Math 151A - Spring 2020 - Week 5

Today:

- Review of methods and codes
- Questions concerning the midterm

At a glance:

Method	**Purpose**
Bisection Method	Solves for p such that $f(p) = 0$
Fixed-point Iteration	Solves for p such that $g(p) = p$
Newton's Method	Solves for p such that $f(p) = 0$
Secant	Solves for p such that $f(p) = 0$
Method of False Position	Solves for p such that $f(p) = 0$
Modified Newton's	Solves for p such that $f(p) = 0$
Aitken's Method	Solves for p such that $g(p) = p$
Steffensen's Method	Solves for p such that $g(p) = p$
Horner's Method	Evaluate $P(x_0), P'(x_0)$ where P is a polynomial, x_0 given

Bisection Method: Use `bisection.m` and `bisection_ex.m`.

- In `bisection_ex.m`, change *a*, *b*, *tol*, *max_iter*, and *f*
- Current example approximates the root of $f(x) = x - \cos x$ on the interval $[0, 1]$ with tolerance 10^{-4}
- Example summary: "The bisection method approximates the root `p = 0.739075` in `14` iterations with a tolerance `1e-4`."

Fixed-Point Iteration: Use `fixedpoint.m` and `fixedpoint_ex.m`.

- In `fixedpoint_ex.m`, change p_0, *tol*, *max_iter*, and g
- Current example approximates the fixed point of $g(x) = \cos x$ (i.e. the root of $f(x) = x - \cos x$) with initial guess $p_0 = 0.75$ and tolerance 10^{-4}
- Example summary: "The fixed-point iteration approximates the root `p = 0.739129` in 14 iterations with a tolerance `1e-4`."

Newton's Method: Use `newton.m` and `newton_ex.m`.

- In `newton_ex.m`, change p_0, tol, max_iter, f, and f'
- Current example approximates the root of $f(x) = x - \cos x$ with initial guess $p_0 = 0.75$ and tolerance 10^{-4}
- Example summary: "The Newton's method approximates the root `p = 0.739111` in 1 iteration with a tolerance `1e-4`."

Secant Method: Use `secant.m` and `secant_ex.m`.

- In `secant_ex.m`, change p_0, p_1, *tol*, *max_iter*, and f
- Current example approximates the root of $f(x) = x - \cos x$ with initial guesses $p_0 = 0.75$, $p_1 = 0.5$ and tolerance 10^{-4}
- Example summary: "The secant method approximates the root `p = 0.739124` in 3 iterations with a tolerance `1e-4`."

Method of False Position: Use `falseposition.m` and `falseposition_ex.m`.

- In `falseposition_ex.m`, change p_0, p_1, tol, max_iter, and f
- Current example approximates the root of $f(x) = x - \cos x$ with initial guesses $p_0 = 0.75$, $p_1 = 0.5$ and tolerance 10^{-4}
- Example summary: "The method of false position approximates the root `p = 0.739084` in 3 iterations with a tolerance `1e-4`."

Modified Newton's Method: Use `modifiednewton.m` and `modifiednewton_ex.m`.

- In `modifiednewton_ex.m`, change p_0, tol, max_iter, f, f', and f''
- Current example approximates the root of $f(x) = x - \cos x$ with initial guess $p_0 = 0.75$ and tolerance 10^{-4}
- Example summary: "The Modified Newton's method approximates the root `p = 0.73908` in 2 iteration with a tolerance `1e-4`."

Aitken's Method: Use `aitkens.m` and `aitkens_ex.m`.

- In `aitkens_ex.m`, change p_0, *tol*, *max_iter*, and g
- Current example approximates the fixed point of $g(x) = \cos x$ (i.e. the root of $f(x) = x - \cos x$) with initial guess $p_0 = 0.75$ and tolerance 10^{-4}
- Example summary: "The Aitken's method approximates the root `p = 0.739067` in `1` iteration with a tolerance `1e-4`."

Math 151A - Spring 2020 - Week 5

Steffensen's Method: Use `steffensens.m` and `steffensens_ex.m`.

- In `steffensens_ex.m`, change p_0, *tol*, *max_iter*, and g
- Current example approximates the fixed point of $g(x) = \cos x$ (i.e. the root of $f(x) = x - \cos x$) with initial guess $p_0 = 0.75$ and tolerance 10^{-4}
- Example summary: "The Steffensen's method approximates the root `p = 0.739067` in 1 iteration with a tolerance `1e-4`."

Horners's Method: Use `horners.m` and `horners_ex.m`.

- In `horners_ex.m`, change x_0, $\mathbf{a}$, and n
- Current example evaluates $P(x) = 2x^4 - 3x^2 + 3x - 4$ at $x_0 = -2$

Comparing All Root Finding Methods: Use `bisection.m`, `fixedpoint.m`, `newton.m`, `secant.m`, `falseposition.m`, `modifiednewton.m`, `aitkens.m`, `steffensens.m`, and `compare_ex.m`

- In `compare_ex.m`, change a, b, p_0, p_1, tol, max_iter, f, f', f'', and g
- Current example approximates the root of $f(x) = x - \cos x$ (or fixed point of $g(x) = \cos x$) on the interval $[0, 1]$, with $p_0 = 0.75$, $p_1 = 0.75$, and tolerance 10^{-4}

Math 151A - Spring 2020 - Week 5

Questions?