Programming Assignment 1 – Part 1: Developing a platform for capturing 2D demonstrations

Due: Monday, February 8th 11:59pm

The objective of the first part of this assignment is to develop a graphical user interface that allows a human teacher to perform a set of 2D demonstrations. The platform should be programmed using Python 3.x and should include the following minimum requirements:

a. User can use the computer mouse to perform the demonstrations
b. User can specify the number of demonstrations (either before or during the process)
c. GUI captures raw data (data must include position of the points in 2D but you can consider capturing other information such as time, velocity, acceleration, etc.)
d. User can select or deselect any demonstrations, and save data into a file.
e. GUI should be capable of smoothing the noisy demonstrations if the user requires. However, the user should be able to save both raw and smoothed demonstrations.
f. GUI should be able to read and plot a saved file that was recorded before and includes data.
g. It would make the process of providing demonstrations much easier and more convenient if the user can observe the previous demonstrations while providing a new demonstration. However, the previous demonstrations should not distract or confuse the user when providing a new demonstration.

File format

You can use a simple `txt` file with `ASCII` encoding and separate each individual datum with a pre-specified delimiter (e.g. space, comma). The best and most conventional file formatting used for this purpose is `h5` which is a data file saved in the Hierarchical Data Format (HDF) and contains multidimensional arrays of data. You can use the `h5py` library for this purpose (https://docs.h5py.org/en/stable/high/file.html).

Trajectory Smoothing

Several trajectory smoothing methods based on various mathematical methods exist. One of the commonly used methods is interpolation where you first fit a smooth curve to the raw data and then resample a set of new datapoints using the curve equation. The user should be able to set the number of samples in each interaction. Several types of curves such as polynomials, splines, piecewise-splines, and B-splines can be used for interpolation. You can use `scipy.interpolate` for this part of the assignment (https://docs.scipy.org/doc/scipy/reference/tutorial/interpolate.html).

Python Packages

You are allowed to use `numpy`, `scipy`, `h5py`, and `pygame` for this assignment. Use of any other library should be discussed first.

Submission: By 11:59pm on Tuesday February 8th 2021, submit **only** one python file through Blackboard. Make sure your code is entirely contained within this file. The final version of the GUI should be submitted by 11:59pm on February 15th 2021.