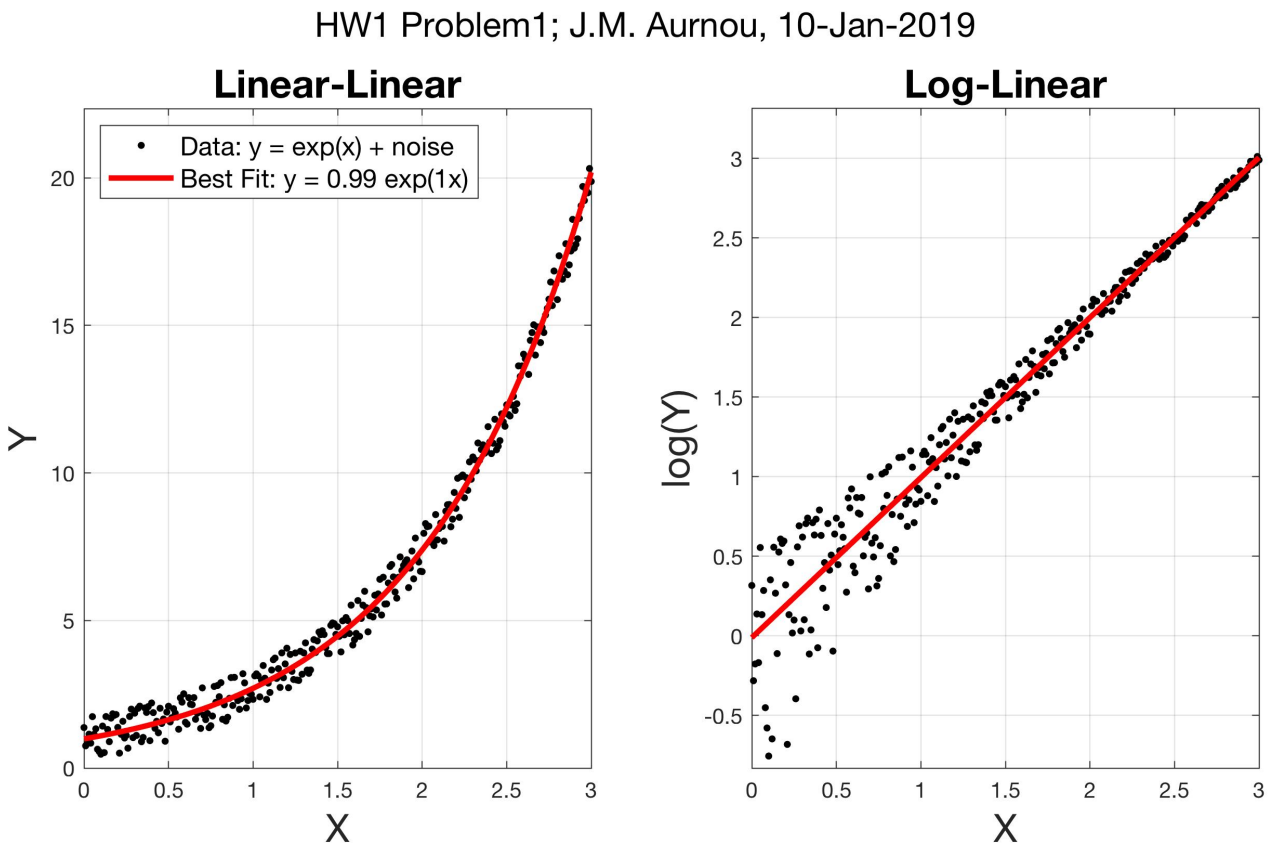
Write a separate script for each problem. Submit the script, its published PDF (i.e., >>help publish), and a ~250 dpi PNG for each figure. Label all your files *YourLastName_HW1Prob#.###*.

DUE: Wednesday, January 16th, 8:00 pm

(with 10% off the final score for every hour it is turned in after 8pm).

