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APPM4600
Prelab 5

Method	Input	Iteration	Idea behind method	Required for convergence	Pros	Cons
Bisection	- Interval [a,b] - Tolerance - Maximum number of iteration	- Divide the interval [a, b] by two. Check the sign change and update new interval.	- Find the midpoint in the interval where the function changes the sign till finding the root	- The function is continuous. - $f(a)f(b) < 0$	- It is guaranteed that it converges. - It is simple and reliable	- Slow convergence
Fixed point	- Initial guess (x_0) - Tolerance - Maximum number of iteration - A function x = g(x)	- $x_{n+1} = g(x_n) - C(x)f(x_n)$	- Rearrange $f(x) = 0$ to $g(x) = x$, then find the iteration from $x_{n+1} = g(x_n) - C(x)f(x_n)$ till finding the root	- The function is continuous. - The function is a contraction mapping on the interval (The absolute value of the first derivative at a fixed point is less than 1)	- Do not required the derivative function - Can apply to more complicated functions	- Slow convergence if the first derivative at a fixed point is 1 - There are multiple ways to find g(x). It is difficult to find the most efficient g(x)
Newton	- Initial guess (x_0) - Tolerance - Maximum number of iteration - A function f(x) and the f'(x)	- $x_{n+1} = g(x_n) - \frac{f(x_n)}{f'(x_n)}$	- Same as Fixed point, but $C(x) = \frac{1}{f'(x_n)}$	- Initial guess has to be close to the root to converge quadratically. - The function is continuous and differentiable. - The first derivative of the function is not zero in the interval.	- Fast convergence	- Required to find the derivative of the function - Need a good initial guess to converge efficiently.
Secant	- Initial guess (x_0 and x_1 to find the tangent line) - Tolerance - Maximum number of iteration - A function f(x)	- $x_{n+1} = g(x_n) - f(x_n)\frac{x_n - x_{n-1}}{f(x_n) - f(x_{n-1})}$	- Same as Newton, but $f'(x_n) = \frac{f(x_n) - f(x_{n-1})}{x_n - x_{n-1}}$	- The function is continuous. - Initial guess has to be close to the root to converge super linearly.	- Faster convergence than bisection method but slower than Newton - Do not required the derivative function	- Need 2 initial guesses - Converge slower than Newton (with an order close to the golden ratio)