Universidad Industrial de Santander, Colombia
Numerical Analysis, 2020-1
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August 4, 2020

Lab 9. Numerical Integration

Name: ____

1 Instructions

- Make a **pdf** report including the solution to each point of the practice with name *Lab9_name_lastname.pdf*.
- Send the report and all created files in a rar or zip file with name *Lab9_name_lastname.rar* in the Moodle.
- You are allowed to use internet, notes, and .m files that you have created before.

2 Purposes

- To apply the numerical integration methods.
- To implement the numerical integration methods in Matlab.
- To interpret problems which can be solved by the numerical integration methods.
- To propose problems in which the numerical integration methods can be used.

3 Practice

3.1 Applying

(0.5 points) Integrate $f(x) = x\ln(x)$ over $[1, 2]$ using the trapezoidal rule with step size $h = 0.25$.

(0.5 points) Integrate $f(x) = x\ln(x)$ over $[1, 2]$ using the Simpson's rule with step size $h = 0.25$.

3.2 Implementing

- (1.0 point) Create a Matlab function called *my_trapezoidal_function_name_lastname()* to approximate an integral using the **composite trapezoidal rule**. The arguments of the function must be: the function to be integrated $f(x)$ (as an inline function), the limits of integration $[a, b]$, and the the value of M. Make a script called *run_3a_name_lastname.m* in which you use the created function to solve the exercise in 3.1 and determine the root. For instance,

  fun = @ $XXXXXX$;
  $a = XX$;
  $b = XX$;
  $M = X$;
  Integration=my_trapezoidal_function_name_lastname(fun,a,b,M);

- (1.0 point) Create a Matlab function called *my_simpson_function_name_lastname()* to approximate an integral using the **composite Simpson's rule**. The arguments of the function must be: the function to be integrated $f(x)$ (as an inline function), the limits of integration $[a, b]$, and the the value of M. Make a script called *run_3b_name_lastname.m* in which you use the created function to solve the exercise in 3.1 and determine the root. For instance,

  fun = @ $XXXXXX$;
  $a = XX$;
  $b = XX$;
  $M = X$;
  Integration=my_simpson_function_name_lastname(fun,a,b,M);

3.3 Interpreting

(1.0 point) The probability that a machine fails in the process follows a normal distribution given by $f(t) = \left(1/\sqrt{2\pi}\right) \mathrm{e}^{-t^2/2}$. The cumulative distribution to determine the probability to produce any amount of failures is then defined by $\Phi(x) = \dfrac{1}{2} + (1/\sqrt{2\pi}) \int_0^x \mathrm{e}^{-t^2/2}$. Determine the probability that the machine produces 5 failures using the trapezoidal and Simpson's rules. *Hint.* Use $M = 5$.

3.4 Proposing

- (0.5 points) Propose an application problem in which the trapezoidal and Simpson's rules can be used.
- (0.5 points) Solve the proposed problem using the created functions.