- **The Bisection Method**

The Bisection Method is a successive approximation method that narrows down an interval that contains a root of the function f(x).

1- The Bisection Method is given an initial interval [a..b] that contains a root.

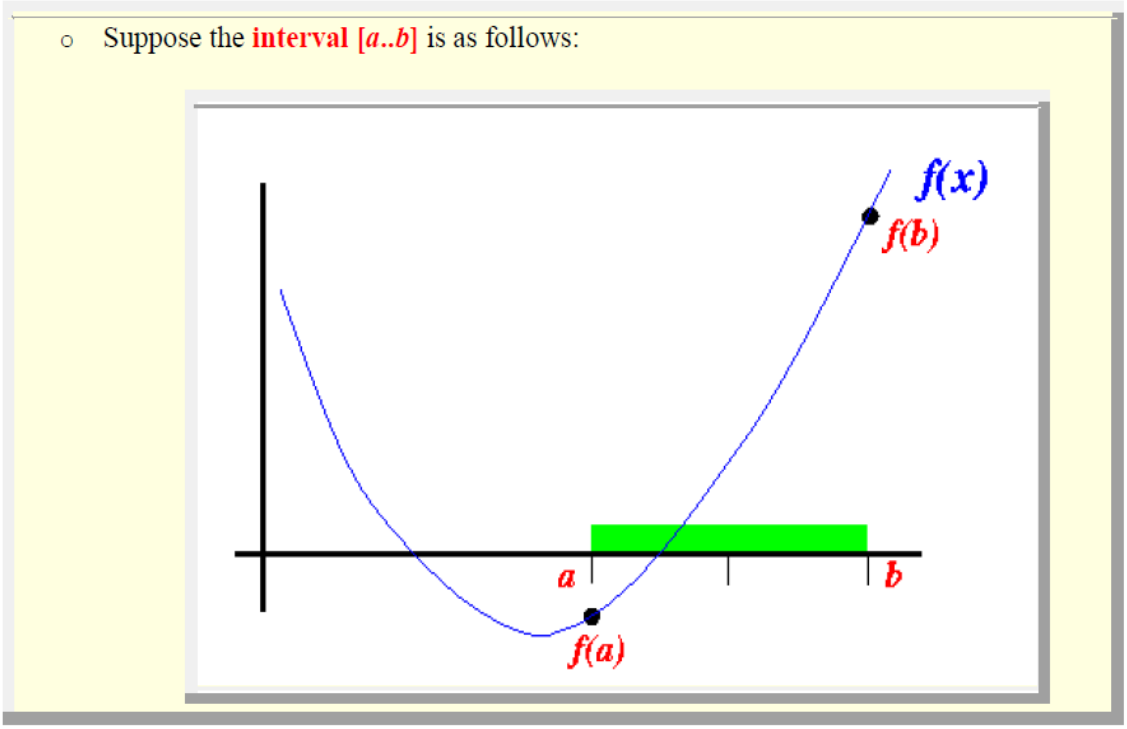
(We can use the property sign of f(a) ≠ sign of f(b) to find such an initial interval).

2- The Bisection Method will cut the interval into 2 halves and check which half interval contains a root of the function.

3- The Bisection Method will keep cut the interval in halves until the resulting interval is extremely small, The root is then approximately equal to any value in the final (very small) interval.

