Worksheet 2: Root finding

If you are using Julia or Python, we recommend using a jupyter notebook. In WeLearn, you need to submit this file. Please clearly indicate in the markup cells, the number of the question for which you are writing the program. Also, please remember to add documentation through comments in your program.

You may also use scripts and use REPL to evaluate them. In that case, please keep all your files for a particular worksheet in a folder and you may upload the compressed archive of that folder.

Please feel free to ask for help!

1. (9 points) Use bisection, Secant and Newton-Raphson to solve the equation $3x = \tan(x)$
2. (3 points) Given a particle is moving in the potential $V = -(x^4 + x^3 + x^2 + x + 1)$, find out the point of equilibrium for the particle. Use Newton-Raphson Method (numerically) to find out the root of the equation you find out. Use -0.5 as your initial guess.
3. (8 points) Consider a particle moving in an asymmetric one-dimensional double-well potential $V(x) = x^4 + \left(\frac{2x}{3}\right)^3 - x^2$ eV with a total energy -0.125 eV. You need to find the turning points for the particle when it is in either potential well. Your result should be accurate (in terms of position, not the value of the energy) upto 5th decimal place. [Hint: plot and choose appropriate initial conditions.] Use the following methods.
   (a) (4 points) Bisection
   (b) (4 points) Secant