

IS5306: NUMERICAL METHODS
TAKE HOME ASSIGNMENT 1

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PROBLEM

Find the roots of the Nonlinear Equation $\sin(x) + x^2 - 1 = 0$ with an error less than 0.0001. Newton - Raphson method was used to solve this problem using MATLAB Software.

MATLAB CODE

```
clc
clear

n = 0; % Iteration counter
x = 0.5; % Initial guess, can be adjusted based on the problem
error = 1; % Initial error
tol = 0.0001; % Tolerance

% Function and its derivative
f = @(x) sin(x) + x^2 - 1;
f_der = @(x) cos(x) + 2*x;

while error > tol
    f1 = f(x);
    f2 = f_der(x);
    x_n = x - (f1 / f2);
    error = abs(x_n - x);
    x = x_n;
    fprintf('\nn = %i', n)
    fprintf('\nx_%i = %f', n, x)
    fprintf('\nf = %f', f1)
    fprintf('\nf-derivative = %f', f2)
    n = n + 1;
end

fprintf('\nx_%i = %f', n-1, x)
```

SIMULATION USING MATLAB

```
1 -   clc
2 -   clear
3
4 -   n = 0; % Iteration counter
5 -   x = 0.5; % Initial guess, can be adjusted based on the problem
6 -   error = 1; % Initial error
7 -   tol = 0.0001; % Tolerance
8
9   % Function and its derivative
10 -  f = @(x) sin(x) + x^2 - 1;
11 -  f_der = @(x) cos(x) + 2*x;
12
13 -  while error > tol
14 -      f1 = f(x);
15 -      f2 = f_der(x);
16 -      x_n = x - (f1 / f2);
17 -      error = abs(x_n - x);
18 -      x = x_n;
19 -      fprintf('\nn = %i', n)
20 -      fprintf('\nx_%i = %f', n, x)
21 -      fprintf('\nfx = %f', f1)
22 -      fprintf('\nf-derivative = %f', f2)
23 -      n = n + 1;
24 -  end
25
26 -  fprintf('\nx_%i = %f', n-1, x)
```

Figure 1: MATLAB simulation

```
Command Window

n = 0
x_0 = 0.644108
fx = -0.270574
f-derivative = 1.877583
n = 1
x_1 = 0.636751
fx = 0.015360
f-derivative = 2.087852
n = 2
x_2 = 0.636733
fx = 0.000038
f-derivative = 2.077534
fx x_2 = 0.636733>>
```

Figure 2: MATLAB program output

SOLUTION

According to the MATLAB simulation,

The root of the Nonlinear Equation $\sin(x) + x^2 - 1 = 0$ is 0.636733

Accuracy $= 1.8 \times 10^{-5}$

Number of iterations $= 03$