

WORKSHEET #2: MATH 471
NUMERICAL ANALYSIS COMPUTER LAB

1. We seek a solution of the nonlinear system of equations $F(x, y, z) = \mathbf{0}$, where

$$F(x, y, z) = \begin{bmatrix} xy - z^2 - 1 \\ xyz + y^2 - x^2 - 2 \\ e^x + z - e^y - 3 \end{bmatrix} \quad (1)$$

Problem #1: Compute a solution of (1) using the Newton's method code with the following MATLAB syntax

```
>> [x,k,iter_hist] = newton([1,1,1]', 1e-10, 1e-10, 1000, @fn2);
```

Then plot $\|F(x_k, y_k, z_k)\|$ against iteration count using `semilogy`.

Problem #2: Can you find any additional roots? Can you find any initial guesses for which Newton's method does not converge?

Problem #3: Use `newton.m` to solve

$$x^3 - \sinh(x) + 4x^2 + 6x + 9 = 0. \quad (2)$$

2. *Homework Problem:* Modify `newton.m` so that it uses, instead, the secant method

$$x_{n+1} = x_n - f(x_n) \left[\frac{x_n - x_{n-1}}{f(x_n) - f(x_{n-1})} \right].$$

Call your new code `secant.m` and use it to solve (2). Compare the convergence properties of the secant method and Newton's method by plotting the function value versus iteration for the two methods, as was done in **Problem #1** above.