COMP3850 - Assignment #1
(Due Date: 13^{th} February 2018)

Instructions: You are submit a **.zip** folder named using your UWI ID number to inzamam.rahaman@sta.uwi.edu. This folder should contain four subfolders - one per part named accordingly. Moreover, at the top of each file, you should write (using comments) your UWI ID number.

Part A (5 marks)

Consider the following system of equations:

$$4x_1 - 3x_2 + x_3 = -10$$

$$2x_1 + x_2 + 3x_3 = 0$$

$$-x_1 + 2x_2 - 5x_3 = 17$$

Write MATLAB code to compute its solution. You are not to use the built-in linear algebra functions of MATLAB.

Part B (5 marks)

We can approximate the derivate of a function f at point x using the following:

$$\frac{f(x+h) - f(x)}{h}$$

where h is very small.
Write a MATLAB function called *deriv* based off of the above that accepts three arguments: a function f,a number h, and a number x.

Part C (10 marks)

The Bisection method is well known method for root finding. It can be described by the following pseudocode where lo and hi are the initial points, tol provides us a tolerance between lo and the midpoint at at iteration for use as stopping criterion, $nmax$ gives the maximum number of iterations, and f is the function under consideration.
NB: The *sign* function returns -1 is its input is negative, 1 if its input is positive, and 0 if its input is 0. The *abs* function returns the magnitude of its input, i.e. the output for both -23 and 23 is 23.

BISECTION-METHOD($lo, hi, tol, nmax, f$)

$N = 1$
while $N < nmax$
    $mid = lo + \frac{(lo-hi)}{2}$
    if $f(mid) == 0$ or $abs(f(mid)) \leq tol$
        break
    elseif $sign(f(mid)) == sign(f(lo))$
        $lo = mid$
    else $hi = mid$
    $N = N + 1$
return mid

Using the initial points of 3.0 and 4.0, and a tolerance of 0.01 use the bisection method to find a root of $e^x(3.2sin(x) - 0.5cos(x))$.

Part D (10 marks)

The Netwon-Raphson Method is another root-finding method. We start at initial guess at iteration 0, x_0, and compute the guess at iteration n using the following formula:

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

where f is the function under consideration and f' is its derivative. In Newton-Raphson, we can iterate for a predefined number of iterations. The following pseudocode describes the Netwon-Raphson method:

NETWON RAPHSON($x_0, nmax, f, f'$)

$prev = x_0$
$curr = prev - \frac{f(prev)}{f'(prev)}$
for $i = 1$ **to** $nmax - 1$
    $prev = curr$
    $curr = prev - \frac{f(prev)}{f'(prev)}$
return $curr$

Using the Netwon-Raphson method find a solution to $x^3 = sin(x)$ using a starting point of 2.0 and using 50 iterations. You may use your *deriv* function defined in **Part B** or differentiate your function (using Wolfram-Alpha) and hard-code the derivative. (Hint: recall that the root is the point in the domain of a function where the output is 0).