

Intermediate Value Theorem

Let f be a continuous function on the interval $[a, b]$. Then f realizes every value between $[f(a), f(b)]$

Root Finding

Method Title	Requirements on $f(x)$	Convergence info	Notes
Bisection	- continuous on $[a, b]$ - $f(a) \cdot f(b) < 0$	Global, Linear, $s = 1/2$	#n = $\log_2((b-a)/\epsilon_p) - 1$ $\epsilon_p = 0.5^{n+1}$
Fixed Point Iteration	$g(r) = r \Leftrightarrow f(r) = 0$ $x_{i+1} = g(x_i)$ cont. diff.	Local, Linear, $s = g'(r) < 1$	
Newton's Method	-twice cont. diff. -Need $f'(x)$ $x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$	Local, if $f'(r) \neq 0$: quadratic, $s = f''(r)/2f'(r)$. else linear $s = (m-1)/m$.	#n = $((m-1)/m)^n = 0.5^{n+1}$

Error

Forward Error	Backward Error
$ r - x_a $	$ f(r) - f(x_a) $

Factorization

LU	PA=LU
Ax=b	Ax=b
A=LU	PAx=Pb and LUx=Pb
Lc=b	Lc=Pb
Ux=c	Ux=c

Newton's method Error

$$e_{i+1} \sim |f''(r)/2f'(r)|e_i$$

Elimination Method/Operation Count

Naive Gaussian	$(2/3) \cdot n^3$
Back Substitution	$k \cdot n^2$
LU Factorization	$(2/3) \cdot n^3$
Twice Back Substitution	$2k \cdot n^2$

Error Magnification Factor



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Not published yet.
Last updated 3rd December, 2018.
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