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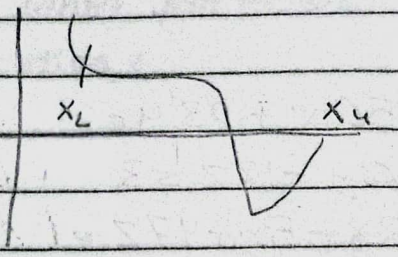
★ Bisection Method (non linear eq.)



$X_L = ○$ $X_u = ○$

$X_m = \frac{X_L + X_u}{2}$

$f(x_L) \cdot f(x_m) < 0$ $X_L = X_L$, $X_u = X_m$

// > 0 $X_L = X_m$, $X_u = X_u$

// $= 0$ Algorithm stop root = X_m

★ Solve $F(x) = x^3 + 4x - 2$ by using bisection method on $[0,1]$

$|\epsilon_s| = 3\%$

$f(x_L) \cdot f(x_m)$

$X_m = \frac{0+1}{2} = 0.5$

n	X_L	X_u	X_m	$\lvert\epsilon_a\rvert$	Sign $f(x_L) \cdot f(x_m)$	
0	0	1	0.5	—	(−)	← $f(0) \cdot f(0.5)$
1	0	0.5	0.25	100%	(+)	← $f(0) \cdot f(0.25)$
2	0.25	0.5	0.375	33.3%	(+)	
3	0.375	0.5	0.4375	14.285%	(+)	
4	0.4375	0.5	0.46875	6.66%	(+)	← $f(0.4375) \cdot f(0.46875)$
5	0.4687	0.5	0.4843	3.225%	(−)	
6	0.46875	0.484375	0.4765	1.6%		← root

★ $f(x) = -0.4x^2 + 2.2x + 4.7$ $[5,10]$

a) Conduct Three iterations to estimate the root of the above eq.

b) find the absolute relative approximate error at the end of each eq.

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$X_l = 5$ $X_u = 10$

n	X_l	X_u	X_m	ϵ	sign
0	5	10	7.5	—	−
1	5	7.5	6.25	20%	+
2	6.25	7.5	6.875	9.09%	−
3	6.25	6.875	6.5625	4.761%	
4					

root = 6.5625

$\epsilon_s = 4.761\%$

★ Sheet → $f(x) = x + \ln x$ $X_l = 0.5$, $X_u = 0.6$

★ Newton Raphson

$$X_{i+1} = X_i - \frac{f(x_i)}{f'(x_i)}$$

Solve by newton raphson

$f(x) = x^2 - \ln(x) - 2$ $X_0 = 1.6$, $|\epsilon_s| = 0.04\%$

$f'(x) = 2x - \frac{1}{x}$

$$X_{i+1} = X_i - \frac{X_i^2 - \ln(x_i) - 2}{2X_i - \frac{1}{x_i}}$$

n	X_n	$\lvert\epsilon_a\rvert$
0	1.6	—
1	1.5650	2.23%
2	1.5644	0.03%
3		

root = 1.5644

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★ $f(x) = x^3 - 3$ $\quad x_0 = 1.8$, $|\epsilon_s| = 0.0008$

$f'(x) = 3x^2$

$$x_{i+1} = x_i - \frac{x_i^3 - 3}{3x_i^2}$$

n	x_n	$\lvert\epsilon_a\rvert$
0	1.8	—
1	1.508	19.32%
2	1.4454	4.354%
3	1.44225	0.190 %
4	1.44229	0.0003%
5		

root = 1.44229 ✓

$\epsilon_s = 0.0003\%$ ✓

★ Sheet

$f(x) = x^2 - 612$ $\quad (x_0 = 10 , n = 5)$