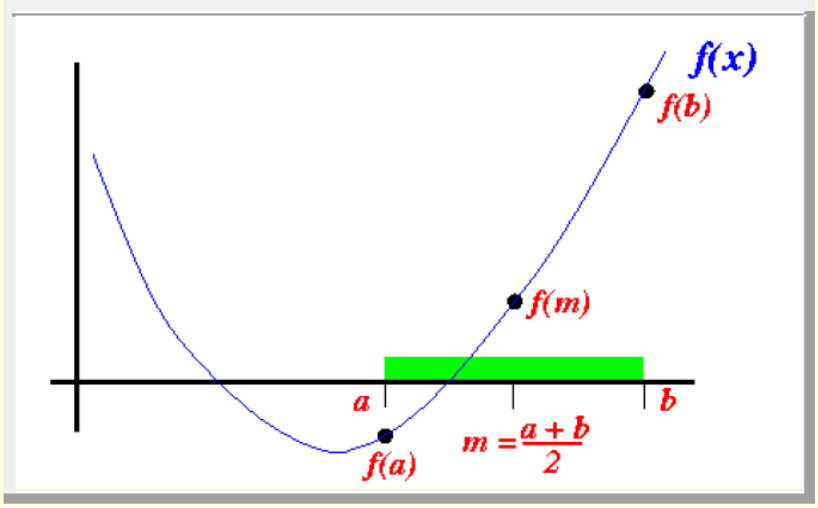
- **How it works:**

Step-1: Find points a and b such that a<b and f(a)·f(b)<0.



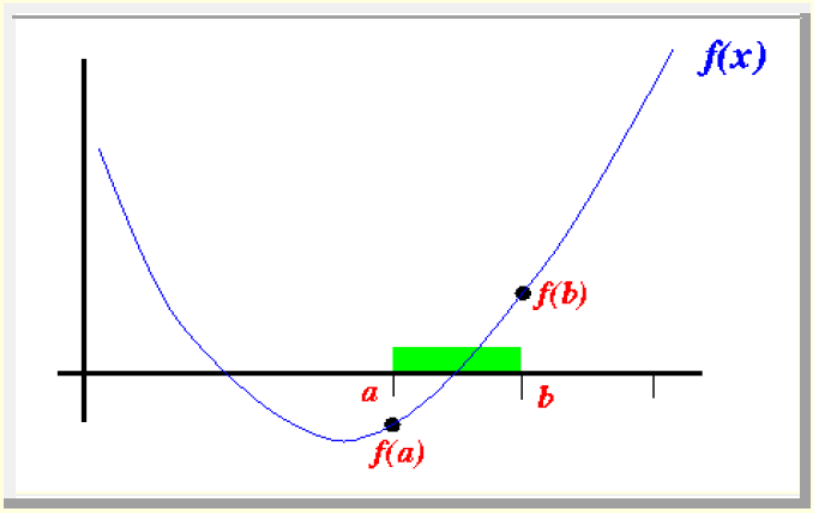
Step-2: Take the interval [a,b] and find next value of bisection m=(a+b)/2.

- We **cut** the **interval** [*a..b*] in the **middle**: *m = (a+b)/2*



Step-3: If f(m) = 0 then m is an exact root,
else if f(a)·f(m) <0 then b=m,
else if f(m)·f(b)<0 then a=m.

- Because **sign of** *f(m)* ≠ **sign of** *f(a)* , we ***proceed*** with the **search** in the ***new*** **interval** [*a..b*]:



- We can use **this statement** to change to the **new interval**:

```
b = m;
```

EX1: Find the root of $x^4-x-10 = 0$ using Bisection Method. Let a = 1.5 and b = 2.

Solution in MATLAB code:

```
ClC
clear all
% define the function
f = @(x)  x^4 - x - 10 ;
% input the interval values [a, b]
a=input('a=')       % a=1.5
b=input('b=')       % b=2
% Bisection Method
c=0;
fprintf(' iter         root    \n')
while abs(b-a)>= 1e-4
    c=c+1;       % counter
    w=(a+b)/2;   % midpoint

    if f(w)==0
       fprintf('%3d     %12.8f    \n',c,w )
       break;

    elseif sign(f(w)*f(a))==-1
        b=w;   % update b value
    else
        a=w;   % update a value
    end
   fprintf('%3d     %12.8f    \n',c,w )
end
```

iter	root
1	1.75000000
2	1.87500000
3	1.81250000
4	1.84375000
5	1.85937500
6	1.85156250
7	1.85546875
8	1.85742188
9	1.85644531
10	1.85595703
11	1.85571289
12	1.85559082
13	1.85552979