MTP 290, Computational Laboratory, Tutorial Sheet 2

Please attempt all the question. Experimentation and exploring is encouraged. The tutorial is aimed to give you practice of the basics, but additional effort might be required to get comfortable with the tools used. Some questions might be open ended deliberately.

Question 2.1
Plot the graph of the following functions.

a) $y = \sin(x - 0.5)$ in $[0, 2\Pi]$.

b) $y = e^x \log(x)$ in $[0, 1]$.

Question 2.2
Write a program that adds the numbers 1 through 100, and save it as a MATLAB script.

Question 2.3
Write a program that adds the even numbers between 1 and 100, and save it as a MATLAB script.

Question 2.4
Write down a MATLAB script for finding the maximum of three given numbers a, b and c. Test the code by taking $a = 1$; $b = -1$ and $c = 2$.

Question 2.5
Write the MATLAB script to find the first integer n for which $n!$ (the factorial of n) is a 100-digit number.

Question 2.6
Write down the MATLAB script for computing a root of a given function $f(x)$ using Newton-Raphson's method. The script takes as input the function $f(x)$, it's derivative $f'(x)$, the starting point x_0, error e and number of iterations.

Question 2.7
Write down the MATLAB script for computing a root of a given function $f(x)$ using Secant method. The script takes as input the function $f(x)$, it's derivative $f'(x)$, the starting points x_l and x_u, error e and number of iterations.

Use the above two scripts to solve the following problems.

Question 2.8
Use Newton's method to find solutions accurate within 1×10^{-3} for the following problems. Use the mid point of the intervals as the starting point.

- $x^3 - 2x^2 - 5 = 0$ on the interval $[1, 4]$.
- $x \cos(x) = 0$ on $(0, \pi)$

Question 2.9
Apply Newton's method to find the approximation of the root of $x = \tan x$, starting with initial guess $x_0 = 4$ and $x_0 = 4.6$. Compare the results obtained from these two initial guesses. Does the method converge?

Question 2.10
$f(x) = x - 2 + \log(x)$ has a root near $x = 1.5$. Use the Newton Raphson formula to obtain the better estimate upto error of 0.05%.

Question 2.11
Obtain an estimation (accurate till 4 decimal point) of the point of intersection of the curves $y = x - 1$ and $y = \cos x$.

Question 2.12
Apply Newton's method to the function

$$f(x) = \begin{cases} x^{2/3} & \text{if } x \geq 0 \\ -x^{2/3} & \text{if } x < 0 \end{cases} \tag{1}$$

with the root $x_0 = 0$. What is the behavior of the iterates? Do they con- verge, if yes, at what order?

Question 2.13
Use Newton's method and secant method forfinding the approximations of the two zeros, one in $[-1, 0]$ and other in $[0, 1]$ to within 1×10^{-3} accuracy of $f(x) = 230x^4 + 18x^3 + 9x^2 - 221x - 9$. Use the end points of the interval as initial guesses for the secant method and the midpoint for Newton's method.

Question 2.14
Redo Problem 2.8 using Secant method.

Question 2.15
Solve the Problem 2.8 using MATLAB inbuilt function "fzero" and compare the results obtained with the bisection and secant method.