

Data Structures and Algorithms

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Session: Bisection Method

Introduction

- Finding the root of a nonlinear equation $f(x) = 0$
- Also called binary search method
- Given a function $f(x)$ continuous on the interval $[a, b]$
 - ▶ Let the initial guesses be a and b
 - ▶ The function has at least one root between a and b , if $f(a) * f(b) < 0$
 - ▶ If $f(a) * f(b) > 0$, there may or may not be any root
 - ▶ Guarantees only one root

Algorithm for Bisection Method

Algorithm BisectionMethod($f(x)$)

Input Given a function $f(x)$ continuous on an interval $[a, b]$ and $f(a) * f(b) < 0$

$NMAX$ = max number of iterations

TOL = tolerance limit

$N = 1$

$c = (a + b)/2$

while $N < NMAX$ & $f(c) < TOL$ **do**

if $f(a) * f(c) < 0$ **then**

$b = c$

else

$a = c$

end if

$N = N + 1$

$c = (a + b)/2$

end while

Figure: Bisection Algorithm

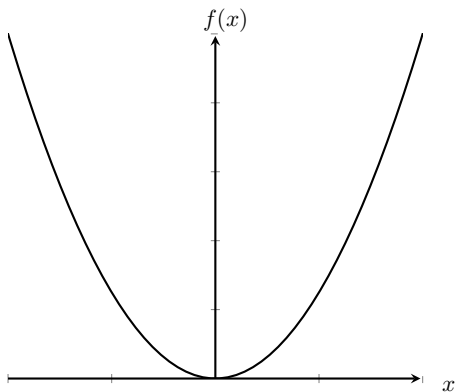
Advantages and Disadvantages

■ Advantages

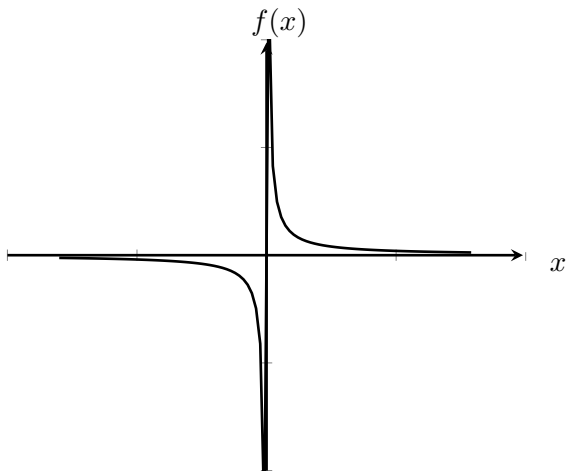
- ▶ The method is guaranteed to converge
- ▶ The search interval is halved for every iteration

■ Disadvantages

- ▶ Convergence is slow
- ▶ If the initial guess is closer to the root, it will take more iterations to converge
- ▶ It may not be possible to find the root for certain equations like $f(x) = x^2$, $f(x) = \frac{1}{x}$, etc.



The equation $f(x) = x^2 = 0$ cannot be solved using this method



The equation $f(x) = \frac{1}{x} = 0$ has no root, but changes sign.

Thank you