

ME685 HW3

Aman Parekh - 180073

August 28, 2021

1. The code is attached along with the submission. This is a screenshot of the code run:

```
aman@xps ~/ME685 ./a.out
Initial Guess= 4.50000
Value of Root After 0 iteration= 4.50000000, and Function Value= 1.3733205E-01
Value of Root After 1 iteration= 4.49361390, and Function Value= 4.1318738E-03
Value of Root After 2 iteration= 4.49340966, and Function Value= 3.9796808E-06
Value of Root After 3 iteration= 4.49340946, and Function Value= 3.6992488E-12
Number of Iterations Required= 3
Final Root= 4.49340946, and Final Function Value= 3.6992488E-12
```

2. Step-By-Step Algorithm

Algorithm 1 Newton-Raphson Algorithm

Function(**f**), its derivative(**f_prime**) and the initial guess(**guess**) passed to the subroutine

```
root = guess
```

```
for n = 1,maxiter do
```

▷ Will run until maximum iterations or until converged

```
    root = root - f(root)/f_prime(root)
    if (f(root)) < tolerance then
        number_of_iterations = n
        break
    end
```

```
end
```

Manually

$$f = \tan(x) - x$$

$$f' = \sec^2(x) - 1$$

$$root = root - \frac{f}{f'}$$

- Step 0

$$root = guess = 4.5$$

$$f(root) = f(4.5) = \tan(4.5) - 4.5 = 0.1373$$

This is not less than $1e-6$

- Step 1

$$\begin{aligned}\text{root} &= 4.5 - \frac{\tan(4.5) - 4.5}{\sec^2(4.5) - 1} = 4.5 - 0.00638 = 4.49362 \\ f(\text{root}) &= f(4.49362) = \tan(4.49362) - 4.49362 = 0.004255\end{aligned}$$

This is not less than 1e-6

- Step 2

$$\begin{aligned}\text{root} &= 4.49362 - \frac{\tan(4.49362) - 4.49362}{\sec^2(4.49362) - 1} = 4.49362 - 0.00021 = 4.49341 \\ f(\text{root}) &= f(4.49341) = \tan(4.49341) - 4.49341 = 1.14\text{e-}5\end{aligned}$$

This is not less than 1e-6

Therefore, this can go on till we reach a value of root for which the value of the function is less than tolerance.