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Assignment Number: 1

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Course: MA311M (Scientific Computing)

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How to run the code:

Language: Python

Requirements: Libraries such as Numpy , Matplotlib and math are required.

Running: Can simply upload the .ipynb file attached on jupyter notebook or on google colab and run all at once.

Question 1: Firstly we will find the guess value of the root by using the bisection method and running three iterations of the same, considering An = 0 and Bn = 1 as the upper and lower bounds for the root and also checking f(0)*f(1) <0 and perform the iterations by finding Cn = An + (Bn-An)/2.

- After 3 iterations on bisection method we get guess value of root = **0.625.**
- Considering the tolerance of 1e-5 in the error using NMR , we get the saturation value after 2 iterations only:
  1) Iteration 1: x0 = 0.625 -> x1 = 0.58798 , error = 0.000765
  2) Iteration 2: x1 = 0.58798 -> x2 = 0.58853 , error = 1.68 * 1e-7
- Final value of root = **0.58853**
- The last part boils down to show that the order of convergence is 2(quadratic in nature):
  1) First condition in our problem is satisfied as f(m) * f(n) = -0.473592 (<0) with m=0 and n=1.
  2) f(x)!=0 for all x in [m , n]as can be shown in Plot1 in python file. Also, from Plot 1 f'(x) takes -ve values in [0,1].
  3) f''(x) > 0 or <0 in [m , n]. As can be seen in Plot2 in python file f''(x)>0 in [0,1] and this condition is satisfied.
  4) Here m = 0 and n = 1 therefore m-n = 1, and abs(f(a))/ abs(f'(a)) = 0.50 (< (m-n)) ,also abs(f(b))/ abs(f'(b)) = 0.52147 (< (m-n))

  Therefore all the 4 conditions satisfy for quadratic convergence.

Question 2: Solving the equations with x = 1 and y =2 and tolerance = 1e-3.

Following is printed on executing the code:

1) Iteration = 0 , Xn =1 , Yn = 2, error = 0.134279
2) Iteration = 1 , Xn =1.079665 , Yn = 1.945385, error = 0.008145
3) Iteration = 2 , Xn =1.086138 , Yn = 1.943713, error = 7.72 * 1e-5

Finally **Xn =1.086138 , Yn = 1.943713**

The execution stops here.