PHYS 352 – Assignment 5

Due: Weds., Mar 2, midnight

Submit code solutions and the .png's, .sh's, .plt's, and any test requested below. **Source files for your main executables** should be named "assignment5_X.c", where "X" corresponds to the question numbers. Include your name enclosed in C comment tags (ie: `/*YourName*/`) at the top of each program. Create a zip archive containing all of your files, name it "assignment5_YourLastName.zip" (with the appropriate name replacement) and copy it to your homework directory under /projects/e20271.

1. **Bifurcation : Exercise 3.20 (5 pt.)**

   From the text: "Calculate the bifurcation diagram for the pendulum in the vicinity of $F_D = 1.35$ to 1.5. Make a magnified version of the diagram (as compared to Figure 3.11) and obtain an estimate of the Feigenbaum δ parameter.

2. **Find the Higgs (10 pt.)**

   This problem involves the use of the non-linear least-squares approach reviewed in the lecture. Please see the slides for additional information regarding the problem. and on the GSL software package. The raw data to fit is contained in `https://github.com/KristianHahn/Phys352/blob/main/lecture13/data/higgs.dat`.

   (a) Implement a 2-parameter exponential function (and Jacobian) and fit this to the Higgs data using the NLLS GSL routines. Plot the fitted exponential on top of the Higgs data. Your best-fit values for the exponential parameters should be similar to those shown in lecture.

   (b) Next, implement the 3 parameter Gaussian signal model (and Jacobian), and fit the sum of this + a background component fixed to the best-fit exponential found above. Plot the fitted "signal + fixed background" function and the fixed background function on top of the data. Your best fit signal parameters should be close to those shown in class.

   (c) Finally, perform a full signal (3-parameter Gaussian) + background (2-parameter exponential) fit with 5 free parameters. Compare the results to what you obtained from the signal + fixed background fit and comment on the differences.