CS 4970 - Parallel Programming

Assignment 7 - Due 2021.10.15

Overview:

The purpose of this assignment is to modify your functioning finite difference program from Assignment 6.

Background:

Your current Assignment 6 program does the following:

(1) Load a data file generated in Mathematica from a .dat file in your working directory
(2) Uses a command line argument to allow the user to state the number of points in the data set.
(3) Computes Δx and performs the finite-difference scheme on the data set.
(4) Exports the data in the same method that it was imported, but to a different file.

Assignment:

When using the second data set from Assignment 6, you should have noticed a problem at $x = 0$, as the function the data was derived from was not differentiable at that point. You are to modify Assignment 6 to do the following:

(1) Have a second command line argument, with values 0 and 1.
(2) If the value is 0, then your code should run exactly as in Assignment 6.
(3) If the value is 1, then the program will look for a *third* command line argument which is a double corresponding to an x-value.
(4) If this x-value is in the range of the x-values for your data set, the process which contains the point closest to this x-value will treat this entry in the data set as a break in the differentiation process.
(5) If the x-value is actually in the data set, set the derivative there to zero. Else, treat the two points for which the x-value lies between as end points of intervals. (I.e. the point immediately to the left of the x-value is the right endpoint of an interval, and the point immediately to the right of the x-value is the left endpoint of an interval. In this case, there is no need to set any point's derivative to zero.
(6) Run your new code on the second data set and see if your new results are more accurate than those from Assignment 6.

To expand on item 5, for this given value of x, to compute any finite-difference derivative to the left of the point, assume there is no data to the right of the x-value, thus treating this x-value (or if it is not a point in the array, the point to the left of the x-value) as the right-most point in the data set for the affected points in the array. Similarly, for data to the right of this x-value, assume that it is the left-most point in the data set (or the point immediately to the right of the x-value if it does not lie on a point in the data set). Thus, you will have to use the non-centered finite-difference formulas for three points on either side of this x-value, just as you would for a true first or last entry of a data set.