Falsi Method in MATLAB

Numerical Computing – 7th Semester

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Objective

- Implement the Falsi (False Position / Regula Falsi) method in MATLAB to find a root of $f(x) = 0$.
- Requirement: choose initial interval $[a, b]$ with $f(a)f(b) < 0$ and iterate until tolerance is met.
- Show code, explanation, and sample output.

False Position Formula

Linear interpolation (regula falsi)

Given interval endpoints a and b with $f(a)f(b) < 0$, compute

$$x_r = \frac{a\,f(b) - b\,f(a)}{f(b) - f(a)}.$$

Evaluate $f(x_r)$. If $f(a)f(x_r) < 0$ then new interval is $[a, x_r]$, else $[x_r, b]$.

Repeat until $|f(x_r)| < \text{tol}$ or maximum iterations reached.

Algorithm (Steps)

1. Choose continuous $f(x)$ and initial guesses a, b such that $f(a)f(b) < 0$.
2. Compute $x_r = \dfrac{af(b) - bf(a)}{f(b) - f(a)}$.
3. Compute $f(x_r)$. If $|f(x_r)| <$ tol stop.
4. If $f(a)f(x_r) < 0$ set $b \leftarrow x_r$; else set $a \leftarrow x_r$.
5. Repeat steps 2–4 until convergence or maxIter.

MATLAB Code

```
f = @(x) x^3 - x - 2;
% Initial guesses (must have sign change)
a = 1;
b = 2;
% Tolerance and max iterations
tol = 1e-5;
maxIter = 100;
for i = 1:maxIter
fa = f(a);
fb = f(b);

% False position formula
c = (a*fb - b*fa) / (fb - fa);
fc = f(c);

% Print iteration info
fprintf('Iter %d: a=%.6f, b=%.6f, c=%.6f, f(c)=%.6e\n', i, a,
```

MATLAB Coding cont...

```
% Check convergence
if abs(fc) < tol
fprintf('Root found at x = %.6f after %d iterations\n', c, i);
break;
end

% Update interval
if fa * fc < 0
b = c;
else
a = c;
end
end

if i == maxIter
fprintf('Stopped after maxIter = %d\n', maxIter);
```

Sample Output (Example)

$f(x) = x^3 - x - 2,\ a = 1 \text{=} 2\ \text{tol} = 10^{-5}$

- Iter 1: a=1.000000, b=2.000000, c=1.333333, f(c)=-0.962963
- Iter 2: a=1.333333, b=2.000000, c=1.462686, f(c)=-0.333339
- Iter 3: a=1.462686, b=2.000000, c=1.504023, f(c)=-0.107800 ...
- Root found at x = 1.521379 after 10 iterations

Classwork

Task 1

Use the Falsi Method to find the approximate root of

$$f(x) = \cos(x) - x = 0$$

in the interval $[0, 1]$, up to tolerance 10^{-5}.

Task 2

Find the root of the equation

$$f(x) = x^3 - 4x - 9 = 0$$

in the interval $[2, 3]$, correct to four decimal places using the **Falsi Method**

Task 3

Find the real root of

$$f(x) = x^3 - x - 1 = 0$$

without an initial interval.
First determine suitable values a and b such that $f(a)f(b) < 0$, then apply the **Falsi Method** to find the root up to four decimal places

Task 4

Solve

$$f(x) = x^2 - 3 = 0$$

using the Falsi Method, without a given interval.

Homework

Assignment 1

Solve using fasli Method:

$$f(x) = \ln(x) + x^2 - 3,$$

Assignment 2

Solve using MATLAB:

$$f(x) = xe^{-x} - 0.1, \quad [0, 1]$$