**Root Finding**

The *root* of a function f(*x*) (f:**R** → **R**) is simply some value *r* for which the function is zero, that is, f(*r*) = 0.

This topic is broken into two major sub-problems:

1. Finding the root of a real-valued function of a single variable, and
2. Finding the root of a vector-valued function of a many variables.

There are several techniques which may be used to find the root of a univariate (single variable) function. Among them

1. Bisection method
2. False-position method
3. Newton's method

**Bisection Method:**

The Bisection Method also called the **interval halving method**, the **binary search method**, or the **dichotomy method** is based on the Bolzano’s theorem for continuous functions.

Advantages of Bisection Method:

* One of the simplest root finding methods
* The Bisection Method converges to a solution which depends on the tolerance and number of iteration the algorithm performs.
* For a particular tolerance **we can calculate how many iterations n we need to perform**
* Easy to implement
* Very robust & Straight
* No limitations
* Always get you to the same answer eventually
* Every method is less reliable than bisection
* Solve an equation, to the desired accuracy

Disadvantages of Bisection Method:

* Used as a starting point to obtain a rough value of the solution
* Used later as a starting point for more rapidly converging methods.
* Relatively slow
* Nevertheless is guaranteed to converge at a useful rate, roughly halving the error with each iteration

**False-position method:**

False-position Method is a trial and error method of solving problem by substituting value for the unknown variable and test the function based up on that decide the next interval to find the solution of the equation.

Advantages of False-position method :

* One of the best methods
* Provides an exact solution for linear functions
* Considerably faster than bisection
* Original un-improved version would often be the best choice
* Failure mode is easy to detect:

Disadvantages of False-position method :

* Situations can slow its convergence
* Sometimes doesn't work properly
* Used to calculate only a single unknown in the equation

**Newton-Raphson method:**

The Newton-Raphson method is one of the most widely used methods for root finding. It can be easily generalized to the problem of finding solutions of a system of non-linear equations, which is referred to as Newton's technique.

Advantages of Newton-Raphson method :

* Quadratically convergent as we approach the root
* Very small error
* Very fast convergence.

Disadvantages of Newton-Raphson method :

* Can’t work when the derivative is prohibitively time-consuming to evaluate
* Can fail to find a root under certain circumstances
* May be computationally costly
* Requires a computation of the function's [derivative](https://en.wikipedia.org/wiki/Derivative).