Numerical Methods in Engineering: Assignment week 1

1. Develop an algorithm to define if an integer number is a prime number. Write a MatLab program that implements the algorithm. The program should start by asking the user to assign a value x in the command window. A message should be displaced that states if the assigned value x is a prime number. Execute the program for values x=83, x=127 and x= 367 and report the results. Submit apart from the MatLab file, a pdf where the algorithm is explained with steps (1, 2, 3…). (30%)
2. Develop an algorithm to transform a number to binary floating point form for both single and double precision. Write a user-defined MatLab function that has as input arguments the number y and the precision p (1 single precision, 2 double precision). If the input is one argument, the program automatically should select single precision. The function should evaluate only numbers with absolute values between 2^{-100} and 2^{100} and should show an error for numbers outside of this range. The output arguments should be three numbers in binary form: the sign, the exponent+bias and the mantissa. Submit apart from the MatLab file, a pdf where the algorithm is explained with steps (1, 2, 3...). (30%)

The only built-in functions of MatLab you are allowed to use for the first two assignments are the following: fprintf, rem, mod, input, nargin, abs, sign, error, zeros, clearvars, close, clc.

3. Write a user-defined MatLab function that is able to transform a decimal fixed-number ℓ to a number of base b with number of digits m. The output should be a row array. The name of the function is `TransDecOtherBase(ℓ,b,m)`. The first digit of the output array should be allocated for the sign of the number (0 if positive, 1 if negative). The number of digits m includes one digit for the sign. The function should also inform about overflow by showing a message. The commands that must be used are if end, while end. The built-in functions that must be used are zeros, fix, disp. These they only functions and commands you can use. (30%)

4. Complete the following computation by hand:

$$\int_0^{1/4} e^{x^2} dx \approx \int_0^{1/4} \left(1 + x^2 + \frac{x^4}{2!} + \frac{x^6}{3!}\right) dx = \hat{p}$$

Calculate the relative error if the true value (exact solution) is equal to p=0.2553074606. What kind of error is present in this case? (10%)

Grading criteria:

Correctness (code)

Justification (algorithm)

Efficiency (algorithm and code)

Presentation