UNIVERSITÉ DE MONTPELLIER

FACULTÉ DES SCIENCES MONTPELLIER

M2 Modélisation et Analyse Numérique
UE Programmation 2 - 2022/2023

CC 1 - Language basics and functions

les fichiers à rendre à l'issue de cette évaluation sont indiqués en rouge. merci de respecter la dénomination demandée. Certains fichiers headers sont fournis dans le dossier /CC1

The Newton–Raphson method is often used to solve nonlinear equations of the form $f(x) = 0$. This is an iterative algorithm: given an initial guess x_0, successive iterates satisfy:

$$x_i = x_{i-1} - \frac{f(x_{i-1})}{f'(x_{i-1})}, \qquad i = 1, 2, 3 \ldots$$

In this exercise, we will apply the Newton-Raphson algorithm to the function $f(x) = \exp(x) + x^3 - 5$, with initial guess $x_0 = 0$.

(1) By using a **for** loop, and an array for the iterates x_i, write a newton_1.cpp program that implements the Newton-Raphson method for $i = 1, 2, 3, \ldots, 100$. Print out the value of x_i on each iteration, and confirm that the iteration does converge as i increases (at this stage, do not worry about terminating the iteration when ϵ is sufficiently small),

(2) It is not necessary to store the value of x_i on each iteration to implement the Newton-Raphson algorithm. All that is needed is the previous iterate, x_{i-1}, and the current iterate, x_i. Modify your code (and rename it to newton_2.cpp) so that the array representing x_i , $i = 1, 2, \ldots, 100$ is replaced by two scalar variables, x_{prev} and x_{next},

(3) in a newton_3.cpp program, modify your code so that, by use of a **while** statement, the iteration terminates when $|x_{\text{prev}} - x_{\text{next}}| < \epsilon$. Investigate the use of different values of ϵ,

(4) Now, separate the algorithm from the main() function: place the Newton-Raphson alrorithm in a dedicated function, with the use of two additional files: func_newton.cpp and func_newton.hpp respectively for the definition and declaration of the function. A newton_4.cpp main program is provided and should be used to check the validity of your new function.

Fin du sujet.