ENEL101

Problem set 5

M File Programming

Important Notes:

- This assignment is about writing user defined functions. The questions are based on content from chapters 6 and 7 of the textbook "Matlab, An introduction with applications".
- Complete this assignment by filling in the template file, assign5.m, which already has the function templates done for you.
- Before you submit your script file, make sure there are no syntax errors.
- The functions will be tested by the auto-tester using randomly generated data.
- Do NOT use 'clear' OR 'clear all' anywhere in your code.

Q1. Write a function that accepts a general row vector X as an input and generates a row vector P such that P contains all of the positive elements of X.

Q2. Write a function that determines *y* for a given input *x*. Assume that x is a scalar (as opposed to being a vector or a matrix).

$$y(x) = (-0.2x^3 + 7x^2)e^{-0.3x}$$

Q3. Modify the function above such that the input x can be a 2x2 matrix.

Q4. Write a function that uses the **switch – case** statement (refer to pg.189-192 in the textbook). The function takes a vector of strings in a structure (see assign5.m to see how this is done) and a number x as input. Each string is the case condition which specifies the type of operation to be performed on '*x*'. The two cases for mathematical operations are 'invert' and 'root2'. The function produces a numeric output for a given numeric value of x and the condition s. If s is anything other than 'invert' or 'root2', the function sets the output equal to 0. Place the results in a row vector corresponding to operations as listed in the structure s i.e. for the list of operations 'invert','root2','none' and x=0.5 the answer will be [2.0000 0.7071 0].

Q5. Write a function that takes the coefficients a, b, c of a quadratic equation of the form $ax^2 + bx + c = 0$ as inputs and calculates the discriminant $D = b^2 - 4ac$. Then,

If $D > 0$ the program sets $numroot = 2$.

If $D < 0$ the program sets $numroot = 0$.

If $D = 0$ the program sets $numroot = 1$.

Q6. Fibonacci numbers are the numbers in a sequence in which the first two elements are 0 and 1, and the value of each subsequent element is the sum of the previous two elements as 0,1,1,2,3,5,8,13, ... Write a function that takes an integer $n > 2$ as input and stores the first n Fibonacci numbers in a column vector. You do not need to check for the condition of $n > 2$.

Q7. Write a function that finds the fifth root of input P using Newton's method, applying the recursive formula

$$x_{i+1} = x_i - \frac{x_i^5 - P}{5\,x_i^4}$$

For the first value use $x_1 = P$. Continue with the recursive formula until the estimated relative error $E < 0.00001$ where

$$E = \left|\frac{x_{i+1} - x_i}{x_i}\right|$$

The function must output a 1x2 vector, with the first element being the answer (the fifth root) and the second element being the number of iterations that were needed.

Q8. Given a point $x_0 = 0.25$ and function $f(x) = x^2 e^x$ approximate the function's derivative at x_0 using the four-point difference formula

$$\frac{d\,f(x)}{d\,x} = \frac{f(x_0 - 2h) - f(x_0 - h) + f(x_0 + h) - f(x_0 + 2h)}{12\,h}$$

using $h = \frac{x_0}{10}$ (h must be a small number relative to x_0). The function must output a 1x3 vector, the first element being the numerator, the second the denominator, and the third the resulting approximation.