Problem 3:   Data-smoothing with Savitzky-Golay

Pertinent reading for Problem 3:

The wiki page for Savitzky-Golay   (it's actually the best source for this topic !)

https://en.wikipedia.org/wiki/Savitzky%E2%80%93Golay_filter

Perform a 51-point, cubic local least-squares fit

For this problem, we will use a 51-point cubic model for our Savitsky-Golay filter:

Data window   *Local polynomial model*

$$m = 51 \qquad\qquad y_{local}(z) = a_0 + a_1\,z + a_2\,z^2 + a_3\,z^3$$

The input data is a pulse oximeter measurement of me (yup !!) breathing in / out periodically for a brief period of time. You are given:

    a) Time axis (seconds), each data point are separated by a constant $\Delta t = 1/18$ seconds

    b) Laser intensity (arbitrary units) through my left thumb, measured by the oximeter !
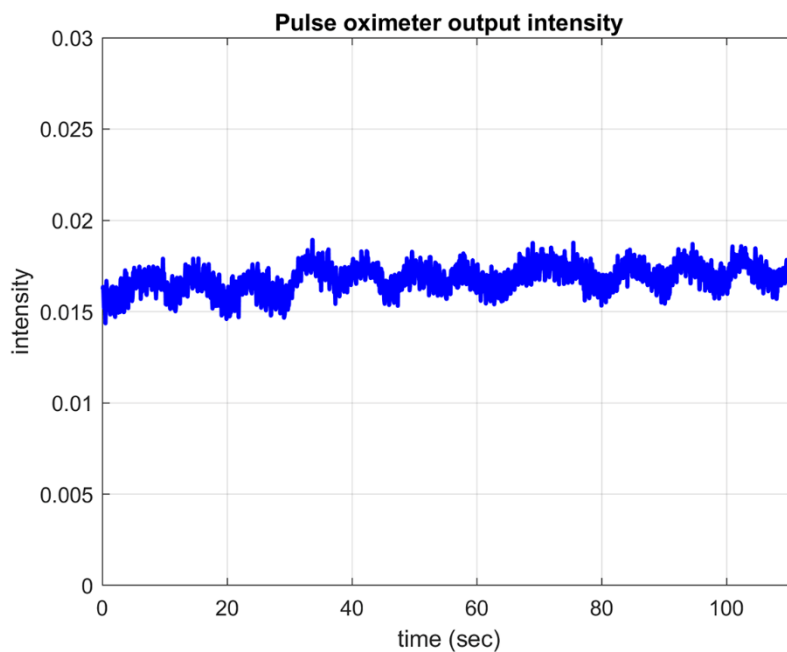

Figure 1: Pulse oximeter data of my left thumb - *measured by Raeef Istfan, Robyler lab*

The data is quite noisy, and your job is to clean it up with a Savitzky-Golay filter !   =)

Your tasks:

1) Using matlab's *textread* command, load the data file

'my_breathing_data_singleChannel.txt'

2) Make this dataset smooth by applying your 51-point, cubic Savitzky-Golay routine.

Hint #1: *You will NOT be able to derive the intercept term a_0 for a 51-point least-squares fit ! Just don't do it......*

Hint #2: Be sure you add your "mirror-imaged ghost nodes" on the left and right boundaries of the dataset.   To round-up or round-down numbers, you should Google the floor and ceil functions.

Hint #3:   Since you're gonna have repeated least-squares fit, you should definitely think about coding the least-squares portion of your program in a small, separate function…..   and then, let the main program call it over and over again.

3) Let's plot your results !

   a) Using the *plot* command, plot the original data. Pick whatever color you want, but make the Linewidth of the plot = 2

   b) Then, overlay your filtered data on top. Pick a different color, and make your filtered data's Linewidth = 1 (thinner)

   c) Add a legend to differentiate between the 2 curves

4) Finally, echo the following values for your post-smoothed output:

   $Time\ point\ sec$:   9.00 $thru$ 10.00

   $The\ post-filtered\ output\ vaues$:   ⋯   ⋯