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Prelab 5

Method	Input	Iteration	Idea Behind Method	Rate of Convergence	Pros	Cons
Bisection	continuous function f on (a,b) s.t. $f(a)$ has diff sign than $f(b)$	for $x_n \in (a_n, b_n)$ check if f changes sign in (a_n, x_n) (x_n, b_n), repeat till convergence.	IVT	$O(\frac{1}{2^n})$	• Easy to implement • Guarantees convergence if initial conditions met.	• Strict conditions on input • slower convergence than other methods.
FPI	initial guess x_0	$x_n = f(x_{n-1})$ until $x_n - f(x_{n-1}) < TOL$	Move along line $y=x$ until intersection with $f(x)$ since this implies $f(x)=x$.	linearly for $f(x)$ if f is contractive map on $[a,b]$	• No derivative required • Guarenteed convergence if f is contractive map on $[a,b]$	• $f' < 1$ on $[a,b]$ • slower convergence than Newton's method • struggles to find multiple roots.
Newton	twice cont + diff function f, initial guess x_0	$x_n = x_{n-1} - \frac{f(x_{n-1})}{f'(x_{n-1})}$	Uses Taylor approximations to follow tangent lines until convergence.	quadratic if f' at root $\neq 0$, else likely faster.	• If x_0 near solution we get quadratic convergence	• Not reliable if x_0 not near solution. • Must have differentiable function
Secant	Same as Newton's Method	$x_n = x_{n-1} + \frac{f(x_{n-1})(x_{n-1} - x_{n-2})}{f(x_{n-1}) - f(x_{n-2})}$	Similar idea to newtons method except we approximate derivatives instead of direct computation.	≈ 1.618 (Golden Ratio)	• Dont need to compute derivatives like in Newton's method.	• Slower convergence that similar Newton's method.