Fisi 4125 *24 de febrero de 2021*

Universidad de Puerto Rico
Recinto Universitario de Mayagüez
Departamento de Física
Laboratorio 6

Instrucciones: Para entregar en o antes del miércoles, 24 de febrero de 2021 antes de las 11:59 PM. (10 puntos = 100%).

Exercise 4.3 Calculating Derivatives

Suppose we have a function $f(x)$ and we want to calculate its derivative at a point x. We can do that with pencil and paper if we know the mathematical form of the function, or we can do it on the computer by making use of the definition of the derivative:

$$\frac{\mathrm{d}f}{\mathrm{d}x} = \lim_{\delta\to 0} \frac{f(x+\delta) - f(x)}{\delta}.$$

On the computer we can't actually take the limit as δ goes to zero, but we can get a reasonable approximation just by making δ small.

a) Write a program that defines a function `f(x)` returning the value $x(x-1)$, then calculates the derivative of the function at the point $x = 1$ using the formula above with $\delta = 10^{-2}$. Calculate the true value of the same derivative analytically and compare with the answer your program gives. The two will not agree perfectly. Why not?

b) Repeat the calculation for $\delta = 10^{-4}$, 10^{-6}, 10^{-8}, 10^{-10}, 10^{-12}, and 10^{-14}. You should see that the accuracy of the calculation initially gets better as δ gets smaller, but then gets worse again. Why is this?

We will look at numerical derivatives in more detail in Section 5.10, where we will study techniques for dealing with these issues and maximizing the accuracy of our calculations.

Instrucciones para Entregar sus Laboratorios

1) Prepare un archivo en pdf con la información que pide el ejercicio. Por ejemplo, si el ejercicio pide que escriba un programa, deberá mostrar su programa. Si el ejercicio pide output para un input dado, deberá mostrar el input y el output. Este archivo lo subirá a la plataforma Moodle del curso.

2) Suba también en archivos separados los programas usados para la hacer la asignación a la plataforma Moodle.