1985

جامعة محمد بوضياف - المسيلة
Université Mohamed Boudiaf - M'sila

2019-2020, Bachelor 2ND Year (L2)
Faculty of Technology
Depart: Electronic Engineering

Class: Numerical Methods Lab

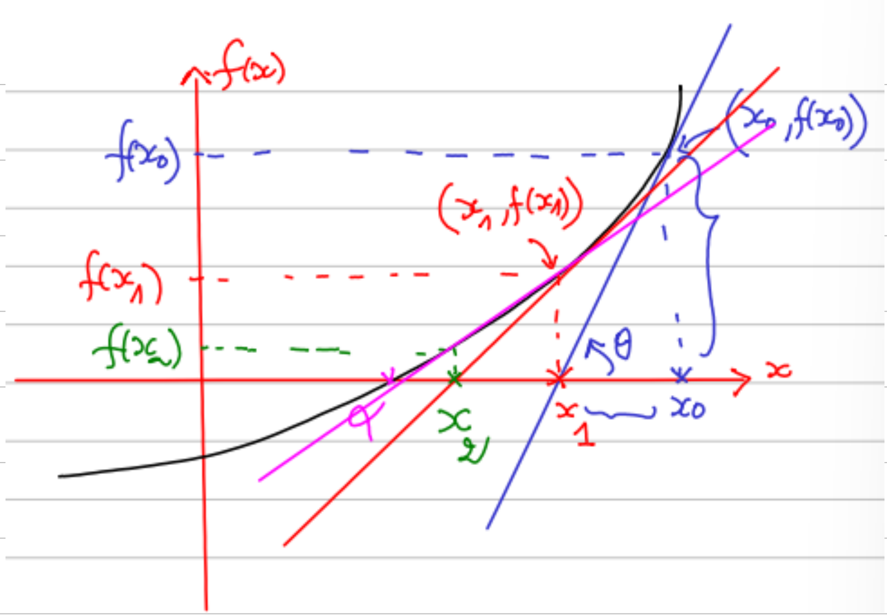
Lab 4 : Newton method

The objectives of this lesson:

- Understand the bisection method.
- Write an algorithm/flowchart for this method.
- Write a Matlab script for this method.
- Be able to apply this method to solve a non-linear equation $f(x) = 0$.
- Be able to use various stopping criteria to exit the algorithm of the bisection method.

Basic ideas and fundamental concepts:

$$\left.\begin{array}{l} f(x) = 0 \\ \text{search } \alpha \\ \text{s.t } f(\alpha) = 0 \end{array}\right\}$$



$$tg\theta = \frac{f(x_0) - 0}{x_0 - x_1} = f'(x_0)$$

$$\Rightarrow \quad \boxed{x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}} \quad \text{———} \quad (1)$$

Following the same steps, one can write

$$x_2 = x_1 - \frac{f(x_1)}{f'(x_1)}$$

$$x_3 = x_2 - \frac{f(x_2)}{f'(x_2)}$$

$$\vdots$$

An algorithm for the method

we can generelize Eq ① to get

$$x_{k+1} = x_k - \frac{f(x_k)}{f'(x_k)} \qquad \text{―――} \qquad \textcircled{1}$$

This formula concerns Newton's method .

NB. One can also derive the same formula as in Eq ①, by performing a Taylor's series expansion near to x_0. It means

$$f(x) = f(x_0) + \frac{f'(x_0)}{1!}(x-x_0) + \underset{\longrightarrow 0}{R} \quad .$$

Stopping criteria :

