Universidad Industrial de Santander, Colombia
Numerical Analysis, 2019-1
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Lab 2. Bisection Method

1 Instructions

- Make a **pdf** report including the solution to each point of the practice with name *Lab2_name_lastname.pdf*.
- Send all files in a rar o zip file with name *Lab2_name_lastname.rar* to **analisis-numero@outlook.com**. Write in the subject **LAN 2019-2 Lab 2**.
- You are allowed to use internet, notes, and .m files that you have created before.

2 Implementing

- (1.5 points) Create a Matlab function called *my_finding_interval_name_lastname()* to find two adequate initial points $[a, b]$ given a function $f(x)$. Make a script called *run_2a_name_lastname.m* in which you use the created function with and example (start the search at 0).
- (1.0 points) Create a Matlab function called *my_bisection_function_name_lastname()* to find the root of a function. The arguments of the function must be: the function to be evaluated $f(x)$ (as an inline function), the initial points $[a, b]$, and the stopping criteria (the number of iterations or the relative error). Make a script called *run_2b_name_lastname.m* in which you use the created function to solve any example. For instance,

  fun = @ $XXXXXX$;
  a=XX;
  b=XX;
  Iter=X;
  root=my_bisection_function_name_lastname(fun,a,b,Iter);

- (1.5 points) Given the function $f(x) = (x - 8)(x - 3)^2$ use your script to find each one of the roots. Compare the theoretical number of iterations N with respect to the practical number of iterations when the stopping criteria is established as $\epsilon = 1e^{-2}, 1e^{-4}, 1e^{-6}, 1e^{-8}, 1e^{-10}$. Plot the results where the x-label corresponds to the value of epsilon, and the y-label corresponds to the number of iterations for both cases: theoretical and practical. Conclude about the figure.
- (1.0 points) Create a Matlab function called *my_visual_bisection_function_name_lastname()* to visualize the behaviour of the Bisection method. The arguments of the function must be: the function to be evaluated $f(x)$ (as an inline function), the initial points $[a, b]$, and the number of iterations. Make a script called *run_2d_name_lastname.m* in which you use the created function to visualize the behavior of the bisection method when solving any example and conclude about the convergence of the method. For instance,

  fun = @ $XXXXXX$;
  a=XX;
  b=XX;
  Iter= XX
  P=my_visual_bisection_function_name_lastname(fun,a,b,Iter);

2.1 Interpreting

When the mortality rate is neglected, the world population N can be simulated by a function that grows in proportion to the number of individuals existing at any time t. Also, if λ is the growth rate, φ is a coefficient that simulates the immigration, and N_0 is the population at the beginning of the simulation, the function to determine the quantity of individuals at any time t is given by

$$N(t) = N_0 e^{\lambda t} + \varphi \frac{e^{\lambda t} - 1}{\lambda} \tag{1}$$

Assume that in $t = 0$ the world population has 1500 individuals, also assume that the inmigiriation rate is of 475 individuals per year, and after one year ($t = 1$) the population has amounted to 2264 individuals.

- (0.2 points) Determine a nonlinear equation $f(\lambda) = 0$ to calculate the growth rate λ by finding its root. $f(\lambda) =$____
- (0.8 points) Make a script to find the root of the nonlinear equation $f(\lambda) = 0$ by using the created function in 2. Also plot the function between $\lambda = 0.01$ and $\lambda = 1$.