Newton Raphson Method: MATLAB Coding

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Objective

- Solve a nonlinear equation $f(x) = 0$ using Newton-Raphson method.
- Example function: $f(x) = x^2 - 2$

General Steps of Newton-Raphson Method

1. Define the function $f(x)$ and its derivative $f'(x)$
2. Choose an initial guess x_0
3. Apply iterative formula:

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

4. Check convergence: $|x_{n+1} - x_n| < \text{tolerance}$
5. Repeat until convergence

MATLAB Code Example

```
f = @(x) x^3 - 2*x - 5;
df = @(x) 3*x^2 - 2;
x0 = 2;
tol = 1e-6;
maxIter = 50;
% Display table header
fprintf('Iter\t x_n\t\t f(x_n)\t\t x_{n+1}\n');
fprintf('-----------------------------------------\n');
% Iterative process
for i = 1:maxIter
x1 = x0 - f(x0)/df(x0);      % Newton-Raphson formula
% Display current iteration
fprintf('%d\t %.6f\t %.6f\t %.6f\n', i, x0, f(x0), x1);
if abs(x1 - x0) < tol
```

con....

```
%fprintf('Converged after %d iterations.\n', i);
break;
end
x0 = x1;  % Update for next iteration
end
% Display final result
fprintf('Approximate root: %.6f\n', x1);
```

Output

- For initial guess $x_0 = 2$, the method converges to:

$$\text{Root} \approx 2.094551$$

Class Work

Find the root of the given equation by using Newton Raphson method.

1. $f(x) = x^2 - 2$ with initial guess $x_0 = 1$
2. $f(x) = x^3 - 5x + 1$ with initial guess $x_0 = 1$
3. $f(x) = \cos(x) - x$ with initial guess $x_0 = 0.5$
4. $f(x) = x^3 - 2x - 5$ with initial guess $x_0 = 2$
5. $f(x) = e^x - 3x$ with initial guess $x_0 = 1$