MATH 437 Lab

Zoom W 8:00am – 8:50am

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Updates

- We meet on Zoom now
- Regular Zoom office hours will be W 8:50am – 10:00am (right after lab)
- Typed lecture notes on my website `https://jordanhoffart.github.io/teaching/math437-2026-spring.html`
- Homework 1 due this Saturday Jan 24 11:59pm on Canvas

About homeworks

- Turn in a pdf of answers and code output on Canvas
- I'll try to be specific about what exactly I want turned in for each question. When in doubt, ask!
- Homeworks are 20 points per assignment, following the same grade percentages as the syllabus (A 90% – 100%, B 80% – 89%, C 70% – 79%, D 60% – 69%, F 0% – 59%)
- No late work unless you have a good reason and you let me know before the due date
- Accepted late work gets a 10% grade penalty

Homework 1

- Assignment on Canvas: `https://canvas.tamu.edu/courses/433393/assignments/2937946`
- Fixed-point methods and Newton's method
- 5 questions, let's look at them. I fixed some typos and ambiguities in the problems on the slides, so refer to them here instead of the problem set on Canvas.

Question 1

Let f be a three times differentiable function with a root p and $f'(p) \neq 0$. Let

$$g(x) = x - \frac{f(x)}{f'(x)} + f(x)^2 f''(x).$$

(1) Show $g(p) = p$.

(2) Show $g'(p) = 0$.

Comments

Nothing to say here. Just compute and remember the quotient rule, product rule, and chain rule for part 2.

Question 2

Consider the fixed point iteration to solve $x = g(x)$ with

$$g(x) = x^3 - x + 1.$$

(1) Do 3 iterations starting with $x_0 = 1.1$.

(2) Does the method converge to the fixed point $p = 1$ with this initial value? Why or why not?

Comments

Recall that the fixed point iteration is $x_{n+1} = g(x_n)$. Tell me the values of x_1, x_2, and x_3 to 6 digits. For the second part, the reasoning does not have to be rigorous. Just 1 or 2 sentences for completion.

Question 3

Determine an interval $[a, b]$ for which the fixed-point iteration will converge for

$$x = \frac{5}{x^2} + 2.$$

Implement the fixed-point iteration and choose a starting value x_0 that gives convergence. Iterate until the residual is within 10^{-5} and report the iterates in a table.

Comments

I changed the problem slightly from what's on Canvas. The rows of the table should be n, x_n, r_n, where n is the iteration number, x_n is the computed iterate, and

$$r_n := |x_n - g(x_n)|$$

is the residual. Stop when $r_n < 10^{-5}$.

Question 4

Consider the fixed point problem $x = g(x)$ with $g(x) = x^3 - 6$.

(1) Take $x_0 = 2.001$ and run 5 iterations of the fixed-point algorithm. Does the method converge to the fixed point $p = 2$? Why or why not?

(2) Now do 5 iterations of Newton's method on the function $f(x) = x - g(x)$ starting with $x_0 = 3$. Does the method converge to the root $p = 2$?

Comments

Same comments as question 2. Recall that Newton's method is

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}.$$

Question 5

Implement Newton's method and find the root $p \in [1, 2]$ of

$$f(x) = e^x + 2^{-x} + 2\cos x - 6$$

until the residual is within 10^{-5}.

Comments

Recall that the residual is $r_n := |f(x_n)|$. Turn in a table similar to question 3.