Criteria #1. The length of the intrvl. [a,b] <<< → $|a-b| < \varepsilon$

→ Stop if abs(a-b) < epsilon → while (abs(a-b) > eps) ↴

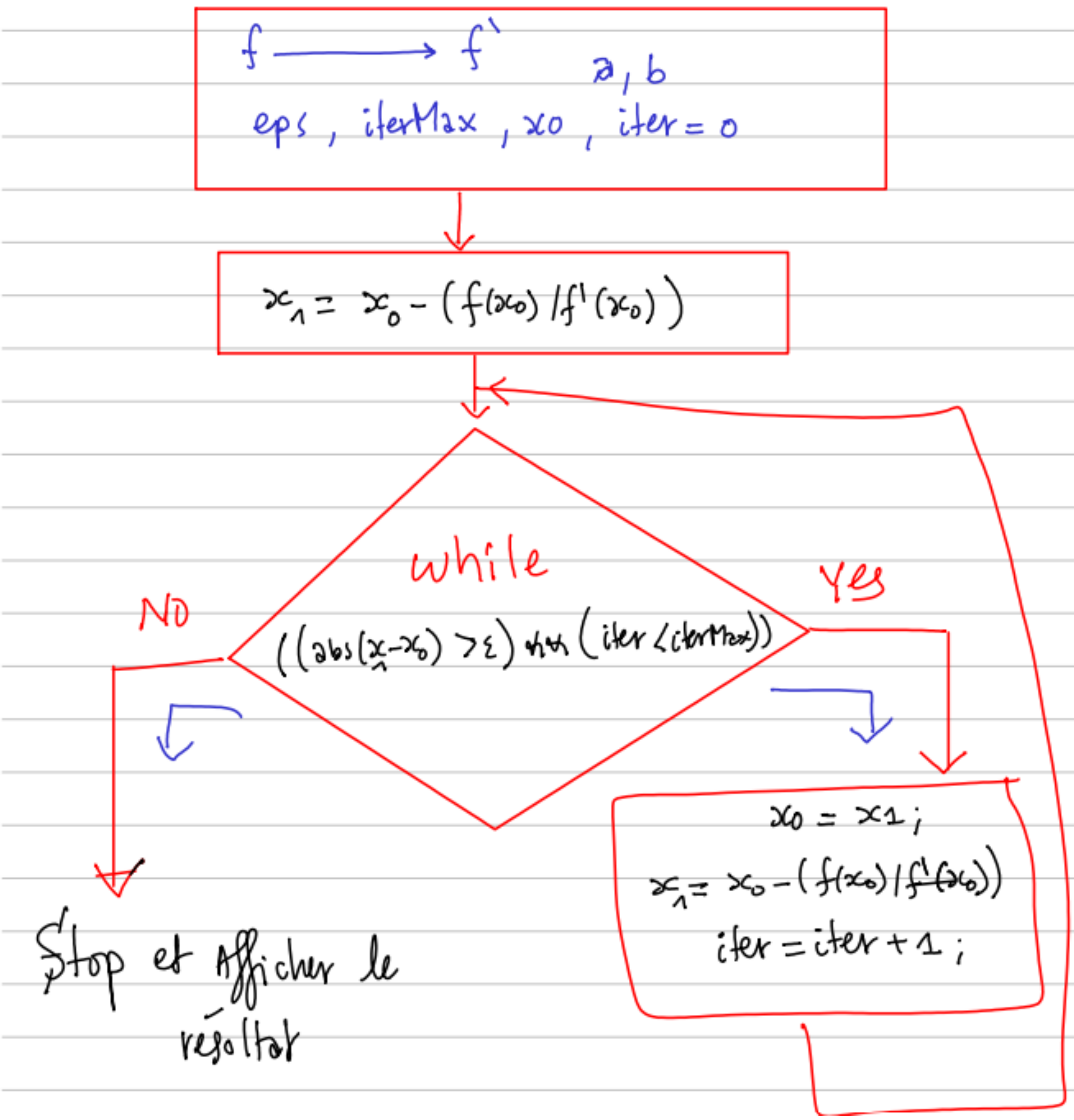
Criteria #2. The number of iterations (MaxIter)

→ for iter = 1 : MaxIter ↴

Criteria #3. Both criteria combined →

while ((abs(a-b) > eps) && (iter < MaxIter)) ↴

A flowchart for the method



f → f'
a, b
eps, iterMax, x0, iter = 0
$x_1 = x_0 - (f(x_0) / f'(x_0))$
while
$((abs(x_1 - x_0) > \varepsilon)$ and $(iter < iterMax))$
Yes
NO
$x_0 = x_1;$
$x_1 = x_0 - (f(x_0) / f'(x_0))$
$iter = iter + 1;$
Stop et Afficher le résultat

Matlab script(s) for the method:

```matlab

f = inline('x.^3 + 4*x.^2 - 10');
fp=inline('3*x.^2 + 8.*x');
a=1;
b=2;
x0 =1.5;
x1 = x0-(f(x0)/fp(x0));
eps=1.0e-6;
iter=0;
if ((f(a)*f(b))< 0)
while (abs(x1-x0) > eps)
x0=x1;
x1 = x0-(f(x0)/fp(x0));
iter=iter+1;
fprintf('For iteration =%d \t , the solution is x0=%f\n',iter,x0)
end
fprintf('The final solution is x0 = %f \n',x0) ;
else
disp('There is no solution in [a,b]')
end
```

```


f = inline('x.^3 + 4*x.^2 - 10');
%--------------------------
fp=inline('3*x.^2 + 8.*x');
a=1;
b=2;
x0 =1.5;
x1 = x0-(f(x0)/fp(x0));

iterMax=10;
if ((f(a)*f(b))< 0)
for iter=1:iterMax
x0=x1;
x1 = x0-(f(x0)/fp(x0));

fprintf('For iteration =%d \t , the solution is x0=%f\n',iter,x0)
end
fprintf('The final solution is x0 = %f \n',x0) ;
else
disp('There is no solution in [a,b]')
end
```