

Bisection Method

The Bisection Method is a simple and reliable numerical technique used to find the root of a continuous function. It is based on the Intermediate Value Theorem and works by repeatedly dividing an interval into two halves and selecting the subinterval that contains the root.

Basic Concept

Suppose a continuous function $f(x)$ is defined on an interval $[a, b]$ such that $f(a)$ and $f(b)$ have opposite signs. This guarantees that at least one root lies between a and b . The interval is repeatedly halved until the root is approximated with sufficient accuracy.

Algorithm

1. Choose initial values a and b such that $f(a) \cdot f(b) < 0$.
2. Compute the midpoint $c = (a + b) / 2$.
3. Evaluate $f(c)$.
4. If $f(c) = 0$, then c is the root.
5. If $f(a) \cdot f(c) < 0$, set $b = c$; otherwise set $a = c$.
6. Repeat steps 2–5 until the desired accuracy is achieved.

Stopping Criteria

The iteration is stopped when either the interval length becomes smaller than a given tolerance or the value of $f(c)$ is sufficiently close to zero.

Advantages

- Simple and easy to understand
- Guaranteed convergence for continuous functions
- Does not require derivatives

Applications

The Bisection Method is widely used in numerical analysis, engineering, and scientific computations where a robust and dependable root-finding method is required.