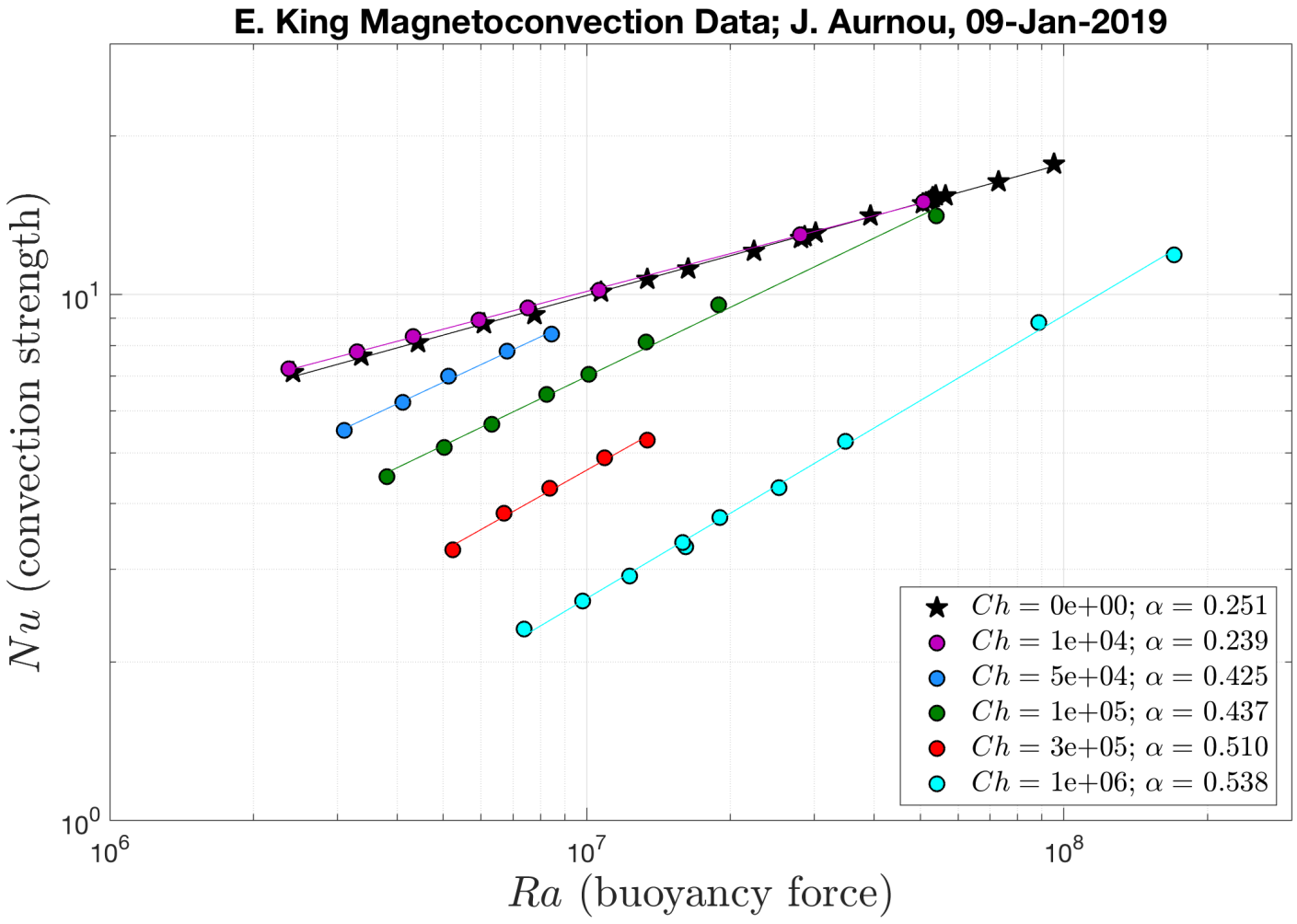
PROBLEM 1 (2 points): Data Fit. Use the command '>>load HW1Prob1_ExptlData.mat;' to import the data into Matlab (or you could use >>uiimport). This will load two vectors into Matlab, x = [0:0.01:3] and y=exp(x) (plus noise). Plot the raw data and then use polyfit to make a best fit, yfit, to the data. You may have to look online or in the reserved Matlab book [Gilat, section 8.2.2] how to use polyfit to fit an exponential.

End Product: Use subplot to make plots showing y and yfit vs. x (left panel) and then log(y) and log(yfit) vs. x (right panel). Also, please include a grid and legend boxes with best fit reported (use num2str), and a supertitle (sgtitle).



PROBLEM 2: Magnetoconvection Data (4 points). For this problem, you will work with a data set of about 50 liquid metal convection experiments made in the presence of a magnetic field (carried out by Eric King in about 2010). (Convection occurs when hot fluid rises and cold fluid sinks, like on a pot on the stove. We were simulating convection in Earth's molten iron core.) The data, contained in the file "MCData.mat" is made up of 3 vectors: the first is Rayleigh (Ra), the second is Chandrasekhar (Ch) and the third is Nusselt (Nu).

The **Rayleigh (*Ra*)** number describes the strength of the buoyancy forces driving the convection. The **Chandrasekhar (*Ch*)** number describes the strength of magnetic damping on the convection. The **Nusselt (*Nu*)** number estimates the strength of the resulting convective fluid motions through the rotating tank of fluid. (When there is no convection, its value should be unity.)



Your job here is to make the plot above. The data is grouped into 6 groups of Chandrasekhar values (with approximately, but not perfectly, equal values of ***Ch*** for the members of each group). You will first (log-log) plot the ***Ch***=0 data as black stars and then, within a clean for-loop, overplot the other groups as different color-filled circles. In addition, you will generate power-law fits (e.g., Gilat 8.2.2) to each ***Ch*** data set, overplotting the fits as thin solid lines. In the legend, the mean value of ***Ch*** and the best fit power law exponent (Greek alpha in my plot) are to both be reported.

How to do all this:

1) Create a new script, *YourLastName*_HW1_Prob3.m. Have it do the following.
2) Load MCdata.txt into Matlab.
3) Make a string or cell array of your colors.
4) Create a single for-loop that carries out the following:
    1) On each pass through the loop, isolate the appropriate ***Ch*** values of each ***Ch*** data set. (I used logical vectors to do this.) And then calculate the mean ***Ch*** value for each group.
        1) **All sorting of the data MUST be done within the loop. Scripts that parse the data "by hand" will not be graded.**
    2) Make a log-log plot of the ***Nu***-***Ra*** data in that ***Ch*** group.
        1) Only the ***Ch***=0 data is star symbols. The rest are circles.
        2) I created a vector of handles, hline, one for each loglog plot that was described in the legend.
    3) Find the best power law fit for the ***Nu***-***Ra*** data in that ***Ch*** group. (I did this with a User-Defined Function [aka, UDF].)
    4) Plot the best fit power law as a thin line atop the data, as shown.
    5) Make a cell array whose i^th entry is a text string of the mean **Ch** value and best fit exponent value (as shown in the legend above).

5) After the loop, label the axes and add a title.
6) Then create the figure legend. Note that I used the vector of handles, hline, to control which entries were reported in the legend. (An explanation of how to include/exclude lines from legends is Google-able.)
7) Write the final figure to a 250-dpi PNG file, *YourName*-HW1Prob2-W19.png.
8) Once your script is completed, publish it to a PDF. (NB: This cannot be done from within the script itself.)