EART119 – HW#4
Derivatives and root finding

1. Debugging:
   Download the python script: "`Hw_4a_with_errors.py`" from Canvas. Find all errors in the code and run it in spyder. **Submit the fixed code on Canvas!**

   8 points

2. Find the intersection (cross-over point) between the following two functions using Newton's or the Secant method (Hint: solve for $f(t) - g(t) = 0$)!
   - $f(t) = c(t - t_0)^2$, with $t_0 = 2.5$, c = 1.1, and $-10 \leq$ t ≤ 10
   - $g(t) = At + t_0$, with $A = 5$, and $-10 \leq$ t ≤ 10
   a) How many cross-over points are there for $-10 \leq$ t ≤ 10?
   b) What are the values of t, $f(t)$ and $g(t)$?
   c) Compare your solutions with the solution from week 2 (in class assignment inC_2_1_vec_matrix.pdf, functions and vectors). For the comparison: plot $f(t) - g(t)$ and one of the cross-over points detected with both methods. You may have to zoom a bit to see the difference. Save the plot as .png and submit to canvas.

   Submit your answers and the png file on canvas!

   10 points

3. Modify the function we developed in class for Newton's method so that the iteration (while loop) stops if following convergence criterion is met:

   $$f\left(x_0^{i+1}\right) - f\left(x_0^{i}\right) < \varepsilon,$$

   with ε being some small number e.g. 1e-6

   Upload the new function as python file on canvas!

   4 points

4. Find the root of the following functions using the Secant method:
   a. $f_1(x) = -x^5 + \frac{1}{3}x^2 + \frac{1}{2}$, with -10 < x < 10
   b. $f_2(x) = cos^2(x) + 0.1$, with -10 < x < 10
   c. $f_3(x) = \sin(x/3) + 0.1(x + 5)$, with -3 < x < 3

   Submit your answers and python script.

   10 points

5. Download the following data file from canvas: `HW4_vertTraj.txt`. This file represents the position, *z*, of an object on a vertical trajectory as a function of time. Compute the velocity (d*z*/d*t*) and acceleration (dz^2/d^2t) at every point in time using a central difference approach. **Create three different subplots of position, velocity and acceleration as a fct of *t* and save the figure as .png.**

   8 points