Homework 3

Due 10/18/2019

1. In an attempt to have Matlab compute the sum $S = 0.1 + 0.2 + \ldots + 0.9$, someone writes the following code:

```
s = 0
x = 0
while x~=1.0
    s = s + x
    x = x + 0.1
end
S = s
```

   (a) Test this code on Matlab. Why does the program keep running indefinitely?
   Note: to terminate the procedure, place the cursor in the command window and press Ctrl + C.

   (b) What should be changed in the code to make it stop?

2. We would like to compute approximately a solution to the equation $e^{-x} = \sin x$. *You are recommended to do the Matlab Practice 2 (posted on Canvas and course website) before starting this problem.*

   (a) Plot the function $f(x) = e^{-x} - \sin x$. What is an interval $[a, b]$ that contains *only* the smallest positive root of f?

   (b) With the interval $[a, b]$ found in Part (a), use the bisection method with the help of your pocket calculator to do 4 iterations. What do you get?

   (c) Write a Matlab program to compute an approximate solution with error tolerance $\epsilon = 10^{-6}$. You can modify the program given in the lecture (also posted on course website) or the program given on pages 75-76 of the textbook.

3. (Similar to Prob. 7, page 78.) The following functions are theoretically the same.

$$\begin{aligned} f_1(x) &= (x-1)^3, \\ f_2(x) &= -1 + x(3 + x(-3 + x)), \\ f_3(x) &= x^3 - 3x^2 + 3x - 1. \end{aligned}$$

   However, their computations in floating-point format are different. Let us do some experiments on finding roots of each function by bisection method. (Note that $x = 1$ is the only root.)

   (a) Modify slightly the program in Problem 2, Part (c) to a program that computes approximately the root of f_1, f_2, f_3 with error tolerance $\epsilon = 10^{-6}$.

   (b) Try the following initial intervals $[a, b] = [0, 1.5]$, $[0.5, 2.0]$, $[0.5, 1.1]$. Explain the results.