Bisection method

Instructions

1. ***Use Python3***
2. ***Use any editor of your choice (eg: Atom) to implement the Algorithm***
3. ***Run your Implementation against the given Test Equations***
4. ***Research and provide additional Test Equations***
5. ***Push the Code and Test Output on Github***
6. ***Publish the link on Moodle***

Aim

Implementation of the Bisection Algorithm in Python

Background

The Bisection method is a simple root finding Algorithm. The root is found by successivly halving the search space for the root until the root is found.

The Algorithm

1. Choose two initial end points a and b such that $f(a)$ and $f(b)$ have the opposite sign. This ensures that the root is inbetween a and b.
2. Estimate the new root c with

$$c = \frac{a + b}{2}$$

3. Calculate the function value at the midpoint, $f(c)$. Check If $f(c)$ is sufficiently close to 0.

- ***IF YES*** then the Bisection has converged and *c* is the root of the function. Print the root and exit.
- ***IF NO*** the Bisection has not converged. Replace the value of a with c if the root is inbetween c and b, otherwise replace the value of b with c if the root lies inbetween a and c.

4. Loop back to step 2

Pseudocode

The Pseudocode for Bisection according to Wikipedia.

```
INPUT: Function f, endpoint values a, b, tolerance TOL, maximum iterations NM
CONDITIONS: a < b, either f(a) < 0 and f(b) > 0 or f(a) > 0 and f(b) < 0
OUTPUT: value which differs from a root of f(x)=0 by less than TOL

N ← 1
While N ≤ NMAX # limit iterations to prevent infinite loop
  c ← (a + b)/2 # new midpoint
  If f(c) = 0 or (b − a)/2 < TOL then # solution found
    Output(c)
    Stop
  EndIf
  N ← N + 1 # increment step counter
  If sign(f(c)) = sign(f(a)) then a ← c else b ← c # new interval
EndWhile
Output("Method failed.") # max number of steps exceeded
```

Assignment

1. Implement the Bisection method in Python
2. Find the roots for the following equations:

   i.

   $$x^2 - 5x - 7 = 0$$

   ii.

   $$x^3 + 8x = 0$$

Reference

https://en.wikipedia.org/wiki/Bisection_method